THESIS

THE RELATIVE PERSUASIVENESS OF HEALTH INFOGRAPHICS

Submitted by

Channing Faith Downing Bice

Department of Journalism and Media Communication

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Master's Committee:

    Advisor: Gaya Sivakumar

    Daniela Castillo
    Daniel Graham
    Marilee Long

ABSTRACT

THE RELATIVE PERSUASIVENESS OF HEALTH INFOGRAPHICS

This study explores the persuasiveness of infographics, as a quantitative communication strategy to support medical decision making and health risk appraisal compared to its equivalent text-based condition, within in the context of promoting STD and STI prevention and screening among young adults. This work uses the ELM as the guiding theoretical framework in a web-based experiment which utilizes a 2 x 1 posttest only experimental design investigates the influence manipulated visual content and message formats have on health-related persuasive message processing among young adults within in the context of promoting STD and STI prevention and screening among young adults. Predictions based on previous literature and empirical testing suggest that enhancing the vividness of the appearance of a health-related message in an infographic format will enhance elaborative processing, resulting in desired health behavior outcomes. To make these predictions, the study poses research questions that explore the cognitive processing and the number of positive thoughts generated by recipients randomly assigned to the infographic condition. In addition to these research questions, this study poses hypotheses that predict elaborative processing, knowledge, and attitude will be greater in the infographic condition, rather than its text-based equivalent, consistent with previous empirical findings. The results of this study can inform further investigations between these pathways and applications to future health communication strategies.

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DEDICATION

"If I can move to San Francisco with no money, no house, and no job on a total whim, you can do this. Be brave."

This thesis is lovingly dedicated to my dad, JR Bice. Thank you for teaching me how to be brave and challenging me to be the best version of myself every day.

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Chapter 1: Introduction

Health communication professionals research and structure health promotion campaigns with the goal of inducing positive change in health-related behaviors. In order to effectively facilitate a positive change in health-related behaviors, practitioners have increasingly turned to the Elaboration Likelihood Model (ELM) to obtain desired attitude and behavior change outcomes. Empirical support for health-related attitude and behavior change exists on a wide variety of health outcomes such as, nutrition (Lazard & Mackert, 2014), physical fitness (Bassett-Gunter, Latimer-Cheung, Martin Ginis, & Castelhano, 2014; Berry, Jones, McLeod, & Spence, 2011), early cancer detection or screening (Holt, Lee, & Wright, 2008; Parrish, 2016), sexual health (Lustria et al., 2016), autoimmune diseases (Keys, Morant, & Stroman, 2009), and the management of chronic health conditions (So & Alam, 2018).

Research related to the use of ELM in health communication has shifted in recent years, as the mediums through which health information is sought out are increasingly online through health websites, mobile applications, or social media (Lazard et al., 2017; Lazard & Mackert, 2014). While this shift in mediums has presented new opportunities for health communicators, it also presents challenges in capturing and holding the attention of recipients in a media environment that is becoming increasingly overstimulating (Jacobs et al., 2017; Lustria et al., 2016). ELM pioneers, Cacioppo and Petty (1989), have suggested the use of heuristic appeals (such as the use of popular songs or visual imagery) as a crucial first step in catching attention and enhancing the likelihood message recipients will engage in thoughtful cognitive and elaborative processing through central or peripheral routes (Petty, Barden, & Wheeler, 2002; Petty & Cacioppo, 1996). When information is presented by using vivid heuristic appeals, it can make the message emotionally interesting, which will in turn make the content seem

psychologically and temporally close to the recipient (Parrott & Maibach, 1995; Petty, Cacioppo, & Schumann, 1983). Although the use of heuristic appeals has been cautioned against by researchers, for their short-lived changes in attitudes, it can attract individuals who may otherwise were not motivated to evaluate the message prior to exposure (Parrott & Maibach, 1995; Petty et al., 2002; Taylor & Thompson, 1982).

Effective quantitative health risk communication strategies which support medical decision making and health risk appraisal have been proven to raise health risk awareness and promote risk-reducing behaviors (Ancker, Senathirajah, Kukafka, & Starren, 2006). One of the strategies to accomplish this, can include well-designed visual displays, such as infographics. Infographics, short for informational graphics, use visual cues, illustrations and large typography to display facts in a long, vertical orientation, and are distributed through print media, embedded into websites, and shared on social media (Krum, 2014; Lankow, Ritchie, & Crooks, 2012; Smiciklas, 2012). Infographics allow an individual to absorb more information at a glance by laying out the scope of an issue through step-by-step methods interwoven with powerful quantitative data (Krum, 2014; Lankow et al., 2012; Smiciklas, 2012).. The message recipient is able to use automatic visual perception, rather than relying on the amount of mental computation needed for reading text alone (Ancker et al., 2006; Siricharoen & Siricharoen, 2018). Although health communicators have embraced the use of graphs and charts within patient education materials, health infographics have remained an underutilized and under researched medium in working to promote desired health behavior outcomes (Ancker et al., 2006; Parrish, 2016).

The current study will explore the persuasiveness of infographics, compared to its equivalent text-based condition, within in the context of promoting STD and STI prevention and screening among young adults. This work uses the ELM as the guiding theoretical framework in

a web-based experiment which utilizes a 2 x 1 posttest only experimental design investigates the influence manipulated visual content and message formats have on health-related persuasive message processing among young adults. Designing persuasive health related messages targeted toward young adults and adolescents, can be particularly challenging for health communication practitioners because they do not see health-related messages as being engaging or personally relevant, which poses an immediate barrier to persuasive message processing (Petty et al., 2002; Scott, 1996; Scott & Ambroson, 1994).

This study predicts, based on previous literature and empirical testing that enhancing the vividness of the appearance of a health-related message in an infographic format will enhance elaborative processing, resulting in desired health behavior outcomes. To make these predictions, the study poses research questions that explore the cognitive processing and the number of positive thoughts generated by recipients randomly assigned to the infographic condition. In addition to these research questions, this study poses hypotheses that predict elaborative processing, knowledge, and attitude will be greater in the infographic condition, rather than its text-based equivalent, consistent with previous empirical findings. To the best of the author's knowledge, this is the first study to examine pathways between the cognitive response approach, elaborative processing, infographic design, and persuasion on health behavior outcomes. The results of this study can inform further investigations between these pathways and applications to future health communication strategies.

Chapter 2: Literature Review

Elaboration Likelihood Model

The ELM is a useful theoretical framework proposed by Petty and Cacioppo (1986b) that analyzes message processing determinants that explain attitude formation and behavior change as a result of persuasive communication (Petty & Cacioppo, 1984). The dual process model contends that attitudes can be influenced by mass-mediated persuasive messages that either elicit deeper message processing or use simple heuristics to cue a response. The ELM predicts that persuasion is enhanced when an individual critically thinks about the issues presented in a message and evaluates the arguments made in the message against prior knowledge or experience. ELM considers this pathway of influence as central route processing. Attitudes formed through central route processing are characterized as being more resistant to counter persuasion attempts and more predictive of behavior change (Petty, Brinol, & Priester, 2009). Central route processing is more likely to occur when conditions foster an individual's motivation and ability to engage in issue-relevant thinking, where the "elaboration likelihood," is said to be high. For example, the motivation to process a message can be determined by how interesting the topic of the message is for the recipient or if the topic is personally relevant. Alongside motivation, an individual must also have the ability to process the information in the message. Examples of this can include prior knowledge the recipient has about the topic, the amount of external distractions while evaluating a message and whether or not the message is comprehensible.

However, the ELM recognizes that not all circumstances are conducive to thoughtfully analyzing the content of media messages, especially in over stimulated media environments that exist throughout social media and the internet. In these contexts, which are characterized as low-elaboration, the model suggests that persuasion may occur through peripheral route processing.

This pathway of influence forms judgments through the use of simple heuristics or cues (e.g., source appearance, perceived credibility of the source) without individuals having to think as critically about issue-relevant information (Petty, Cacioppo, & Schumann, 1983).

As persuasive message content or campaign strategies are developed, it is critical to recognize that consequences of either the central or peripheral routes to persuasion, last beyond the initial exposure to a message. Central route attitude changes will have different attributes than peripheral attitude changes (Petty et al., 2002; Smith, Haugtvedt, & Petty, 1994). Attitudes that form as a result of central route processing have been found to be stronger and more persistent over time because it is more resistant to change when challenged with opposing information (Petty et al., 2002). Strong attitudes have been proven to guide thinking and most importantly guide behavior (Krosnick and Petty, 1995; Petty Barden and Wheeler, 2002). Therefore, stronger attitudes that have been produced through central route processes, increase the likelihood of long-term behavioral change (Petty et al., 2002).

The Elaboration Likelihood Model in Health Communication

Although central route persuasion has been proven to facilitate long term attitude and behavior change, it does not mean peripheral approaches should be dismissed as being ineffective. Health promotion researchers recognize the difficulty of creating message content that relies solely on central route attitude change, especially as it relates to engaging young adults with health-related topics. Oftentimes, young adults do not see health-related messages on topics such as safe sex practices or substance abuse as being personally relevant to them, which becomes an immediate barrier to attempting to change attitudes via the central route (Petty et al., 2002; Scott, 1996; Scott & Ambroson, 1994).

