DISSEMINATING RESEARCH FINDINGS ABOUT SUBSTANCE USE: EFFECTS OF INOCULATION MESSAGES, MESSAGE SOURCES, AND VISUAL REPRESENTATIONS

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by

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The undersigned, appointed by the dean of the Graduate School, have examined the dissertation entitled

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a candidate for the degree of doctor of philosophy,
and hereby certify that, in their opinion, it is worthy of acceptance.

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Professor Shuhua Zhou

DEDICATION

To mom and dad,

for love and wisdom

To my brother, Jaehoon,

for every little and huge help

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Completing this doctorate took me four-and-half years (and with the pandemic!). I am thankful for this footprint I have made because regardless of how small or big an achievement it is, I know that God has always been with me during this adventure. He prepared and planned this journey, and I am excited to start a new journey with Him now.

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Disseminating Research Findings about Substance Use:

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By Namyeon Lee

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Abstract

The dissemination of scientific knowledge to the public is important, because the public's increased awareness and knowledge of science and scientific findings can contribute to creating healthy discourses about relevant topics. The dissertation was designed to understand how inoculation messages, message sources, and visual representations of risk information influence newsreaders' attentional, cognitive, and behavioral responses on health news articles. The findings suggested that inoculation messages may not be effective in promoting changes in college students' attitudes regarding substance use. However, inoculation messages encouraged readers to think more deeply and also agree with the message. The results also showed that readers perceived health information more credible and reported less favorable toward substance use behavior when a medical scientist delivered health news. In addition, illustrative risk visualizations, such as bar graphs, were found to be effective in drawing the reader's attention especially with an expert source. Theoretical and practical implications of this study are discussed.

Keywords: health communication, inoculation theory, information processing, information visualization, message source, source expertise

CHAPTER 1: INTRODUCTION

Substance abuse and its related consequences are major public health problems that impact individuals, families, and society (Shillington et al., 2012). Despite considerable progress in the past decade in health communication research that aids in campaigns to deter alcohol, tobacco, and cannabis abuse, these issues remain significant (Shillington et al., 2012). Specifically, college students make up one of the largest groups of substance abusers (Palmer et al., 2012; Rockafellow & Saules, 2006). For college students, alcohol is the most commonly used substance with one out of three young adults reporting binge drinking (Centers for Behavioral Health Statistics and Quality, 2015) and cannabis use is the second most prevalent substance on college campuses today (Suerken et al., 2014). Also, college students are considerably more likely than their nonstudent peers to use prescription stimulants, such as Adderall or Ritalin, for cognitive enhancement (Arria & Dupont, 2010; Palmer et al., 2012). Lastly, the use of electronic cigarettes (known colloquially as "e-cigs") is rapidly growing in popularity among college students, although little is known about the long-term health effects associated with their use (Littlefield et al., 2015; Sutfin et al., 2015).

Substance abuse can lead to serious health problems in college students. For instance, substance abuse is associated with poorer academic performance (Mekonen et al., 2017), discontinuous enrollment (Arria et al., 2013), and impairment of cognitive functions (Bruijnen et al., 2019). Substance abuse can also put users in physical danger, such as drunk driving (McCabe et al., 2005) and risky sex behaviors (Turchik et al., 2010). In addition to these immediate consequences, lifelong patterns of substance abuse may be established (Godbold & Pfau, 2000). The incidence of alcohol, tobacco, and other substance use escalates from early to late adolescence, peaks during young adulthood, and declines through the remainder of adulthood

(Brown et al., 2008; Griffin & Botvin, 2010). Furthermore, there is accumulating evidence showing that the initiation of substance use early in life contributes to higher levels of use and abuse later in life (Griffin & Botvin, 2010).

The high rates of drug abuse among college students may be explained by several factors. Some substances are used recreationally (e.g., alcohol, tobacco). For instance, students facing high demands of coursework, extracurricular activities, and social obligations, may turn to substances as a coping device to deal with stress (Sinha, 2009). However, other drugs may be more likely to be viewed by students as useful tools and thus may have a lower perceived risk. For example, academic pressure may lead students to take stimulants, such as Adderall or Ritalin, as effective aids to complete coursework instead of using them for prescribed medical purposes (Abelman, 2017; Palmer et al., 2012). Students may hear anecdotal evidence from their peers that stimulants are "performance enhancers" and are therefore may be perceived as beneficial to students who struggle with examinations and other situations of academic responsibility (Arria & Dupont, 2010). Lastly, using substances is one of the ways in which college students socialize with one another (Slutske et al., 2004), and in these situations, substance use may be actively encouraged (Sessa, 2007).

Since people's perception of the risks associated with substance use has been an important determinant of whether they engage in substance use (Lipari & Jean-Francois, 2016), providing young adults with credible, accurate, and relevant information about the harm associated with substance use is a key component in prevention programming. Previous research on health communication research has documented that college students make decisions regarding substance use without accurate information on risks associated with substance use (Stainback & Rogers, 1983). Thus, it is reasonable to assume that once students are more

informed they will better understand the health risks associated with substance use and may also make changes to their behavior. As a result, the majority of substance use communication campaigns have focused on disseminating factual knowledge but have enjoyed little to no success in changing substance use-related attitudes and behavior (Bocker, 2000; Morgan & Hayward, 1976). Research building on these results has suggested that presenting only factual information about substance use may not be an effective approach to target attitudinal and behavioral changes (Carroll, 2019; Parker et al., 2012; Stainback & Rogers, 1983). Instead, research now recognizes that substance use messages are highly similar to *persuasive* communication, which involves overcoming message receivers' resistance to the appeal (Crano et al., 2017; Freeman & Scott, 1966). For instance, since substance use among college students is closely tied to peer pressure, a persuasive message may focus on risky social situations and then provide information that builds resistance to substance use (Compton & Craig, 2019; Miller-Day et al., 2014).