The ELM has been empirically tested and applied across a variety of disciplines to investigate consumer behavior, political advertising, advocacy and other social issues. Among

these issues, the ELM has proven to be especially successful in designing health messages that will influence the recipient's ability to process information, centrally and peripherally to aid in health decision making (Lazard & Mackert, 2014). Flora and Maibach (1990) used the ELM framework in their study by testing audience members' involvement in the HIV/AIDS issue. To achieve this, they empirically tested persuasive public service announcement (PSA) messages related to acquired immune deficiency syndrome (AIDS). Flora and Maibach (1990) randomly assigned AIDS PSA messages that had vivid, emotional appeals, or persuasive AIDS PSAs that were characterized as being more rational with solid arguments. The within-subjects designed study tested memorability of the PSA alongside the participants cognitive involvement with AIDS. Flora and Maibach (1990) measured cognitive involvement using a four-item scale (α=0.86) where an analysis of variance showed that the PSAs with vivid, emotional appeals were more effective for audiences with low issue involvement. Conversely, individuals with more motivation to pay attention and reflect on the arguments (i.e. high involvement) were more persuaded by the PSA with rational arguments.

Flora and Maibach's (1990) findings helped guide Igartua, Cheng, and Lopez (2003) investigation of college students' level of involvement with the HIV/AIDS issue, by manipulating the format of the message's peripheral cues. College students were showed either a musically formatted or dialogue formatted AIDS prevention message and their individual behavioral intentions were measured after exposure. The goal of Igartua et al.'s (2003) study was to attempt to analyze affective and cognitive processes to explain impacts of fictional shorts about HIV/AIDS prevention. The 2 x 2 factorial designed study measured involvement (high/low) relative to message format (musical/dialogue) as independent variables and found that individuals with low issue involvement reported more intention for a prevention behavior in

response to the musically formatted message, whereas high issue involvement individuals reported more behavioral intention when exposed to the dialogue formatted message.

The Cognitive Response Approach in Health Communication

In addition to the aforementioned literature and empirical research on the application of ELM to health communication, cognitive response theory, an extension of ELM, can provide another perspective on how message recipients actively participate in the persuasion process. Cognitive response theory was developed to address message learning relative to the message content (Greenwald, 1968; Petty, Brinol, & Priester, 2009; Petty, Ostrom, & Brock, 1981). It acts as an extension of ELM by maintaining that the impact of variables on persuasion is dependent on the extent individuals mentally rehearse their own thoughts in response to information presented. This "mental rehearsal," allows recipients to actively participate in the persuasion process by simultaneously relating the information they are presented with to existing repositories of information they have about the message's content (Petty, Brinol, & Priester, 2009; Petty, Ostrom, & Brock, 1981). The cognitive response approach asserts that when external information is presented, the recipient's own thoughts to this information will further determine the extent of influence based on the number of thoughts and polarity (favorability or unfavorability) of those thoughts (Greenwald, 1968; Petty, Brinol, & Priester, 2009; Petty, Ostrom, & Brock, 1981). Cognitive response researchers contend that the more favorable thoughts a recipient has toward the message, more persuasion will occur; similarly the more unfavorable thoughts a recipient has toward a message, less persuasion will occur (Greenwald, 1968; Petty et al., 1981; Wright, 1973).

Should the cognitive response approach be empirically deployed, categorization schemes must be established when preparing to analyze responses. Petty and Cacioppo (1986) suggest categorizing responses based on issue relevant thoughts or message relevant thoughts. Issue

relevant thoughts are defined as all thoughts listed that relate to the topic presented in the message (Petty & Cacioppo, 1986a). Message relevant thoughts are sparked by reactions to specific message arguments presented (Petty & Cacioppo, 1986a). Additionally, responses can be analyzed based on the polarity of the thought, number of thoughts listed, and other categorization schemes to determine the extent of influence of the message. Examples of other types of categorizations include, but are not limited to, the origin of the thought, perceived personal relevance, thoughts about the stimulus, thoughts about the source of the stimuli, thoughts about the medium used to deliver the stimulus, et cetera. (Cacioppo & Petty, 1981; Petty et al., 2009; Shavitt & Brock, 1990)

The cognitive response approach has been applied in health communication to research cognitive responses to tailored messages about breast cancer awareness, physical activity beliefs, cognitions, and perceptions of attractiveness (Bassett-Gunter, Latimer-Cheung, Martin Ginis, & Castelhano, 2014; Bassett-Gunter, Martin Ginis, & Latimer-Cheung, 2013; Berry, Jones, McLeod, & Spence, 2011; Holt, Lee, & Wright, 2008; Kreuter, Clark, Oswald, & Bull, 1999; Pankratow, Berry, & McHugh, 2013). When health communication messages are developed and tailored to appeal to recipients of specific populations, increased levels of positive cognitive responses, positive behavioral intention thoughts, and positive self-assessment thoughts have been found (Kreuter et al., 1999). Holt et al.'s (2008) study analyzed the polarity of cognitive responses to spiritually-based messages about breast cancer awareness found that positive personal connection and self-assessments of health were greater in the spiritually study groups, deemed as being more personally relevant, than in secular study groups (Holt et al., 2008). Similarly, Berry et al., (2011) also coded thought listing results based on the valence of thoughts in their study, which analyzed the implicit and explicit believability of exercise-related messages.

Responses in the study were coded based on categories such as, positive health, positive general, negative health, negative general, believable, not believable, neutral, and other, among other subcategories (Berry et al., 2011). Among the responses received that were able to be coded into the aforementioned categories, Berry et al. (2011) also found positive and negative comments emerged from respondents related to the presentation of the advertisement. A positive example of these comments included "good use of lighting [in the advertisement]" a negative example was "the font used [in the advertisement] is strange." (Berry et al., 2011)

Visual Health Communication Persuasion Strategies

The aforementioned findings in Berry et al.'s (2011) study emphasizes the role visual communication plays in health promotion messages. Visual health messages have the ability to garner more positive feelings toward the promoted health behavior in the respective message, given that the message is factual, has straightforward clinical directives, and positive affect appeals (Parrott & Maibach, 1995). The positive feelings toward the health behavior are a result of what Parrott and Maibach (1995) describe as, "vividness of the appeal," which can be in the forms of vivid colors, photos, or pictorial displays. Health information content that is vividly crafted is emotionally interesting and makes the content seem closer to the person experiencing the information (Parrott & Maibach, 1995). Researchers have contended that vivid information is more likely to capture and maintain a recipient's attention to the message and increases the likelihood that the information will be persuasive and recalled at a later time (Green & Myers, 2010; Lazard & Atkinson, 2015; Lazard & Mackert, 2014; Parrish, 2016; Parrott & Maibach, 1995). The vividness of health information, also known as visual communication strategies, has been empirically tested and discussed as ways to effectively reduce overarching barriers to persuasion (Green & Myers, 2010; Parrish, 2016; Svensson & Waern, 2013).

Visual communication is defined as a process of sending and receiving optically stimulating messages that are crafted with visual images or representation to structure the message (Trumbo, 1999; Lester, 1995). What makes these images "optically stimulating" are the ways the visual encompasses design elements such as images, photographs, colors, shapes or fonts (Cyr, Head, Lim, & Stibe, 2018). Visual representations have the power to communicate more efficiently and effectively than words alone, based on the two roles of attention-getting and eliciting emotional responses that visuals play in the communication process (Lazard & Atkinson, 2015; Trumbo, 1999). Visuals capture the viewer's attention, which is the first step in the communication process (Messaris, 1997). In an era of information overload, individuals have to constantly evaluate messages they encounter based not just on the content but also on the personal relevance of the message's content to the viewer (Berger, 1972; Lazard & Atkinson, 2015; Rose, 2007). By capturing the attention of the viewer, it enables further comprehension of the message based on personal relevance and prior attitudes formed toward the message content.

Beyond capturing a viewer's attention, visual message aesthetics have the power to communicate "an immediate visceral understanding," which elicits emotional responses that impact attitude and trust (Cyr et al., 2018; Green & Myers, 2010). Emotional responses arise based on the viewer's attitude and trust toward the way an image represents reality (Messaris, 1997). By presenting comparisons or correlations, visuals can convey cognitive information, such as comparisons or correlations, at a glance (Barry, 1997; Lazard & Atkinson, 2015; Messaris, 1997). Considering this, the persuasiveness of images has the ability to overpower words in text or speech alone in attitude change and formation (Griffin, 2008; Messaris, 1994).

The persuasiveness of visual communication has been empirically tested most recently through website mediums. Lazard and Mackert (2014) investigated the impact of visual

perceptions for online health communication relative to the theoretical frameworks of design complexity, technology acceptance, and information processing. Lazard and Mackert (2014) experimentally tested fitness and nutrition websites with high and low design complexity. They found that the impact of design complexity was positively associated with higher levels of perceived message quality and informativeness, and more positive attitudes toward the website (Lazard & Mackert, 2014).

Similarly, to Lazard and Mackert (2014), Lustria et al. (2016) empirically tested the persuasiveness of a web-based intervention. Conversely, Lustria et al. (2016)'s web-based intervention promoted sexually transmitted disease (STD) testing among young adults and empirically testing its persuasiveness using ELM and the theoretical framework of message tailoring. Results from Lustria et al. (2016) suggested that exposure to the tailored website, increased attention, perceived personal relevance, and elaboration of the message. Findings from Lazard and Mackert (2014) and Lustria et al., (2016) emphasize design complexity and tailoring health messages to target audiences must be considered as an influential health communication variable, especially in an age of increased online health information seeking.

Multimodal Media Communication

During a growing trend in online health information seeking, health information is displayed through a variety of mediums such as websites, videos, images, and graphics, among other mediums. As a result of digitization, screens are becoming the primary site where multiple modes of communication are composed for dynamic ways of meaning making (Kress, 2005; Kress & Van Leeuwen, 2001). Multimodality, a rhetorical theory which integrates communication and social semiotics, suggests communication is not confined to a singular mode (e.g. oral, visual, textual) (Cope & Kalantzis, 2000; Kress, 2003). Recently, the conceptualization

of multimodality suggests that multimedia texts are inherently multimodal texts as they come in a variety of modes, such as images, texts, animations and sounds, which are digitally disseminated through a single medium (Lauer, 2009).