The inoculation theory of resistance (McGuire, 1961) posits that it is possible to increase the persuasiveness of a communication message by eliciting empathy in persuasive messages. This theory postulates that when both sides of an issue are presented, greater resistance to persuasion is conferred against counterattitudinal messages by eliciting credibility and empathy in persuasive messages. Two-sided messages sort into two types: non-refutational messages (i.e., acknowledging the opposing arguments but not attempting to refute them) and refutational messages (i.e., acknowledging and refuting the opposing arguments). By employing the two-sided refutational message as one of its message features, this study tests whether college students will be less resistant and more susceptible to the future persuasive effort that promotes substance use.

Specifically, little research has been conducted on how inoculation messages affect the recipient's attention, even though there is a consensus that more persuasive health communication messages should be capable of attracting and holding attention (e.g., Ajzen & Fishbein, 1980). Two-sided refutational messages provide enough stimulation to generate a level of attention, as they seem novel compared to conventional campaign messages that focus on preventive information only (Crowley & Hoyer, 1994; Eisend, 2006).

Further, a possible communication source in college student–targeted health news is the contrast between a peer (i.e., high perceived similarity to students) and an expert (i.e., high perceived expertise on news content). Peer messages are delivered from a student perspective and use a conversational tone, whereas expert messages use didactic tones and are delivered by a medical scientist. Recent evidence suggests that the inclusion of like-aged peers cultivate trust effectively, whereas the inclusion of medical experts is effective for motivating compliance (Zillmann, 2002). However, few studies related to inoculation theory have addressed this factor in their message designs (Compton & Pfau, 2005). This study adopts the message source as another message feature of interest.

Lastly, previous research on exemplar representations has found that photographic exemplars that are easily remembered (Reinhardt et al., 2018) lead to more intense affective responses (Zillmann et al., 1999) and appear to be more trustworthy and authentic (Brosius, 1999). By contrast, base-rate information (e.g., statistics) is less attention-grabbing (Uribe et al., 2013) and appears to have less impact on changes in attitudes and beliefs (Zillmann et al., 1999). Indeed, numerical data may seem overwhelming to the message receiver. However, presenting those data within a graphical display can be used to change cognitive processing from a numerical, computational task into a perceptual task (Skubisz et al., 2009). That is, when base-

rate information is communicated through various types of visual formats such as bar graphs, histograms, and pie charts, that may be able to summarize a lot of information and show patterns of the data (Lipkus, 2007). This can enhance cognitive processing of the information from health messages, thus more effective persuasive communication. Based on these previous findings, this study examines whether presenting visual representations of risk information in varying photographic or illustrative (e.g., a photo of a young adult suffering from an alcohol overdose vs. a bar graph that shows the alcohol overdose impact) formats affect responses to the message. Additionally, the study also examines potential discrepancies between newsreaders' information processes and their subjective perceptions regarding visual representations of risk.

In summary, by employing the inoculation theory of resistance as a main theoretical framework, this study investigates how using inoculation message (i.e., two-sided refutational messages) affects audiences' cognitive, attentional, and behavioral responses to health messages in the context of young adults' substance use on topics such as non-medical use of stimulants, e-cigs, binge drinking, and cannabis use. These four topics were chosen based on their degree of relevance, their familiarity, and the attitudes surrounding their use among college students. In addition, message sources will be presented either by a peer or an expert. The messages will include photographic exemplar or illustrated base-rate information that represents the risk-related evidence related to negative health behaviors. Further, this dissertation defines individual characteristics as one's preexisting attitudes and issue involvement because these characteristics appear to play significant roles in the process of inoculation-generated resistance. Lastly, by including visual attention to the messages, which is operationalized as self-reports questions. In sum, this dissertation aims to elucidate the underlying processes that may account for the inoculation process, including message sources and visual representation effects.

II. Literature Review

Inoculation theory: Building Resistance to Persuasion Attempts

The purpose of this dissertation is to investigate effective message designs that can build students' resistance to future attack messages that promote substance abuse. To do so, this study uses the inoculation theory of resistance to persuasion (McGuire, 1961) to examine how message sidedness (one-sided vs. two-sided messages) can have a persuasion effect on audience responses. The inoculation theory, which emerged from studies of message sidedness of the information (Lumsdaine & Janis, 1953), posits that when multiple sides of an issue are presented, greater credibility to the message is established (Crowley & Hoyer, 1994; Eisend, 2010). This leads to the message recipient's greater resistance to persuasion against counter-attitudinal messages (Compton, 2009; Ivanov et al., 2017; Petty & Cacioppo, 1986).

Various psychological mechanisms were proposed to explain the impact of message sidedness. One mechanism is based on humans' strong tendency to ask "why?" to explore explanations about their observations (Crowley & Hoyer, 1994). This mechanism focuses on the information process in which individuals attribute observed behavior to the message sender's disposition, or contextual situations (Weiner, 2000). For instance, when a person reads a product advertisement that focuses on the benefits of the product, the person may attribute the message's claim to either the advertiser's intention to sell the product or conversely, to the true characteristics of the product (Eisend, 2006). Further, when a person reads a message that also mentions the weaknesses of the product, the person would perceive the message as acting against the advertiser's self-interests and therefore acting more truthful (Walster et al., 1966). Consequently, the advertisement will be perceived as more credible and trustworthy (Bohner et al., 2003; Küster & Eisend, 2016), and thus increase its overall persuasiveness (Eisend, 2010).

Further, since one-sided messages are the most common type of communication that people encounter (Cornelis et al., 2013), two-sided messages that also include negative information are perceived as "pleasingly novel" (Crowley & Hoyer, 1994, p. 563). As human beings desire to maintain a preferred level of psychological arousal (Berlyne, 1971; McClelland et al., 1953), such emotional reactions (i.e., stimulation in response to a unique message) would motivate readers to pay attention to and process the message more thoroughly. The following section will discuss in detail about the core elements of the inoculation theory, and how and why it works.

Explaining the Mechanism of Inoculation Theory

Using a medical analogy of immunization against disease, McGuire's (1964) conceptualization of inoculation theory states that the message recipient can be inoculated against persuasive attacks in a similar manner that an inoculated body is protected against possible biological attacks. Medical inoculation works by injecting a weakened form of a virus into a person to build up resistance to future attacks from that virus. Similarly, communication inoculation operates by providing a small amount of belief-threatening viewpoints, *and* forewarning about that viewpoints would build up one's attitudinal resistance (McGuire, 1964; 1970). According to McGuire (1964), resistance to persuasion refers to an ability to withstand a persuasive attack (Wood, 2007), and there are two core elements responsible for inoculation effects: threat and refutations (Banas et al., 2010; McGuire, 1964).

Firstly, an underlying assumption about the inoculation process is that individuals must feel their existing belief is threatened. That is, the person should recognize that their attitude is vulnerable to be changed. One way to generate this threat is through forewarning—an explicit warning that one's predisposed attitude is susceptible to be changed (Josh Compton et al., 2016).

This is because the inoculation process works to build resistance "mostly by increasing people's motivation to *defend* their beliefs" (Petty & Cacioppo, 1986, p. 170). Research suggests that the forewarning component of the inoculation message is largely responsible for the message recipient feeling threatened (Compton & Craig, 2019). Without generating threat, inoculation treatments do not confer optimal resistance (McGuire, 1964). Therefore, it could be said that threat is a message recipient's response to a message followed by forewarning, instead of a feature within a message (Compton, 2013). However, even though the perception of threat is the core component to the inoculation process, the optimal amount of perceived threat desired for inoculation treatments is understudied, thus remaining one of the unresolved issues in the literature (Miller et al., 2013).

Another essential component in the inoculation process is the refutation of the counterarguments, as found in two-sided refutational messages (Lumsdaine & Janis, 1953). An exposure to counterarguments may warn message readers that their beliefs are susceptible to attack. Then, observing an effective refutation of those counterarguments may reduce their susceptibility as a message recipient (Nabi, 2003; Papageorgis & McGuire, 1961). Also, refutation of the counterarguments provides an example case to message recipients on how to respond to and refute possible counterarguments that they may face.

Inoculation messages can be used in a variety of contexts as long as the message recipient has already established a predisposed attitude toward a specific issue. In addition, the message senders should be aware of possible counterarguments that recipients may think in order to provide weakened counterarguments during the inoculation treatment in their message design (Parker et al., 2012). A common experimental setup for testing the inoculation theory is a comparison between an inoculation message and a supportive message (Ivanov et al., 2017; Wan

& Pfau, 2004). A supportive message takes the form of a one-sided message (McGuire, 1964). It only highlights the benefits of the preferred health behavior and it is designed to provide the reasons for maintaining or establishing an attitude.

Main Outcomes of the Inoculation Messages: Attitudinal and Behavioral Responses

Previous studies have consistently supported the effects of inoculation messages on protecting attitudes and behavioral intentions against counter attitudinal attacks. First of all, inoculation treatments are closely related to changes in one's attitude. Early studies (McGuire, 1964; Pryor & Steinfatt, 1978; Ullman & Bodaken, 1975), as well as more recent studies (Banas et al., 2010; Compton & Pfau, 2004; Nabi, 2003; Wood, 2007) have found that people are more likely to have more favorable attitudes and greater intention to follow inoculation messages' instructions than those who are exposed to supportive or control conditions. For instance, Pfau and colleagues (1992) examined the role of inoculation messages in the prevention of future smoking habits among adolescents. They found that inoculation messages promoted resistance to smoking and elicited less positive attitudes toward smoking. In another study that examined the effects of inoculation in resistance to alcohol behaviors, Godbold and Pfau (2000) presented inoculation messages to non-drinking sixth graders. Their audience read normative inoculation messages against drinking, compared to informational inoculation or control messages. Results revealed that students who read inoculation messages reported lower estimates of peer acceptance of alcohol and maintained negative attitudes towards alcohol consumption to a higher degree than those who received the informational message or the control message (Godbold & Pfau, 2000). Consistent with past inoculation research, a more recent study examining audience attitudes towards the safety of the human papillomavirus infection (HPV) vaccine reported that those who received an inoculation message that rebuked medical misinformation related to the

HPV vaccine rated the HPV vaccine as more positive, with more positive attitudes and greater perceptions of safety and efficacy (Wong, 2016).

As well, previous studies have demonstrated that inoculation messages are effective in protecting attitudes against not specific risky health issues, such as cigarette smoking (Pfau et al., 1992), binge drinking (Parker et al., 2012; Richards & Banas, 2015), non-medical prescription drug use (Tucker et al., 2015), methamphetamine (Radatz et al., 2015), opioid-related products (Chhabra & Aks, 2017), and unprotected sex among college students (Parker et al., 2012). In addition, inoculation messages also confer resistance to general health issues and even to different health issues beyond those mentioned in the message. For instance, it was found that the inoculation message aimed at protecting positive attitudes toward vaccinations in the general and broad domain (i.e., all vaccines are safe and effective) can be used to protect attack messages on a specific topic within that domain (i.e., the attack message being: HPV vaccines are not safe and effective)(Wong, 2016). Further, Parker and colleagues (2012) showed that inoculation messages are effective in protecting against binge drinking and unprotected sex, even though only unprotected sex was mentioned in the inoculation treatment message. The result suggests that warning college students about the danger of one risky healthy behavior (e.g., unprotected sex) could lead to conferring protection against engaging in other risky health behavior (e.g., binge drinking). Their findings illustrate the umbrella protection of attitudes that inoculation may offer with respect to related but untreated health issues.