Recent research suggests that combining multiple modalities, such as visual and textual media, into messages is more successful in audience comprehension, recall and adherence (Butler & McManus, 2014; Geise & Baden, 2015). By using the modalities of textual and visual media to complement each other, rather than relying on a singular modality, it presents the opportunity for a heightened emotional response and greater textual comprehension (Geise & Baden, 2015). Therefore, by integrating visual and textual modality into a message, it is likely to influence decisions for elaboration.

Infographics, short for informational graphics, has been argued as being an artifact of multimodal communication (Krum, 2014; Lankow et al., 2012; Parrish, 2016). Infographics use visual cues, illustrations and large typography to display an assortment of facts, typically in a long, vertical orientation (Lankow et al., 2012). Although infographics can be utilized through various forms of print media, the virality of infographics to be shared amongst websites and social media presents opportunities to reach more publics (Krum, 2014; Lankow et al., 2012; Smiciklas, 2012). Infographics also have the ability to be optimized for search engines to allow for maximum exposure (Krum, 2014). Infographics have surged in popularity over the past 10 years (Figure 1), where the growth of the search term, "infographic" began peaking in 2008 (Google, 2018).
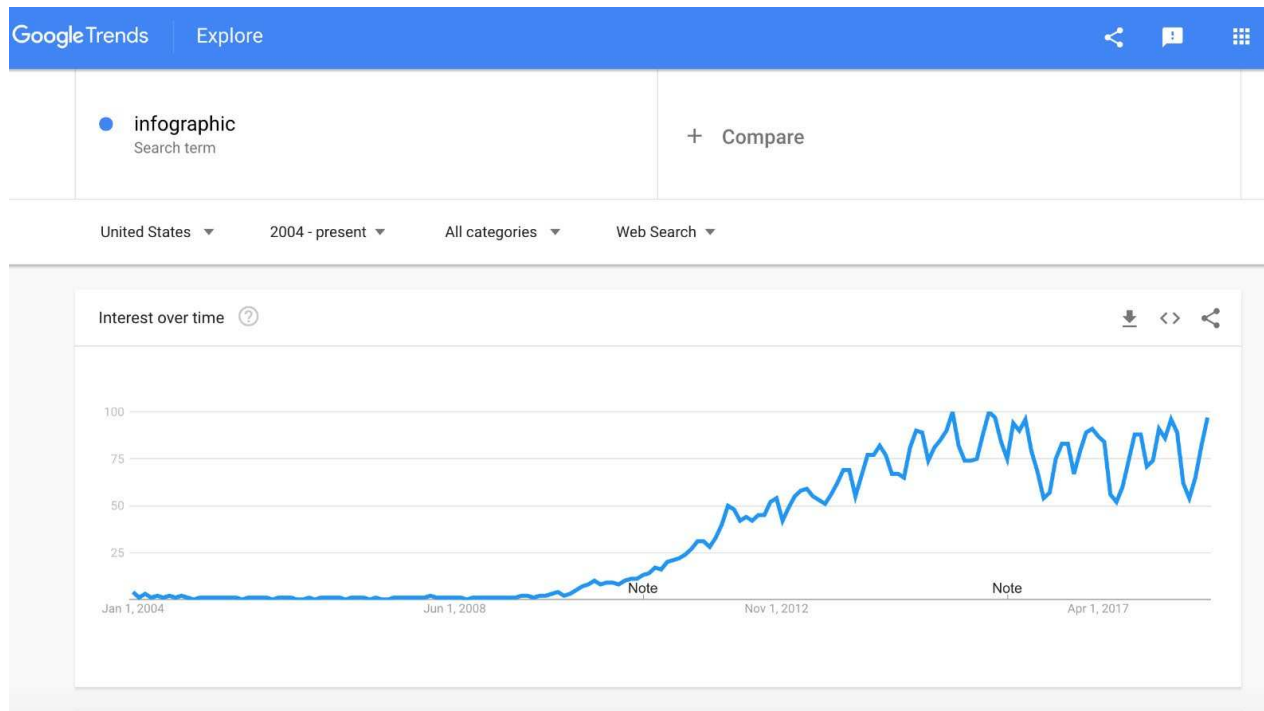
Figure 1. Google Trends Data which shows interest over time for the search term, "infographics" between 2004-2018 (Google, 2018).

Related search term topics and queries, particularly in the past five years, have included "CDC," "health infographic," "mental health infographic, "Ebola infographic," and "bulletproof diet infographic"(Google, 2018). The frequency of the topics and queries being searched suggests infographics play a key role in health information seeking behavior.

Although infographics may be perceived as being relatively new based on Google Trends data and consequences of digitization, their origins date back to the Victorian Era (Lankow et al., 2012). Forms of infographics were created during this era to show parliament causes of mortality of the British Army during the Crimean War (Lankow et al., 2012). Communication scholars and practitioners credit the 1980s as being a "boom for infographics" when USA Today launched in 1982 and popularized the use of graphics in newspapers (Lester, 1995). The newspaper industry followed suit to ensure graphic capabilities as the percentage of newspapers able to produce graphics surged from 40 percent to 90 percent by the late 1990s (Reavy, 2003). Moving into the

2000s when the internet started to become a common method of social interactions, editorial infographics began appearing on various digital social platforms, such as blogs (Lankow et al., 2012).

Lankow et al., (2012) introduced a three-part framework that can be used to judge effective data visualization. This framework, (Figure 2) prioritizes appeal, comprehension, and retention based on whether the infographic is applied to marketing, academic, or editorial objectives. In the order of priorities, appeal is at the top as it is useful in capturing the viewers' attention while enabling the next priority of comprehension. The priority of retention plays a final role in these objectives as this graphic may be used for a resource that an individual can revisit to retrieve the information again (Lankow et al., 2012)
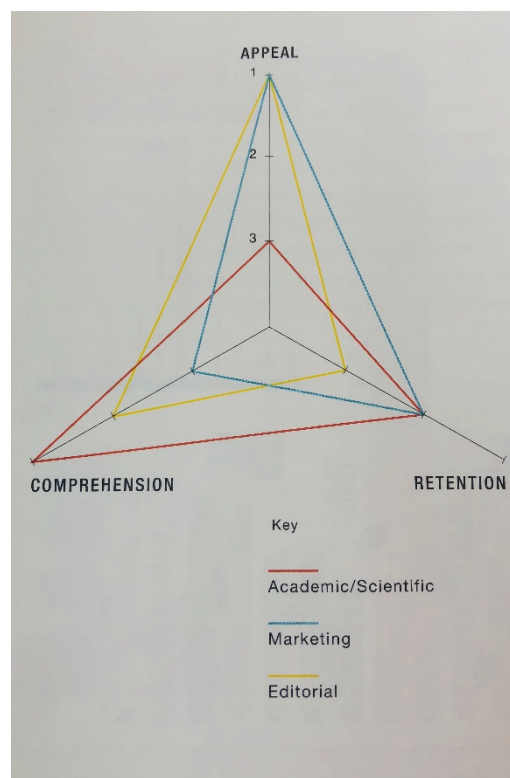

Figure 2. Lankow et al., (2012) infographic priorities framework

Infographics, beyond just getting an audience's attention, are readily accessible online where health information seeking has become more common. Pew Research Center (2013) reported 59 percent of U.S. adults seek health information online, while 53 percent of U.S. adults speak with clinicians about information they found online (Fox & Duggan, 2013). Health information seeking behavior (HISB) is defined as ways patients seek more information about health illnesses, risks, and health-protective behaviors (Jacobs et al., 2017; Lambert & Loiselle, 2007). Often, online health-seeking behaviors turn to the internet or social media to gain alternative perspectives on health information the patient may have been given, or if they had an unsatisfactory experience with a clinician (Rains, 2007). Online health information seeking is advantageous and attractive for individuals because of its accessibility, anonymity, interactivity, and the opportunities it presents for social support (Cline & Haynes, 2001). Considering the opportunities infographics present for information processing, it can be leveraged to ensure individuals who are seeking online health information are provided with visually rich information that can be better processed.

Hypotheses

Based on elaboration, cognitive response, and visual persuasion literature applications to health communication, the following research questions and hypotheses are being posed. Cognitive response literature (Cacioppo & Petty, 1981; Greenwald, 1968; Petty, et al., 2009; Petty, Ostrom, & Brock, 1981; Shavitt & Brock, 1990) and empirical findings in health communication applications (Bassett-Gunter et al., 2014; Bassett-Gunter et al., 2013; Berry et al., 2011; Holt et al., 2008; Pankratow et al., 2013) aid in informing the following two research questions, hypotheses and its subparts.

RQ1: Can an infographic health message generate greater cognitive processing than an equivalent text-based message?

H1: Recipients exposed to a health risk infographic message will experience greater levels of cognitive processing than those exposed to the health risk text-based message when the quantity of text is held constant.

RQ2: Can an infographic health message generate more positive thoughts than an equivalent text-based message?

H2a: Recipients will generate more positive cognitive responses related to sexual health when exposed to the health risk infographic than recipients exposed to the health risk text-based message.

H2b: Recipients will generate more positive cognitive responses about the visual elements of the health risk infographic message than recipients exposed to the health risk text-based message.

H2c: Recipients will generate more positive cognitive responses about personal relevance when exposed to the health risk infographic than recipients exposed to the health risk text-based message.