The current study investigates the effect of using an inoculation message on college students' substance use intentions by measuring the message recipient's behavioral intentions. The ultimate goal of health communication is to initiate positive health behavior changes (Hu & Sundar, 2010; Yu et al., 2010). Scholars have relied on measuring respondent's behavior

intentions as the most effective and proximal psychological predictor of the actual behavior (Fishbein & Ajzen, 1975). In this tradition, the current study examines the effects of inoculation messages on behavioral intention towards substance abuse. Based on previous findings such that inoculation messages (i.e., two-sided message refutational messages) are more effective than the supportive message (i.e., one-sided message that highlights the benefits of a specific health behavior) in affecting one's attitudinal and behavioral responses, this study proposes that when college-student participants are provided with health news with two-sided messages, they are more likely to have an attitude in line with what message argues and more resistance to the attack message (i.e., messages that promotes substance use).

Thus, the following hypotheses are posed:

H1 a-b: Inoculation messages will result in a) more favorable attitudes against risky health behaviors and b) more negative attitudes toward the attack message than a supportive message.

H2: Inoculation message will result in a greater likelihood of intention to the behavior with the message's recommendation compared to supportive messages.

Attention to Health News Content: Inoculation vs. Supportive

One of the considerations in the development of effective health messages is to draw audiences' attention to the message (Houts et al., 2006). Attention is a critical first step in information processing and eventual recall of the information (Wedel & Pieters, 2000). It has been demonstrated that attention plays an important role in the persuasion process (Crowley & Hoyer, 1994; Greenwald & Leavitt, 1984; MacInnis & Jaworski, 1989).

The present dissertation explores how individuals attend to different informational elements presented in the news article. Reading an inoculation message requires some effortful

cognitive processing for individuals to become resistant to the attack message. Specifically, individuals must be attentive to processing or generating the initial counterarguments in addition to being motivated to overcome them (Bizer et al., 2011). Additionally, attention to certain media messages is determined by the extent that the message activates an optimal level of stimulation (Berlyne, 1971; Donohew et al., 1980; McClelland et al., 1953). Therefore, one may conjecture that since inoculation messages (i.e., two-sided) are perceived as a more novel type of message compared to a supportive message (i.e., one-sided), greater attention will be given to the inoculation message compared to supportive messages.

A previous research study examined the relationship between individual attention to inoculation messages via self-report measures. Cornelis and colleagues (2013) investigated whether participants perceive a two-sided inoculation anti-binge drinking message as more novel than a one-sided anti-binge drinking message. In the experiment, participants were instructed to read either one-sided or two-sided messages, and then answer questions regarding their attention toward each message, such as "How much attention did you pay to the written message in the ad?" "How much did you concentrate on the written message in the ad?" and "How much thought did you put into evaluating the written message in the ad?" Their results showed that higher perceived attention scores toward the message were reported for participants who were exposed to a two-sided message than those who were exposed to a one-sided message (Cornelis et al., 2013).

Approximately 40% to 80% of medical information is immediately forgotten after exposure, even though remembering medical information is a prerequisite for following a recommended treatment (Kessels, 2003). Recalling the information, or information retrieval is the ability to encode, store, and then reproduce information correctly (Lang, 2006). In general,

the more pieces of information a person can retrieve, the more that person is considered to have learned (Eveland et al., 2004). Retrieval of information plays an important role in predicting many health behaviors, such as compliance with medical recommendations (Ley, 1988; Linn et al., 2013). There is no empirical evidence supporting the impact of inoculation messages on retrieval. However, prior findings have shown that two-sided messages, compared to one-sided messages are more likely to lead to elaborated, in-depth processing of the messages (Crowley & Hoyer, 1994; Eisend, 2006). This is because two-sided messages prompt more thorough message scrutiny of the message content than one-sided messages (Crowley & Hoyer, 1994; Eisend, 2006; Kamins & Assael, 1987). That is, if the message recipients carefully examine the content of a two-sided message resulting in a more effortful process; the information from the two-sided message will likely be better remembered and retrieved in the future when compared to information from the one-sided message. Therefore, this study predicts that the health information presented via an inoculation message will result in better encoding, and thus, better retrieval than the information presented via a supportive (one-sided) message. Thus, the following hypotheses are proposed:

H3: Inoculation messages will result in greater attention (measured by self-report questions) than supportive messages.

H4: Inoculation messages will result in greater message elaboration (measured by message-relevant thoughts) of the information than supportive messages.

H5*:* Inoculation messages will result in greater retrieval (measured by free recall) of the information from the message than supportive messages.

Message Credibility: Inoculation and Source

The study examines the influence of message sources on message credibility in college students' health context. The message source is defined as "the originator of communication" (Sundar & Nass, 2001, p. 53) and the message credibility is defined as "an individual's judgment of the veracity of the content of communication" (Appelman & Sundar, 2016a). While a source of the message can be a person (e.g., a medical doctor or a college), a group of people (e.g., a student group at the college), or an organization (e.g., National Institute of Health), this study focuses on "person" source. The study also addresses whether inoculation effects vary based on different types of message source conditions.

The present study operationalizes message sources as those individuals providing knowledge via trust built on either perceived expertise or similarity. Consistent with the arguments from dual-process models of persuasion (e.g., the elaboration likelihood of model; Petty & Cacioppo, 1986; the heuristic-systematic model; Chaiken, 1987), the source of the message can serve as a heuristic or peripheral cue, depending on the message recipient's motivation and ability to process the message. Prior research has examined the impact of message sources in relation to source credibility. For example, some research has examined the effect of two salient message source components: *source expertise,* which is conceptualized as a communicator's qualifications and ability to identify the truth about a topic and *source trustworthiness,* which is conceptualized as perceptions of the communicator's motivation telling the truth about the topic (Appelman & Sundar, 2016; Hovland & Weiss, 1951). Trustworthiness is often linked with the perceived similarity between a source and the message recipient (Wang et al., 2008). Theoretical approaches of persuasion state that source "expertise and similarity are

typically processed as heuristic cues, which prompt message recipients to make inferences about features of [the] messages" (Feng & MacGeorge, 2010, p. 569).

Source expertise refers to "a source's presumed knowledge and ability to provide accurate information," (Petty & Wegener, 1998, p. 344). It is also known as source competence (Bock & Saine, 1975), qualification (Berlo et al., 1969), intelligence, experience, or ability (Birnbaum & Stegner, 1979). Messages delivered by experts are often perceived as more likely to be valid than the message delivered by non-experts (Clark et al., 2012). Therefore, message readers are more motivated to carefully attend to an expert instead of a non-expert communicator, because the experts are likely telling the truth (Hovland et al., 1953). For instance, Heesacker and colleagues (1983) found that when participants are moderately involved with an issue, they are more likely to systematically evaluate the message that is presented by an expert compared to messages from a non-expert. This is because the expertise of the source results in viewers' confidence in the potential validity and accuracy of the message, and therefore, message recipients will generate more relevant thoughts to attend to the message. Further, Moore and colleagues (1986) found that when a message recipient needs to engage in an effortful cognitive activity to process a message, participants' attitudes were determined more on argument quality, which means high levels of message elaboration, when the source was high compared to low in expertise. In a more recent study, Clark and colleagues (2012) found that participants are more persuaded by arguments whose message source is an expert, because experts are expected to provide valid information.

Another feature of the message source is the source's perceived similarity with the message recipient. Perceived similarity refers to the degree to which an individual believes that the individual is similar to a character (Moyer-Gusé, 2008). Perceived similarity is based on

attributes such as shared demographics, physical appearance, beliefs, or values (Eyal et al., 2010; Salmon & Atkin, 2003). Based on previous literature, this study defines perceived similarity as a "cognitive assessment of what one has in common [with the message source]" (Moyer-Gusé, 2008, p. 410). Previous studies have shown that sources that are perceived as more similar to the message recipient are evaluated more favorably (Austin & Meili, 1994; Moyer-Gusé, 2008). Attraction to similar others is based on the assumption of several interpersonal and intragroup theories of social psychology. For example, the source-attractiveness model (Kelman, 1961) argues that message recipients identify more closely with sources who are similar to them, and this identification process leads the message recipient to evaluate the message more favorably. Similarly, according to social identity theory (Turner & Tajfel, 1986**),** persuasive appeals from in-group members often result in message acceptance and "genuine cognitive internationalization of group attitudes as one's own," (Hogg & Smith, 2007, p. 97) because the mere perception of belonging to same social categories is sufficient to include in-group favoritism (Turner & Tajfel, 1986). In other words, once message recipients identify an individual (i.e., message source) as an in-group member, they will use the individual and the individual's persuasive message as a guide to their behavior. Even though the two theoretical approaches explain source effects with different psychological processes and individual motivations, both perspectives agree that the message recipients will more accept the idea if it is delivered by a more similar source (Smith & Hogg, 2007).

It has been also shown that young adults, specifically, are more likely to perceive people in their age to their significant reference group, and the peer group influences their attitudes and behaviors (Paek et al., 2011). For instance, in an anti-smoking message study (Robalino & Macy, 2018), social group influence and peer pressure have shown to increase the effectiveness of the

message, especially among young adults who value opinions of peer and social identification compared to other age groups.

Taken together, it is likely that experts and peers both increase the credibility and persuasiveness of the source, but through different mechanisms. The expert source could be effective because of the disparity of knowledge between the source and the message recipients. On the other hand, peer sources may be more effective because of the similarity and the feelings of connectedness to the message source. Although previous findings stressed the effects of perceived expertise and similarity as two important kinds of source characteristics, few studies have compared the effects of perceived expertise or perceived similarity on persuasion research (Paek et al., 2011). Among the limited number of studies, Paek and colleagues (2011) found that peer-to-peer videos were more effective in influencing college students' attitudes and issue importance. In their study, participants watched three PSAs on YouTube about child abuse prevention video. One group watched a YouTube video created by peer producers (i.e., average college students), and the other group watched a video uploaded from a state-level non-profit organization. The results showed that the PSA message created by peer producers was more effective in the enhancement of attitudes toward the PSA and issue importance, and that the effect of peer producer was more pronounced to those who are low-involved with the issue, compared to high-involved students. Further, Wang and colleagues (2008) have suggested that "advice from 'similar others' is more powerful than experts' advice when it comes to online health information" (p. 366). This is because people are motivated to seek support from others who might have similar health experiences and knowledge, and the Internet setting makes users relate to peers more than experts, as they play similar roles online (Wang et al., 2008).

Thus, although perceived expertise may have an impact on message credibility, based on the theoretical claims made by the source-attractiveness model, social identity theory, and prior evidence (Paek et al., 2011; Wang et al., 2008), this study predicts that peer source health messages (which will be considered as a message with high perceived similarity) will have a greater impact on the perceived credibility of the health news. Therefore, the following hypothesis is proposed:

H6: Peer source message will be perceived as more credible than the expert source message.

Relevance and Attention in Health Communication

Message recipients do not uniformly engage in the communication message that is available to them (Southwell, 2001). In order to have an impact on the message recipient, the message should be relevant to the receiver (O'Reilly et al., 2016; Petty & Cacioppo, 1986). People attend more to the messages that are personally relevant to them (Chaiken et al., 1989). And, the more relevant the message is to the recipient, the more extensively it will be processed (Petty & Cacioppo, 1986), and the likelihood of attitude change or behavioral response increases (Anghelcev & Sar, 2011). This study defines message relevance as the perceived relevance by the message recipient in terms of one's goals, values, and interests (Anghelcev & Sar, 2011).