H2d: Recipients will generate more positive cognitive responses about the credibility of information when exposed to the health risk infographic than recipients exposed to the health risk text-based message.

H2e: Recipients will generate more positive cognitive responses overall when exposed to the health risk infographic than recipients exposed to the health risk text-based message.

Next, Lazard and Atkinson's (2015) study informs the following three hypotheses. Their study found significantly greater levels of elaboration for individuals who were randomly assigned to an infographic message about Genetically Modified Organism (GMO) food labels than those exposed to the equivalent text-based message. Comparatively to Lazard and Atkinson

(2015), the current study exclusively investigates elaboration variables of attitude change, knowledge, personal relevance, and perception of the information's credibility, with no moderating variables.

H3: Recipients exposed to a health risk infographic message will generate greater elaboration than those exposed to a health risk text-based message when the quantity of text is held constant.

H4: Recipients exposed to a health risk infographic message will show greater knowledge about the health condition than those exposed to the health risk text-based message when the quantity of text is held constant.

H5: Recipients exposed to a health risk infographic message will experience greater attitude change than those exposed to a health risk text-based message when the quantity of text is held constant.

Chapter 3: Methodology

Design

The current study utilizes a 2 x 1 posttest only experimental design to evaluate the role of elaboration across randomly assigned visual and text-based health promotion message conditions. The experimental design of this study is the most advantageous method to investigating the aforementioned research questions and hypotheses because of its ability to establish cause and effect between variables. This design is also low cost to create and distribute and allows for future replication (Wimmer & Dominick, 2014). This experiment was administered online through Qualtrics survey creation and distribution software. The Qualtrics link was then embedded into the Department of Journalism and Media Communication's SONA research participant management system. Qualtrics was chosen as the preferred survey software because of its versatility to integrate with SONA and its function that allows data to be exported to SPSS for analysis. Considering the online, viral nature of infographics and the idea of online health information seeking, administering this experiment online, was the most beneficial in minimizing artificiality for participants (Wimmer & Dominick, 2014).

Conversely, the attempt to minimize artificiality for participants came at the cost of the researcher being unable to control the environment participants are during their participation in the study. There is a possibility of alternative explanations that may emerge as a result of participants getting distracted or attempting to multitask while participating in the study. To minimize this, the informed consent advised participants to allow an appropriate amount of uninterrupted time to complete the study. To determine whether that request was ignored, Qualtrics allows the collection of paradata that collects the duration of participants' completion time of the study. This paradata aided in establishing an average participation time during data analysis. Participation times that were above or below two standard deviations of the mean

participation time were removed during data cleaning. Participation times outside of two standard deviations of the mean may reasonably be indicative of a participant's distractions or if breaks were taken during the session.

Participants

Participants were recruited from several undergraduate classes at Colorado State University through SONA software. SONA is a research participant management system that recruits and tracks study participation and compensates students with extra credit in Journalism and Media Communication class(es) they were enrolled in during December 2018. Extra credit was calculated based on SONA credits, which awarded one SONA credit (equivalent to five extra credit points in a class) for one hour spent participating in a study. The current study was administered online through Qualtrics and took less than 30 minutes to complete, thus participation in the study was worth one-half SONA credit (equivalent to 2.5 extra credit points in the course). Three emails to recruit participants were sent through SONA's mass email notification function during the data collection time frame. A sample of the SONA recruitment email can be found in Appendix A.

The available convenience sample through SONA consisted of 840 students enrolled in Journalism and Media Communication courses such as; JTC 100, JTC 210, JTC 211, JTC 300, JTC 326, JTC 417, JTC 501. To be eligible to participate, students had to be at least 18 years of age or older and provide informed consent (see Appendix B). While the convenience sampling method was cost effective, it cannot be considered an accurate representation of all 18- to 24-year-olds in the United States. Although this convenience sample cannot be representative of the entire age range of the at-risk population (i.e., population inference), it is reasonable to make a process inference based on the data, which may explain a process that is at work in similar situations (Hayes, 2010).

The age of students who participated in the study ranged between 18 to 32 years, with a mean age of 20.53. Of these participants, 46 percent identified as male and 53 percent identified as female. One participant identified as non-binary and two participants declined to answer. 9 percent of participants identified their ethnicity as Asian, 3 percent identified as Black/African, 81 percent identified as Caucasian/White, 9 percent identified as Hispanic/Latinx, .04 percent identified as Native American, 1 percent identified as Pacific Islander, and 3 percent declined to identify their ethnicity.

Participants were asked about their education level with instructions that stated if the student was currently enrolled, to select the highest degree received. Twenty-three percent of participants identified as having obtained a high school diploma, 61 percent identified as having some college credit but no degree, 6 percent have obtained an associate degree, 8 percent have obtained a bachelor's degree, and 1 percent have obtained a master's degree. Next, participants were asked about their relationship status; 52 percent identified as single, 45 percent identified as being in a relationship, 2 percent identified as married, and 1 percent selected "other."

Participants were then asked about ongoing or serious physical or mental health conditions that require frequent doctor visits or daily medications. Nine percent of participants identified as having an ongoing or serious physical or mental health condition, whereas 91 percent of participants reported they did not. Next, participants were asked if they had a serious injury or illness in the last 12 months that made them miss one full day of usual activities. Fifty-six percent of participants answered "0 times," 18 percent answered, "1 time," 15 percent answered, "2-3 times," 7 percent answered, "4-5 times," 2 percent answered, "6-7 times," no participant answered, "8-9 times," and 1 percent answered, "10-11 times." Below, Table 1

provides more details about the descriptive statistics and all study variables for participants

assigned to the infographic vs. text-based condition.

Table 1. Participant characteristics of the sample by experimental condition (*N*=202)

	Infographic	Text-Based	Total
Age (M [SD])	20.51(1.863)	20.55 (2.086)	20.53 (1.973)
Gender (η [*N*%])			
Male	51 (25.2%)	41 (20.3%)	92 (45.5%)
Female	49 (24.3%)	58 (28.7%)	107 (53.0%)
Non-Binary	1 (0.5%)	0 (0.0%)	1 (0.5%)
Prefer not to answer	0 (0.0%)	2 (1.0%)	2 (1.0%)
Ethnicity (η [*N*%])			
Asian	10 (5.0%)	9 (4.5%)	19 (9.4%)
Black/African	6 (3.0%)	1 (0.5%)	7 (3.5%)
Caucasian/White	79 (39.1%)	83 (41.1%)	162 (80.2%)
Hispanic/Latinx	9 (4.5%)	10 (5.0%)	19 (9.4%)
Native American	0 (0.0%)	1 (0.5%)	1 (0.5%)
Pacific Islander	1 (0.5%)	1 (0.5%)	2 (1.0%)
Prefer not to answer	2 (1.0%)	4 (2.0%)	6 (3.0%)
Education (η [*N*%])			
High school graduate, diploma or equivalent	22 (10.9%)	24 (11.9%)	46 (22.8%)
Some college credit, no degree	64 (31.7%)	59 (29.2%)	123 (60.9%)
Associate degree	7 (3.5%)	6 (3.0%)	13 (6.4%)
Bachelor's degree	8 (4.0%)	9 (4.5%)	17 (8.4%)
Master's degree	0 (0.0%)	3 (1.5%)	3 (1.5%)
Relationship status (η [*N*%])			
Single	47 (23.3%)	59 (29.2%)	106 (52.5%)
In a relationship	51(25.2%)	39 (19.3%)	90 (44.6%)
Married	2 (1.0%)	2 (1.0%)	4 (2.0%)
Other	1 (0.5%)	1 (0.5%)	2 (1.0%)
Ongoing or serious physical or mental health conditions (η [*N*%])			
Yes	10 (5.0%)	9 (4.5%)	19 (9.4%)
No	91 (45.0%)	92 (45.5%)	183 (90.6%)
Number of illnesses or injuries in the past 12 months (η [*N*%])			
0	59 (29.2%)	59 (29.2%)	114 (56.4%)
1	20 (9.9%)	17 (8.4%)	37 (18.3%)
2-3	12 (5.9%)	19 (9.4%)	31 (15.3%)
4-5	8 (4.0%)	6 (3.0%)	14 (6.9%)
6-7	1 (0.5%)	3 (1.5%)	4 (2.0%)
8-9	0 (0.0%)	0 (0.0%)	0 (0.0%)
10-11	1 (0.5%)	1 (0.5%)	2 (1.0%)

Measures

Measures in this study evaluated the motivation of the target audience to process either the message, which ascertains the outcomes of infographic or text-based messages on prevention behaviors and attitude change. Elaboration, which acted as the dependent variable of this study, was operationalized based on cognitive responses, message involvement, visual imagery, prior knowledge, and attitude change.

Stimulus Construction. The independent, manipulated variable in this study was message format. Health risk information that comprised the stimulus was population-specific. Considering the demographics of the sample, the most relevant health risk information for this population is sexually transmitted disease (STD) testing and prevention. Routine STD testing is considered to be one of the most effective ways to prevent rampant transmission, however adherence to this directive has remained subpar among young adults who are sexually active (Geisler, 2011; Haderxhanaj, Gift, Loosier, Cramer, & Leichliter, 2014). This conclusion is evident and alarming considering the Centers for Disease Control and Prevention (CDC) reported 2.3 million cases of chlamydia, gonorrhea, and syphilis in 2017, which surpassed the previous record set in 2016 (Centers for Disease Control and Prevention, 2017).

Participants were randomly assigned to view either the infographic or text-based message containing STD transmission data and clinical directives for prevention and treatment from the CDC. In an effort to maintain consistency between the infographic and text-based condition, the exact information was included and presented in the same order. Additionally, the stimulus was constructed in portrait orientation of the same size (792 x 1224 pixels) and used the same colors and fonts. The construction of the infographic stimulus drew from Edward Tufte's (1983) principles of graphical excellence in displaying quantitative information. Tufte (1983) recommends designing a quantitative display that serves a clear purpose such as, description,

tabulation, decoration, or exploration. The data displayed in quantitative displays should also reveal data at several levels of detail, ranging from broad to fine and integrate statistical and verbal descriptions of the data (Tufte, 1983). Tufte (1990) also recommends the consideration of colors in developing quantitative graphics. Using colors such as blues, greens, yellows, and grays, which can be found in nature, will be most effective because natural colors are familiar to the human eye (Tufte, 1990). Processing quantitative information displayed in nature's colors provides harmony and their source is considered to have a positive authority (Tufte, 1990).

Additionally, considering the information comes from the CDC, the construction of the stimulus also drew from the CDC's guide for creating infographics for a nonscientific audience (Centers for Disease Control and Prevention, 2012). In this guide, the CDC recommends the use of graphs as a way to illustrate trends overtime. Considering the rapid transmission of STDs graphs were embedded into the infographic stimulus condition to draw attention to the upward trend of diagnosed cases between 2013 and 2017. CDC also recommends the use of pictographs to convey information. Pictographs are shapes, images, or icons that are graphically linked to the topic or concept to add interest and instantly connect to the topic of the message (Centers for Disease Control and Prevention, 2012). Samples of the stimulus construction of both conditions can be found in Appendix C.

Cognitive Response. Cognitive response was operationalized based on one open-ended thought listing question which was adapted from Cacioppo & Petty (1981) and Cacioppo, Von Hippel, & Ernst (1997). The question encouraged the participant to list everything that went through their mind about the message they had just viewed. It invited positive, negative, or neutral thoughts the participant had about themselves, the situation or others. Although the question is open-ended, a force response validation function was activated in Qualtrics which

had a minimum character requirement of 25 to ensure adequate participation. Thoughts were coded along the polarity dimension, which is considered the degree to which the participant lists either 1) "favorable thoughts" –statements that are considered to be positive (toward the self) or supportive of the message; 2) "neutral/irrelevant thoughts"—which are neither positive or negative toward the self or message; and 3) "unfavorable thoughts"—which are negative toward the self or opposed to the message (Cacioppo & Petty, 1981).

Message Involvement. The measure of message involvement and sensitivity created by Keys et al., (2009) was adapted for this study to explain participants message involvement. It included seven items on a seven-point semantic differential scale($M = 3.44$, $SD = 1.71$, $\alpha = 0.82$). Shown in Table 2 are the seven items and their anchors on a seven-point semantic differential scale.

Table 2. Message involvement question anchors

Paid attention to the message	1	2	3	4	5	6	7	Did not pay attention to message
Concentrated on the message	1	2	3	4	5	6	7	Did not concentrate on the message
I put a great deal of thought into evaluating the message.	1	2	3	4	5	6	7	I put little or no thought into evaluating the message.
This message was relevant to me.	1	2	3	4	5	6	7	This message was not relevant to me.
This message changed my views about STDs/STIs.	1	2	3	4	5	6	7	This message did not change my views about STDs/STIs.
This message would be effective for students my age.	1	2	3	4	5	6	7	This message would not be effective for students my age.

Visual Imagery. Elaboration with respect to the extent of visual imagery experienced while processing advertisements was derived Gkiouzepas & Hogg (2011) and McQuarrie and Mick (1999). Three items were adapted from Unnava and Burkrant (1991), which have been used by Gkiouzepas & Hogg (2011) and McQuarrie and Mick (1999). Those items were anchored by "provokes imagery/not imagery provoking," "vivid/dull" and "interesting/boring."

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An additional item was adapted from McQuarrie & Mick (1999), which used the anchors of "the message was easy to understand/the message was difficult to understand," in order to gauge the design complexity of the message. Table 3 includes the additional four items on a seven-point semantic differential scale ($M = 3.13, SD = 1.621, \alpha = 0.82$).

Table 3. Visual imagery question anchors

This message provoked imagery.	1	2	3	4	5	6	7	This message did not provoke imagery.
This message was vivid.	1	2	3	4	5	6	7	This message was dull.
This message was interesting.	1	2	3	4	5	6	7	This message was boring.
This message was easy to understand.	1	2	3	4	5	6	7	This message was difficult to understand.

Knowledge. Elaboration with respect to the extent of prior knowledge participants had regarding sexual health and STD/STI prevention strategies had questions derived from Akhtar, Luby, Rahbar, & Azam (2001); Drago et al. (2016); Ford, Wirawan, & Reed (2000); Lustria et al. (2016); Svensson & Waern (2013). The 5 items were formatted as checklist questions. When participants selected correct responses from the checklist of options, one point was awarded for each correct response. A score of 14 was considered to be a perfect score. Two of the five questions contained information derived and the remaining three questions tested prior knowledge on sexual health that were not directly placed on the stimulus materials. These questions can be found in Appendix D.

Attitude. Elaboration with respect to the extent of attitude change participants had toward sexual health and STD/STI prevention strategies was derived from Akhtar, Luby, Rahbar, & Azam (2001) and Svensson & Waern (2013). Eight items were measured on a five-point Likert scale ($M = 2.25, SD = 1.071, \alpha = 0.74$), which can be found in Appendix E.

Procedure

Students were able to access a link to the study on Qualttrics when they registered to participate in the study through SONA. They were first brought to the informed consent, which detailed IRB regulations and other relevant disclaimers, such as being sure to allow plenty of time to complete the experiment, etc., which can be located in Appendix B. Following the informed consent, participants were randomly assigned to view the text-based or infographic health message. Both stimuli conditions were formatted to look like a website page with the background colors, headers, and browser bars remaining consistent between both conditions (see Appendix C). Instructions were consistent across both conditions which were displayed as follows, "Please read through the information about STDs and STIs displayed below. When you have finished reading it, please move on to the next section."

After the participant viewed either the randomly assigned text-based or infographic conditions, participants will be able to move on to the post-test, which first measured cognitive effort toward the message by asking the participant to list their thoughts about the message they viewed and whether the thoughts were about themselves, the situation, and/or others and whether those thoughts were positive, negative, or neutral. After listing their thoughts, participants were brought to the next part of the experiment which measured the participants' elaboration towards the message through the aforementioned ten 7-point semantic differential items. Next, participants were asked five checklist questions which aimed to measure their knowledge about STDs and STIs. After completing the knowledge questions, participants were then asked a series of eight questions which measured the participants attitudes toward sexual health and engaging in STD/STI prevention behaviors.

Data Analysis Strategy

Prior to hypothesis testing, open-ended responses to the thought-listing question were analyzed based on thought types and thought units, where thoughts units were operationalized as independent clauses (So & Alam, 2018). 202 participants produced a total of 506 thoughts between the two conditions; 210 thoughts were listed by participants exposed to the text-based condition, whereas 296 thoughts were listed by those exposed to the infographic-based condition. Two independent scorers blind coded each infographic and text-based thought based on valence, number of thoughts and other categorization schemes that emerged after a preliminary examination of the data (Wimmer & Dominick, 2014).

The categorization schemes used included thoughts related to sexual health, visual elements of the message, personal relevance, and credibility of information. Thoughts were then ranked on the polarity dimension (i.e. positive, neutral or negative) with respect to the aforementioned categorization schemes, where participants that produced thoughts relative to the scheme and polarity is the unit of measurement. The final thought-listing codes reflecting the processing of messages, their definitions, and example codes can be found in Appendix F. Interrater reliability was high for sexual health thoughts $(\kappa > 0.62, \rho < .001)$ visual elements thoughts $(\kappa > 0.82, \rho < .001)$, personal relevance thoughts $(\kappa > 0.75, \rho < .001)$ and credibility of information thoughts $(\kappa > 0.82, \rho < .001)$ (Landis & Koch, 1977). Any coding discrepancies were resolved between the two scorers through discussion. Using SPSS, independent *t* tests were run to investigate whether study group differences existed in the frequencies across the six categories of thought coding. Additionally, a chi-square analysis was run further examine study group differences. Following the independent *t* tests and chi-square analyses on thought-listing responses, independent *t* tests were run on the results from questions measuring elaboration, attitude, and knowledge.

Chapter 4: Results

Data was collected in December 2018. A total of 215 people completed the study. Of these, 13 responses were excluded for the following reasons: participation time fell beyond two standard deviations of the mean completion time ($\eta = 9$) or participants displayed an obvious lack of concentration ($\eta = 4$). This lack of concentration was evident as participants responded in the thought-listing question by saying they were just clicking through the study as quickly as they could for extra credit or gave completely irrelevant answers. Thus, the final sample for analysis consisted of 202 participants; 50 percent ($\eta = 101$) were randomly assigned to the infographic condition and 50 percent ($\eta = 101$) were randomly assigned to the text-based condition. The average participation time for the study was 8 minutes and 56 seconds, with a standard deviation of 7 minutes and 4 seconds.