The source's similarity is thought to create message relevance with two underlying dimensions: persona similarity and usage similarity (O'Reilly et al., 2016). Persona similarity refers to the message recipient's assessment of how alike the source is to them in terms of the character, background, and attributes. Because people tend to favor similar others, people perceive ideas and attitudes that are held by those similar others as more appropriate and relevant (Thompson & Malaviya, 2013). Another dimension of message relevance is usage similarity,

which refers to the message recipient's assessment of how alike the source's use of the topics in the message is to the recipient's intended use. In other words, usage similarity refers to the degree to how the topic is described in the message in the same manner that the message recipient intends to be familiar with. In the present study, message relevance refers to one's perceived relevance to college students' health news messages. If the source delivering the topic to an intended message recipient is perceived as similar to the recipient, that is, both persona similarity (appearance) and usage similarity (relevance of the topic) will increase, it will be likely that message relevance will increase. Therefore, the following hypothesis is proposed:

H7: Peer source messages will be perceived as more relevant than expert source messages.

Further, we attend to the messages that we find personally relevant to us (Roser, 1990). If the peer source message is perceived as higher relevance, it will likely invoke greater attention as well. Therefore, the following hypothesis is proposed:

H8a*:* Peer source messages will result in greater attention (measured by self-report questions) than expert source messages.

H8b: Peer source messages will result in greater visual attention (measured by fixation count and fixation duration) than expert source messages.

Interaction between message type and message source on message credibility

Even though various message features (e.g., styles, design, topics) have been extensively researched in communication studies, there is fewer research that delves into how these message features interact with one another to produce message effects (Lee, 2019). Researchers have investigated the choice of message designs within certain theoretical frameworks, but less on the combinations of multiple features across different frames (Cappella, 2006) and whether those

combinations lead to attenuated or enhanced messages. The current dissertation also explores the domain of interaction across inoculation messages and message sources. Inoculation theory has remained somewhat unclear about how various message features would interact.

Two-sided messages, as used in inoculation messages, are consistently found to enhance the perceived credibility of claims and also the perceived trustworthiness of the message, because the message recipient would perceive the message more transparent by exploring both sides of an issue (Crowley & Hoyer, 1994; Eisend, 2007). However, only a few studies have examined whether these effects would be different between various types of message sources, such as the source with high expertise and/or high trustworthiness. In fact, the process of an inoculation treatment, in general, is more likely to require cognitive resources to process (Lee & Pfau, 1997; Pfau, 1997). Resistance to persuasive attack messages is achieved by exposure to two-sided and counterargument messages. The cognitive processing of such messages requires more time to compare the validity of the argument to the message recipient to validate the claim. Therefore, inoculation messages are effective when the message recipient is involved in an active, thoughtful, and systematic cognitive process. If the message recipient does not have sufficient motivation or ability to participate in the systematic cognitive process, they might participate in a more heuristic process, which has the "economic advantage of requiring a minimum of cognitive effort" (Chaiken, 1980, p. 753). Perceptions of message sources may serve as a heuristic or peripheral factor here, that is likely to require less cognitive processing effort.

It may be argued that the health news message with the peer message source would be perceived as more credible whether or not the message is presented either inoculation or supportive message type. On the other hand, message recipients may find the expert source as

more credible when a source with higher expertise and competence acknowledges the weakness of their arguments, which may be seen more transparently. Because there is a limited amount of studies on the interaction effects between inoculation message and message source, this study propose the following research question:

> **RQ1:** How will the message type and message source interact to influence message credibility?

Role of Visual Representations in Communicating Risk

Visual representations have been increasingly used to communicate medical and scientific processes, discoveries, and knowledge (Anderson et al., 2011; Scheltema et al., 2018). For instance, doctors may present a photograph of damaged lungs to warn patients about the harmful effects of smoking. The use of visual representations to communicate scientific concepts has remained significant over a long period of time because of its utility to support written evidence (Scheltema et al., 2018). In fact, visual representation is a concept that can have multiple meanings: this can refer to photographic representations (i.e., reflects the reality of the scene) or illustrative representations (i.e., created based on shared meaning such as words and logos, artwork, quotations, or infographics) of objects, phenomena, or concepts (King, 2016). A photograph has an indexical nature, which means it is related to reality and offers proof of the presence of a person, people, objects, events, or a combination of these within an image (Avram, 2018). On the other hand, an illustration possesses an iconic nature, meaning that it conveys some type of shared meaning through symbols, such as logos, graphs, and character figures (King, 2016). This distinction is critical, because the audience may respond differently when they perceive these two types of visual representations.

Some previous studies have validated the use of visual representations to improve attention (Delp & Jones, 1996), comprehension (Brotherstone et al., 2006), and recall of and adherence to behavioral recommendations, especially among individuals with lower literacy or fewer years of education (Houts et al., 2006; Peregrin, 2010). However, despite a wealth of health and science research on visual representations, the emphasis of such research has mainly focused on the conceptual understanding when using visual representations (Evagorou et al., 2015), and the distinctions between specific visual representations are not made. The majority of these prior studies consider only the influence of the presence or absence of images in health messaging (King, 2016). Researchers suggest that one important step to increase our knowledge is to continue examining visual message features and presentation types beyond the absence and presence of images (Banerjee et al., 2011; Jensen, 2012; Niederdeppe et al., 2008). The visual presentations in this present study focus on principles outlined in the exemplification theory and dual coding theory to explain photographic and illustrative representations, respectively.