Prior to hypothesis testing, open-ended responses to the thought-listing questions were analyzed based on thought units and thought types. Between the two conditions, 202 participants produced a total of 506 thoughts; 210 thoughts were listed by participants exposed to the text-based condition, whereas 296 thoughts were listed by those exposed to the infographic-based condition. Average thought counts were then analyzed through independent t-tests. Thought units for the infographic condition $(M = 2.93, SD = 1.409)$ were higher than the text-based condition $(M = 2.08, SD = 1.083)$, and there was a statistically significant difference between the conditions, $M = \pm0.85$, 95% CI [.503, 1.20], $t(187.618) = 4.815, \rho < .001$. As an additional check on cognitive processing, the word count was taken on each thought and then analyzed through an independent t-test. Word count for the infographic thoughts listed was higher $(M = 39.81, SD = 34.067)$, than the word count for the text-based thoughts listed $(M = 31.70, SD = 22.97)$, with a statistically significant difference $M = \pm8.11$, 95% CI [.041,

16.177], $t(175.309) = 1.984, p = .049$. The findings from this t-test aid in answering RQ1 which asks: Can an infographic health message generate greater cognitive processing than an equivalent text-based message? This data also supports H1 (Table 4) which states: Recipients exposed to a health risk infographic message will experience greater levels of cognitive processing than those exposed to the health risk text-based message, when the quantity of text is held constant.

Table 4. Independent t tests comparing mean thought and word counts of responses by study group

	Infographic (M [SD])	Text-Based (M [SD])	df	t	p
Thought Count	2.93 (1.409)	2.08 (1.083)	187.618	4.1815	≤0.001*
Word Count	39.81 (34.067)	31.70 (22.960)	175.309	1.984	0.049*

Note: * = significant findings

First, a chi-square test of independence was conducted between the experimental condition and the number of participants who produced positive, neutral, negative, and sexual health thoughts, respectively. Of these, a statistically significant association was confirmed between the infographic condition and positive sexual health thoughts, $\chi^2(1) = 21.388, p < .001$. This data further confirms H2a which states: Recipients will generate more positive cognitive responses related to sexual health when exposed to the health risk infographic than recipients exposed to the health risk text-based message. This test was then repeated with positive, neutral, negative, and irrelevant thoughts related to the theme of visual elements. Of these a statistically significant association was confirmed between the infographic condition and positive visual elements thoughts, $\chi^2(1) = 11.957, p = .001$. This data further confirms H2b which states: Recipients will generate more positive cognitive responses about the visual

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elements of the health risk infographic message than recipients exposed to the health risk text-based message.

Next, this test was repeated with positive, neutral, and negative thoughts related to the theme of personal relevance. Of these a statistically significant association was confirmed between the infographic condition and positive personal relevance thoughts, $\chi^2(1) = 6.470, \rho = .011$ and between the text-based condition and neutral personal relevance thoughts, $\chi^2(1) = 3.974, \rho = .046$. The data from the chi-square analysis confirms H2c, whereas data from the independent t test did not. H2c states: Recipients will generate more positive cognitive responses about personal relevance when exposed to the health risk infographic than recipients exposed to the health risk text-based message.

Then, this test was run with positive, neutral, negative, and irrelevant thoughts related to the theme of information credibility. Of these a statistically significant association was confirmed between the infographic condition and positive information credibility thoughts, $\chi^2(1) = 8.189, \rho = .004$. These data further confirm H2d which states: Recipients will generate more positive cognitive responses about the credibility of information when exposed to the health risk infographic than recipients exposed to the health risk text-based message.

Finally, a chi-square test of independence was conducted between the experimental condition and the ranking of the polarity of the entire thought(s) listed by each participant. Of these a statistically significant association was confirmed between the text-based condition and overall irrelevant thoughts, $\chi^2(1) = 7.788, \rho = .005$. This data further confirms H2e which states: Recipients will generate more positive cognitive responses overall when exposed to the health risk infographic than recipients exposed to the health risk text-based message. Table 5 further details the results from the chi-square analyses, including all findings.

Table 5. Chi-Square Analyses Comparing Infographic and Text-Based Study Groups on Coded Cognitive Responses

Type of thought	Infographic (N, [%])	Text-Based (N, [%])	x^2	p
Positive sexual health				
Yes	28 (27.7%)	4 (4%)	21.388	≤0.001[a*]
No	73 (72.3%)	96 (96%)		
Neutral sexual health				
Yes	12 (11.9%)	12 (11.9%)	0.000	1.000[a]
No	89 (88.1%)	89 (88.1%)		
Negative sexual health				
Yes	36 (35.6%)	31 (30.7%)	0.588	1.000[a]
No	65 (64.4%)	70 (69.3%)		
Positive visual elements				
Yes	18 (17.8%)	3 (3%)	11.957	≤0.001[a*]
No	83 (82.2%)	98 (97%)		
Neutral visual elements				
Yes	5 (5%)	0 (0%)	5.127	0.059[b]
No	96 (95%)	100 (100%)		
Negative visual elements				
Yes	2 (2%)	8 (7.9%)	3.787	0.052[a]
No	99 (98%)	93 (92.1%		
Positive personal relevance				
Yes	35 (34.7%)	19 (18.8%)	6.470	0.011[a*]
No	66 (65.3%)	82 (81.2%)		
Neutral personal relevance				
Yes	7 (6.9%)	16 (15.8%)	3.974	0.046[a*]
No	94 (93.1%)	85 (84.2%)		
Negative personal relevance				
Yes	14 (13.9%)	14 (13.9%)	0.000	1.000[a]
No	87 (86.1%)	87 (86.1%)		
Positive credibility of information				
Yes	36 (35.6%)	18 (17.8%)	8.189	0.004[a*]
No	65 (64.4%)	83 (82.2%)		
Neutral credibility of information				
Yes	5 (5%)	7 (6.9%)	0.354	0.552[a]
No	95 (95%)	94 (93.1%)		
Negative credibility of information				
Yes	6 (5.9%)	4 (4%)	0.421	0.517[a]
No	95 (94.1%)	97 (96%)		

Notes: [a]=Chi-square test. [b]=Fisher's exact test. [*] = significant findings.

After analyzing the results from the thought listing results through independent *t* tests and chi-square tests of independence, independent *t* tests were run on the responses from the elaboration, knowledge, and attitude questions. First, an independent *t* test was run for responses to the elaboration questions, relative to the infographic or text-based condition. These results showed elaboration for those exposed to the infographic condition ($M = 3.14, SD = 1.10$) was

higher than the participants that were exposed to the text-based condition ($M = 3.48, SD = 1.24$), with a statistically significant difference, $M = \pm0.35$, 95% CI [-.671, -.0212], t (200) $= -2.094, \rho = .038$. This data supports H3 which states: Recipients exposed to a health risk infographic message will generate greater elaboration than those exposed to a health risk text-based message, when the quantity of text is held constant.

Next, an independent t test was run for responses to the knowledge questions, relative to the infographic or text-based condition. These results showed knowledge for those exposed to the text-based condition was higher ($M = 11.85, SD = 1.997$) than the participants that were exposed to the infographic condition ($M = 11.81, SD = 1.968$), a difference that was not statistically significant, $M = \pm0.04$, 95% CI [-.590, .511], t (200) $= -0.142, \rho = .887$. This data did not support H4 which states: Recipients exposed to a health risk infographic message will show greater knowledge about the health condition than those exposed to the health risk text-based message, when the quantity of text is held constant.

Finally, an independent t test was run for responses to the attitude questions, relative to the infographic or text-based condition. These results showed attitude for those exposed to the infographic condition scored higher ($M = 2.50, SD = .6131$) than the participants that were exposed to the text-based condition ($M = 2.47, SD = .55033$), a difference that was not statistically significant, $M = \pm0.036$, 95% CI [-.12601, .19730], t (200) $= 435, \rho = .664$. This data did not support H5 which states: Recipients exposed to a health risk infographic message will experience greater attitude change than those exposed to a health risk text-based message, when the quantity of text is held constant. On the following page, Table 8 further details the findings of the independent t tests responses to elaboration, knowledge, and attitude questions.

Table 6. Independent t tests comparing mean results of elaboration, attitude, and knowledge results by study group.

	Infographic (M [SD])	Text-Based (M [SD])	df	t	p
Elaboration	3.1426 (1.10167)	3.4881 (1.23978)	200	-2.094	0.038[*]
Attitude	2.5046 (0.61310)	2.4689 (0.55033)	200	.435	0.664
Knowledge	11.81 (1.968)	11.85 (1.997)	200	-.142	0.887

Note: [*] = significant findings

Chapter 5: Discussion, Limitations & Future Research

Discussion

The current study investigated the persuasiveness of infographics, comparatively to its equivalent text-based condition, within in the context of promoting STD and STI prevention and screening among young adults. These results contribute to a growing body of literature that has investigated the effectiveness of the design of quantitative displays of data in persuasive health communication, during a growing trend of online health information seeking. The role of visual information (or vividness) in communicating health risk information, was specifically tested by manipulating visual content and message format to investigate its influence on persuasive message processing. To the best of the author's knowledge, this is the first study to examine pathways between the cognitive response approach, elaborative processing, infographic design, and persuasion outcomes.

The results of the current study are consistent with previous cognitive response, elaboration, and design literature which indicated the infographic message (which has greater design complexity) than the text-based message was able to invoke more elaboration, suggesting that participants were more likely to engage in central route processing Bassett-Gunter et al., 2014; Cacioppo & Petty, 1981; Holt et al., 2008; Lustria et al., 2016). Central route processing develops stronger attitudes in message recipients that are more durable and able to resist change when challenged by contrary information (Petty et al., 2002; Petty & Cacioppo, 1996). The strong attitudes formed by central route processing are able to foster message processing, provide promising health behavior outcomes that will guide thinking related to perceived risk of contracting STDs or STIs, and most importantly, guiding behavior to implement safe sex practices or intentions for STD or STI testing and treatment (Lustria et al., 2016; Petty et al., 2002; Petty & Krosnick, 1995).

Significant differences by condition were observed on thought-listing and elaboration posttest measures, which included thoughts about sexual health, visual elements of the message, perceived personal relevance, and credibility of the information in the message. These findings set forth additional evidence that design complexity and creating health messages conducive to online environments must be considered as an influential health communication tool (Lazard & Mackert, 2014; Parrish, 2016; Petty et al., 2002).

Often young adults, generally between the ages of 18 and 24 years old, underestimate the likelihood of contracting or transmitting STDs or STIs and thus do not see health related messages about safe sex practices as personally relevant to them (Lustria et al., 2016; Petty et al., 2002; Pollack, Boyer, & Weinstein, 2013). This trend in behavior informed the American College Health Association (ACHA)'s "Healthy Campus 2020" student objectives has listed "increasing the proportion of students who report receiving information on sexually transmitted diseases/infection prevention from their institution" as one of its health communication goals (American College Health Association, 2010). Results from the current study suggest that infographics could indeed be successful in meeting ACHA objectives while also serving as an effective way to elevate risk perceptions among this age cohort.

The results from the thought-listing question provided the most insight into how the infographic message was centrally processed. The thought-listing results also showed that participants had more positive thoughts related to sexual health, visual elements of the message, personal relevance, and credibility of the information presented in the infographic condition than the text-based condition. Additionally, participants exposed to the infographic message had more message relevant thoughts compared to the text-based condition. The thought-listing results provided an indicator of immediate memory recall of the message. Considering the infographic

condition had less overall irrelevant thoughts than the text-based condition, this finding confirms immediate memory recall was better for participants exposed to the infographic condition rather than the text-based condition.

These results provide support for the connections between cognitive responses, elaborative processing, and the use of vivid appeals to increase persuasive health messaging outcomes (Parrott & Maibach, 1995; Petty et al., 2002, 1983; Witte, 1995). Data from thought listing were consistent with previous studies that vivid health messages tailored to a specific target audience, that include vivid visual or auditory content can increase cognitive processing, personal relevance, and positive thoughts (Bassett-Gunter et al., 2014; Lazard & Atkinson, 2015; Lazard & Mackert, 2014; Lustria et al., 2016; Parrish, 2016). These increases in message processing determinants are in turn associated with greater elaboration and attention. Results of greater attention and elaboration were then linked to greater positive thoughts related to sexual health, (e.g. decreasing stigma about STD or STI testing and treatment) and perceived personal relevance and risk of STDs and STIs. These links serve as predictions of intentions related to safe sex practices or getting tested (Lustria et al., 2016; Pollack et al., 2013).

Persuasion literature suggests that multiple exposures a certain topic prior to viewing a persuasive message may impact the knowledge an individual has on the subject or extent of attitude change (Petty, Brinol, & Priester, 2009; Petty & Cacioppo, 1979; Petty et al., 1983). Results from the knowledge and attitude measures of the current study are consistent with the aforementioned literature, considering there were not significant differences between condition in these measures. Being college students, the participants were also educated and had been exposed to CSU's "Get Yourself Tested (GYT)" campaign and other safe sex promotion

messages. This consideration may serve as a possible explanation as to why the results from the knowledge measure did not yield significant results.

In addition to the multiple exposures recipients may have had to this topic, aforementioned literature pertaining to young adults' underestimation of their risk of contracting or transmitting STDs and STIs may serve as explanations as to why the attitude measures of the current study also did not yield significant results between conditions. This study leaves more to be investigated to better inform the creation of visually rich messages, such as infographics, in conveying health risk information about STD and STI testing to young adults. Although the cognitive response and elaboration results from the infographic condition reinforce support for vivid message creation, it may be prudent to consider how the appeal is facilitating persuasion for a particular health risk, such as STD and STI contraction and transmission, that the audience may have been exposed to multiple times prior to participation in this study. Perhaps replicating this web-based experiment with information about another population-specific health risk, such as vaping, which is not communicated as frequently may yield different results.

Limitations

While the findings from the current study help clarify connections between cognitive responses, elaborative processing, and vivid message appeals, there are certain limitations to consider. This study used a convenience sample at Colorado State University; which does not allow for a population inference to be made. While college students between the ages of 18-24 were the population of interest, because they considered the most at-risk population for STD/STI contraction or transmission, these results may not be generalizable to other age groups.

To an extent, the web-based experiment was conducted in a somewhat artificial environment. Considering this, it cannot be assumed whether participants would have actually searched for the information presented in either experimental condition. Although experiments

are artificial by nature, the environment participants would have had for the study would have been more natural than in a lab setting. Participants were able to participate on their own device from wherever they chose, which minimized artificiality but could not guarantee participants were not distracted or multi-tasking, thus not giving the study their full attention.

This study also utilized self-reported measures for the independent variables, which does not guarantee the accuracy of the participants' self-reported measures. Participants may not have been able to accurately recall previous prevention or detection behavior. Participants may have also been driven to provide more socially desirable answers. In order to minimize these issues experimental and survey design best practices were utilized (Dillman, Smyth, & Christian, 2014; Wimmer & Dominick, 2014). Participants were reminded that their answers were anonymous, there were no right or wrong answers, and that their honest answers and opinions were valued, especially in the instructions for the thought-listing measurement in the experiment. Although the thought-listing results served as an indicator or immediate memory recall, it is not a long-term indicator of memory recall of the information.

Similarly, to the thought-listing results, the entire experiment measured the short-term, immediate effects of the message condition but does not show the effects of the infographic on elaboration long-term. This study did not include a follow-up study after message exposure, so it is unclear how durable attitudes formed through central processing in this study were. The results from this study also cannot assume that attitudes related to sexual health had not already been established prior to the participants exposure to the message tested in this study. Additional research is needed to determine how the messages are being processed. Specific recommendations for future research are discussed in the following section.

Implications for Future Research

In an effort to address the aforementioned limitations and extend the theoretical applications the results this experiment provides to health communication literature and practitioners, it should be further replicated and expanded. A way to replicate and expand this experiment could be to re-run this experiment with messages related to a different health condition, rather than sexual health to see if a variance in results has to do with the health condition. If this experiment is replicated and extended, it should also be run with a pre-test/posttest design to better evaluate memory recall. This could also be a beneficial way to investigate whether a message recipient gained more knowledge from the message or not.

Considering the number of significant findings that emerged from the thought-listing portion of this study, a similar study could be replicated which focuses only on thought-listing results. This study only coded and analyzed the thought-listing results based on thought-listing polarity dimensions (positive, neutral, negative, irrelevant) on thought categories that emerged from the results. By replicating the thought-listing portion of this experiment and analyzing beyond the polarity dimensions, results could provide greater insight into other more intricate themes that may emerge from the results.

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Appendix A-SONA Recruitment Study Mass Email

Subject	Health infographics online study
Send Copy to	channing.downing_bice@colostate.edu
	(blank for no copy -- multiple (comma separated) emails are allowed)
Message	A new study about infographics in health communication has now opened. To earn extra credit in your JTC course, please participate in this survey between Sunday, November 25-Sunday, December 9.

Design </> HTML

If you write the text %FIRST_NAME% %LAST_NAME% or %USERNAME%, the system will place the recipient's information in place of that text when it generates the email.

Preview Messages...

Appendix B-Informed Consent

The Relative Persuasiveness of Health Infographics

You are invited to participate in a brief study about sexually transmitted diseases (STDs) and sexually transmitted infections (STIs). You will be asked questions about your prior knowledge of STDs and STIs and your learning preferences for information presented in visual or verbal formats. Then, you will view a website with information from the Centers for Disease Control on STD and STI prevention. Finally, you will be asked questions about the website you viewed. Your responses will help identify effective ways to display health information. To be eligible to participate in this study, you must be 18 or older.

It will take about 20-30 minutes to complete. Please be sure to allow plenty of time, uninterrupted to participate in this study. You will receive extra credit in your JTC class for your time and thoughtful responses.

Your data will be anonymous. Your name will be collected separately through the SONA system to ensure you will receive extra credit points. Your participation in this study is completely voluntary. There is no penalty for not participating. You have the right to withdraw from the study at any time without consequence.

Whom to contact if you have questions about the study:

Channing Downing Bice
Graduate Student, Public Communication & Technology
Department of Journalism & Media Communication
channing.downing_bice@colostate.edu.

Whom to contact about your rights as a research participant in the study: Colorado State University Research Integrity & Compliance Review Office (RICRO),
RICRO_IRB@mail.colostate.edu; 970-491-1553

○ I have read the procedure above and agree to participate in the survey.
○ I have read the procedure above and do NOT volunteer to participate in the survey.