Processing Visual Representation: Exemplification and Dual Coding

According to exemplification theory, people tend to make generalizations about an entire sequence of events or phenomena based on their previous direct or indirect experiences, which may be categorized according to exemplars (Zillmann, 1999). Exemplars are defined as “primary characteristics that allow a grouping of experiences with others of its kind” (Zillmann, 2006, p. S222). In other words, exemplars must represent the events that share features with other members of the population exemplified (Brousius, 1999). Exemplification theory states that exemplars influence information processing by two types of cognitive heuristics: availability and representativeness. These cognitive heuristics affect readers' beliefs, attitudes, and behavioral outcomes (Zillmann, 1999, 2002, 2006). The availability heuristic posits that individuals

perceive and make judgments by relying on information that is most easily available to retrieve from their memory (Zillmann, 2000, 2006) and that information from the memory is likely to have a greater impact on one's perceptions. Representativeness heuristics posit that when individuals encounter an unfamiliar observation, they subconsciously compare that observation to a specific observation that has happened in the past that shares commonality (Zillmann, 2000). When a judgment is made, people generalize observations based on their experience and make decisions based on the observed information of a representative case rather than relying on more valid, base-rate information.

It has been demonstrated that photographic exemplification can be used in the strategic communication of scientific and health information. Health practitioners frequently make use of photographic exemplars to demonstrate the severity of the health problem or the urgency of preventive behaviors. For instance, visual-based exemplars presented in a news article about Lyme disease increased readers' perceived risk (Gibson & Zillmann, 2000). Also, a study (Yoo, 2016) examining the effect of celebrity smoking exemplars in health news on college students' perceptions of smoking-related health risks and smoking intentions reported that presenting photographs of celebrities and their negative health consequences (e.g., throat cancer caused by smoking) lead to significant positive effects on decreasing smoking intentions among college students. Overall, danger-signaling visual representations in news articles were shown to increase news reader's risk perceptions and influence interpretations of text news messages (Yoo, 2016). Photographic exemplars are used in news stories to exemplify an issue with individual experiences to increase vividness and perceived authenticity (Brosius & Bathelt, 1994).

In contrast to photographic representations, the illustrative representation provides a non-photographic, abstract representation of reality. One of the most used examples is the representation of base-rate information. Base-rate information refers to the quantitative expression of statistical distributions or data (Brosius & Bathelt, 1994). Therefore, base-rate information is created based on a large number of cases, giving a more systematic overview of the phenomena compared to a photographic exemplar, which only depicts a few individual cases and provides episodic insights. Thus, illustrative base-rate information can be interpreted as having higher validity (Brosius & Bathelt, 1994). However, base-rate information such as facts, percentages, and risk levels may be seen as "remote, pallid, and abstract," compared to photographic exemplars that are "vivid, salient, and concrete" (Ginosar & Trope, 1980, p. 229). In addition, the message recipient may need some level of visual literacy to understand the visualized information, such as the ability to interpret the graphic variables (Börner et al., 2019), as well as the ability to process those graphical messages along with textual information. However, since much of visual information associated with health materials are concerned with communicating quantitative risk (Ancker et al., 2006; Lipkus, 2007; Lipkus & Hollands, 1999), it is necessary for health message communicators to deliver more comprehendible, visualized base-rate information to the audience.

Information visualization uses both verbal and nonverbal codes to provide message recipients greater opportunity to process and remember the information compared to when the message is perceived in just one of these two ways. This is because the human brain operates with two distinct types of mental representation: verbal and nonverbal mental codes (Paivio, 2007). The cooperative activity between these two functionally independent but interconnected codes, which is called dual coding, yields cognitive processes such as attention, recall, and

elaboration (Paivio, 1991). Previous studies have shown that messages that utilize code-combined memory generally improved attention to the information. For instance, in a study in which respondents were asked to read wound care instructions with or without cartoon illustrations, those who read the instructions with cartoon illustrations were more willing to read the instructions, had greater free recall score and higher compliance rates than those who received the instructions in text only (Delp & Jones, 1996). Visualization of a statistical message is composed of both non-verbal (e.g., shape, pattern, symbol, line, color hue) and verbal (e.g., title, subtitles, annotations, data labels), and the dual coding theory can inform us further understanding of statistical visualization within a theoretical framework.

Overall, any health-related risk information can be visually expressed either through a photographic exemplar that may communicate a narrative, anecdotal experience or through an illustrative representation that may communicate statistical risk information. Statistical risk information includes abstract numerical data and factual assertions about the probability or prevalence of a certain health-related outcome (de Wit et al., 2008). It is assumed that when people perceive the message about the probability of contracting a specific risk, they are more willing to take preventive actions. For instance, Cox and colleagues (2010) found that parents who received statistical information related to HPV reported significantly stronger intentions to have their daughter vaccinated against HPV compared to parents who did not receive that statistical information. However, there is existing evidence that narrative risk-related information may be effective as well. A narrative represents a personal experience of an event, such as somebody getting a disease (Hinyard & Kreuter, 2007), and it triggers a simulation heuristic (Kahnemann & Tyversky, 1982), which is the perceived probability of an event based on how easy it is to picture the event mentally (Gregory et al., 1982; Kahnemann & Tyversky, 1982).

Narratives make heuristics more easily activated, and they are also likely to increase personal probability estimates (Tversky & Kahneman, 1973). For instance, de Wit and colleagues (2008) showed that a narrative risk message resulted in higher behavioral intentions to get the hepatitis B vaccination when compared to a message that only mentioned an increased risk of infection. Lastly, Hopfer (2012) found that exposure to a message containing both statistical and narrative information leads to respondents' hepatitis vaccination uptake to nearly double compared to the exposure to the non-narrative control message. However, because there is a limited number of studies overall, this study asks the following research questions:

RQ3 a-b: How will the visual representations of risk-related evidence influence audience a) self-reported attention and b) risk perception towards the health topic?