→
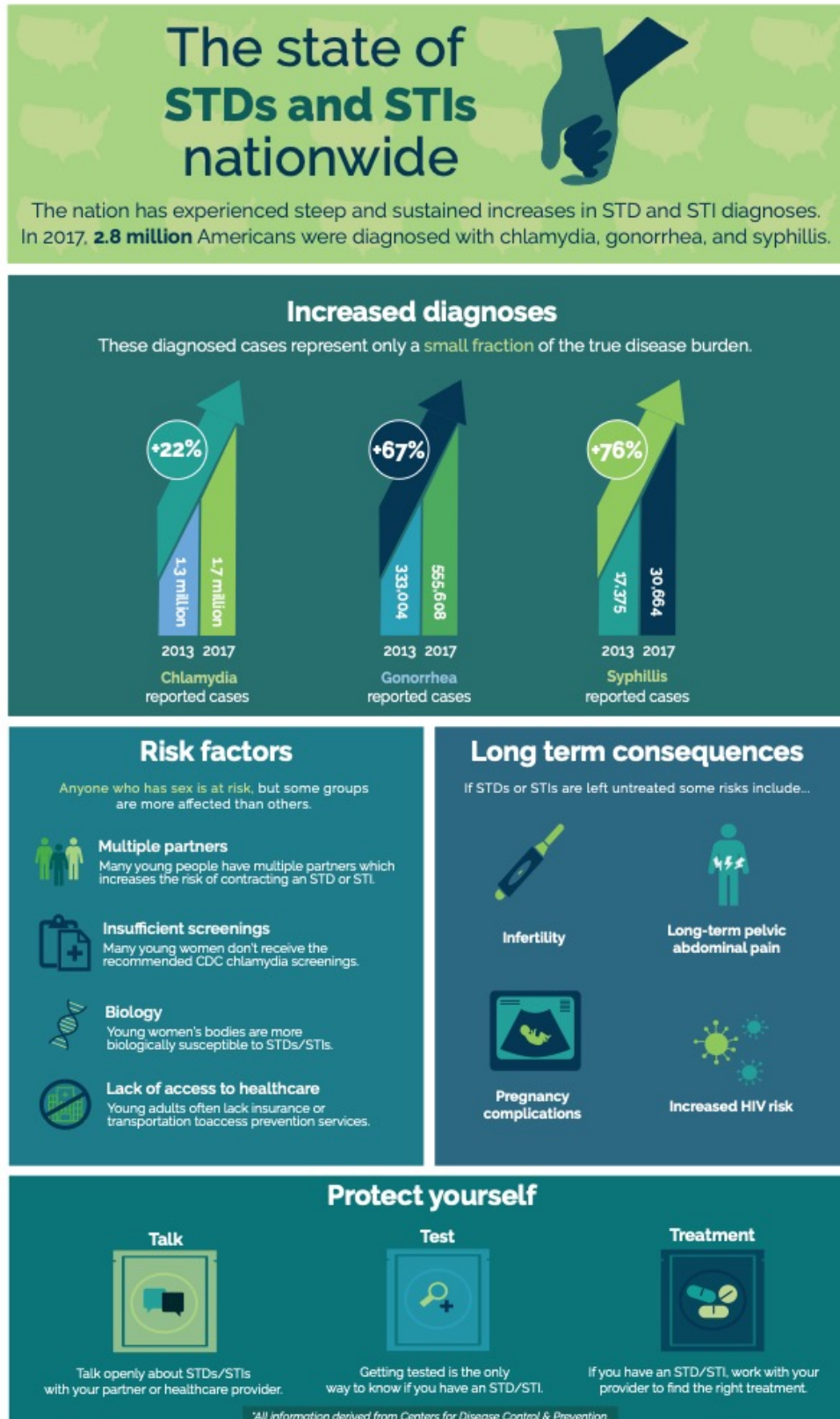
The state of
STDs and STIs
nationwide

The nation has experienced steep and sustained increases in STD and STI diagnoses. In 2017, **2.8 million** Americans were diagnosed with chlamydia, gonorrhea, and syphillis.

Increased diagnoses

These diagnosed cases represent only a small fraction of the true disease burden.

In 2013, 1.3 million cases of chlamydia were reported. In 2017, 1.7 million cases of chlamydia were reported, which is an increase of 22%. In 2013, 333,004 cases of gonorrhea were reported. In 2017, 555,608 cases of gonorrhea were reported, which is an increase of 67%. In 2013, 17,375 cases of syphillis were reported. In 2017, 30,664 cases of syphillis were reported, which is an increase of 76%.

Risk factors

Anyone who has sex is at risk, but some groups are more affected than others.

Multiple partners
Many young people have multiple partners which increases the risk of contracting an STD or STI.

Insufficient screenings
Many young women don't receive the recommended CDC chlamydia screenings.

Biology
Young women's bodies are more biologically susceptible to STDs/STIs.

Lack of access to healthcare
Young adults often lack insurance or transportation to access prevention services.

Long term consequences

If STDs or STIs are left untreated some risks include...

Infertility

Long-term pelvic abdominal pain

Increased HIV risk

Pregnancy complications

Protect yourself

Talk
Talk openly about STDs/STIs with your partner or healthcare provider.

Test
Getting tested is the only way to know if you have an STD/STI.

Treatment
If you have an STD/STI, work with your provider to find the right treatment.

All information derived from Centers for Disease Control & Prevention.

Appendix D-Prior Knowledge Sexual Health Questions

(Please note, answers with * are correct answers for researcher records. The correct answers were not displayed for participants.)

1. **Which of the following diseases are sexually transmitted? More than one answer can be selected.**

   a. HIV*
   b. Syphilis*
   c. Hepatitis A
   d. Herpes*
   e. Chlamydia*

2. **How many partners does it take to contract an STD or STI?**
   a. 1 partner*
   b. 2-3 partners
   c. 3-4 partners
   d. 4-5 partners

3. **Which means of contraception protects against STDs or STIs? More than one answer can be selected.**

   a. Condoms*
   b. Abstinence*
   c. Contraceptive pill
   d. Transdermal patch

4. **What are possible causes of STDs?**
   a. Bacteria*
   b. Virus*
   c. Fungus*
   d. Bad hygiene
   e. Sex during menstruation

5. **What are complications of STDs if left untreated? More than one answer can be selected.**
   a. Infertility*
   b. Ectopic pregnancy*
   c. Long-term pelvic abdominal pain*
   d. Cervical cancer*

STDs are not dangerous because they can be cured. *Please select one.*

Strongly agree   Agree   Neither agree or disagree   Disagree   Strongly disagree

It is necessary to avoid a person who has contracted an STD because they can transmit it to other people. *Please select one.*

Strongly agree   Agree   Neither agree or disagree   Disagree   Strongly disagree

People who are infected with an STD must get treatment. *Please select one.*

Strongly agree   Agree   Neither agree or disagree   Disagree   Strongly disagree

I am worried about contracting an STD or STI. *Please select one.*

Strongly agree   Agree   Neither agree or disagree   Disagree   Strongly disagree

The message I viewed persuaded me to ensure condoms are accessible to my current or future partner and I. *Please select one.*

Strongly agree   Agree   Neither agree or disagree   Disagree   Strongly disagree

The message I viewed persuaded me to get tested for STDs or STIs. *Please select one.*

Strongly agree   Agree   Neither agree or disagree   Disagree   Strongly disagree

The message I viewed persuaded me to talk to my partner, friends, or acquaintances about condom use. *Please select one.*

Strongly agree   Agree   Neither agree or disagree   Disagree   Strongly disagree

The message I viewed persuaded me to talk to my partner, friends, or acquaintances about STD or STI testing. *Please select one.*

Strongly agree   Agree   Neither agree or disagree   Disagree   Strongly disagree

Appendix F-Thought-Listing Codebook

Code	Definition	Example quote
Positive sexual health thoughts	The response states the importance of sexual health, STD/STI testing, or that the stigma/taboo about sexual health should be reduced.	"I was thinking about how a lot of people are talking about this right now in the sense that people are becoming more aware and it shouldn't be such a shameful thing."
Neutral sexual health thoughts	The response states neutrality or not knowing much about sexual health. Response seemed to be a summarization with no additional comments or analyses.	"STI and STDs seem to be an increasing issue among college-age people across the nation."
Negative sexual health thoughts	The response conveys feelings of shock, worry, or fear about the increases of STD/STI transmittal rates. In some cases, negatively stigmatizes the issue of STD/STI transmission.	"I thought these numbers and the increases in them were gross. It is scary to think about STDs and STIs because you never know who can give you one."
Misc. sexual health thoughts	The response does not fit into any of the above sexual health thought codes or is irrelevant.	"I think we need to go back to an abstinence-based approach to sexually transmitted diseases."
Positive visual elements thoughts	The response comments that the stimulus was well-organized, easy to follow, or enjoyable to read.	"I thought the infographic was very eye-catching."
Neutral visual elements thoughts	The response makes a comment about the message and/or visual elements that is neither positive nor negative.	"The message looked similar to all other STD/STI or Get Yourself Tested (GYT) advertisements."
Negative visual elements thoughts	The response comments the stimulus as being hard to read, distracting, or not enjoyable.	"The paragraphs are too long. Shorter bullet points or something faster to read would be better."
Misc. visual elements thoughts	The response does not fit into any of the above visual elements codes or is irrelevant.	"Is there another image that could replace the holding hands image?"
Positive personal relevance thoughts	The response indicates the participant connected the message to themselves or their peers and mentioned positive motivation or intention to take action about their sexual health.	"This message encouraged me to get tested more often."
Neutral personal relevance thoughts	The response indicates that the participant did not make a personal connection to the information or aren't worried about contracting an STD/STI.	"That really sucks for those people, but I probably won't get an STD/STI."

Code	Definition	Example quote
Negative personal relevance thoughts	The response indicates that the participant connected the message to themselves or their peers and mentioned fear, worry, or stress with no indication of motivation or intention to take action about their sexual health.	"Thinking about myself dealing with these issues is stressful."
Misc. personal relevance thoughts	The response does not fit into any of the above personal relevance codes or is irrelevant.	"It made me think about a guest speaker in my MIP 300 lecture today."
Positive credibility of information thoughts	The response indicates that the participant found the information credible, helpful, and should be more accessible to others.	"This information should be readily available for people at risk."
Neutral credibility of information thoughts	The response conveys that the participant found the information to be objective or fact-based.	"The message is neutral, which communicates the information to audiences objectively."
Negative credibility of information thoughts	The response indicates that the participant found the information to not be credible or helpful. May state or indicate that the information is redundant.	"The information was very surface level. These are things most people already know."
Misc. credibility of information thoughts	The response does not fit into any of the above credibility of information codes or is irrelevant.	"Sexually transmitted diseases were not as prevalent when sex was saved for marriage."

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