Interaction effects between Message Type, Message Source, and Visual Representation on Visual Attention

Few studies related to inoculation theory have addressed the potential effects of message delivery and its influence on the inoculation process (Nabi, 2003; Pfau et al., 2000). Inoculation effects may function irrespective of the medium and message sources employed to deliver them or inoculation may result in different message effects. In other words, would a different type of visuals and/or message sources uniquely impact the underlying process of message resistance? This study examines how message contents, message source, and visual representation interact to influence visual attention. Therefore, the current study asks the following research question:

RQ4 a-b: How will message content, message sources, and visual representation interact to influence participants' a) self-reported attention and b) risk perception?

Individual Difference: Moderators of Inoculation Messages

Preexisting attitudes are a moderator during the inoculation process and is a necessary condition for inoculation. This is because inoculation is a preventive strategy from an attack message, the message recipient must have a pre-existing attitude before the inoculation treatment (Compton & Pfau, 2005; McGuire, 1964). Even if the subject does not have a prior attitude, an exposure to an inoculation message would still result in persuasive effects, however, such an application is not consistent with the theoretical framework of the inoculation theory (Wood, 2007). For this reason, most current inoculation scholarship treats pre-attitudes as a covariate in their research (e.g., Pfau et al., 2009). For instance, Ivanov and colleagues (2009) examined attitude bases (affective or cognitive) and their subsequent effects on pretreatment message strategies (affective or cognitive) and found that matching the base of an attitude to message strategy is most effective. In other words, presenting an affective-based inoculation pretreatment message to respondents led to more message effects with an affective-based attitude.

Besides, previous studies on inoculation theory examined individual perceived involvement with an issue because this variable plays a critical role in the process of resistance (Compton & Pfau, 2005). Issue involvement can be conceptualized as “the motivational state induced by an association between an activated attitude and some aspect of the self-concept,” (Johnson & Eagly, 1989, p. 293) as theorized in dual-processing models (Petty & Cacioppo, 1986; Chaiken, 1980). Individuals are *involved* in a message when the topic has an intrinsic importance to them when the topic resonates with them (Sherif & Hovland, 1961), or the topic has significant consequences in their lives (Apsler & Sears, 1968). Regarding the inoculation treatment, issue involvement is known as "the importance or salience of an attitude object for a receiver," (Pfau et al., 1997, p. 190) and it "holds the key to inoculation" (p. 210). For inoculation messages to function properly, issue involvement level should be optimal: not too

high, nor too low. This is because when message recipients are too involved with an issue, they will not be affected by the threat message. On the other hand, when message recipients are not involved with an issue at all, they will not care much about the issue of experiencing the threat from the message. Message recipients with moderate involvement levels, therefore, are most susceptible and ideal to experience threats from inoculation messages.

Thus, the current study examines how exposure to inoculation messages which vary in their message source and visual representations influence the audience's visual attention, attitude, message credibility, and behavioral intentions. Based on previous findings, it is expected that there will be an interaction effect between message type (i.e., inoculations vs. supportive), message source (i.e., peer vs. expert) and visual presentations (i.e., photographs vs. illustrations), and individual characteristics (i.e., preexisting attitude and issue involvement) on the series of outcomes. However, there is no clear empirical evidence to indicate the direction of the interactions. Therefore, the following research questions are proposed:

RQ5 a-b: How will individual characteristics such as a) pre-existing attitude and b) issue involvement interact and influence self-reported attention, risk perception, attitude, behavioral intention, and message credibility regarding college students' health news?

III. Method

Experimental Design and Stimuli

This study employed a 3 (message type: inoculation vs. supportive vs. neutral) x 2 (message source: peer vs. expert) x 2 (visual representations: photographic exemplar vs. illustrated base-rate) x 4 (message topics: non-medical use of stimulants, electronic cigarette use, binge drinking, and non-medical use of cannabis) mixed-factorial design. The message type was treated as a between-subjects factor. Message source, visual representations, and message topics were treated as within-subject factors.

The experimental stimuli messages were news articles on substance use and topics included non-medical use of stimulants, e-cigs, binge drinking, and non-medical use of cannabis. These articles were constructed to maximizes the differences for each independent variable. Messages were manipulated to feature either an inoculation or a supportive message style, presented from either a peer or expert message source, and each article contained either an added photographic exemplar or illustrated base-rate of risk information. The design also included a message replication factor; each of the four treatment conditions were represented by one emphasizing the risk of stimulant drugs as non-medical purpose, one message emphasizing the harm of electric cigarettes, one message emphasizing the danger of binge drinking, and one message emphasizing the risk of using cannabis. All of the messages were presented through a fictitious digital news platform to avoid any other confounding variables that may occur. Based on the message manipulations, a total number of 12 mock health webpages are used.

Procedure

Prior to any research activities, participants completed consent procedures. After consent, participants completed a pre-test questionnaire that measures pretest attitudes towards health

behaviors as well as their involvement with those health behaviors. Then, each participant was assigned to one of the three conditions: the inoculation message condition (Group 1), the supportive message condition (Group 2), or the neutral message condition (Group 3). Each condition displayed two peer messages and two expert messages, combined with a photographic exemplar or illustrative base-rate data for each message. Participants read a total of four news articles. *Figure 1* describes the message combination of the study.

After reading each health news article, participants were asked to list any thoughts that occurred to them while reading the news article (elaboration) and answer a series of outcome measures which measured threat, self-reported attention, posttest attitude, message credibility, risk perception, and behavioral intention. Respondents then read the attack news article that promotes substance uses. Then they answered the attitude towards the attack message questions. After the exposure to all four news articles, participants were asked to write down any information that they recalled from the messages that they have read during the experiment (retrieval). Lastly, participants answered demographic questions. It took approximately 40 to 50 minutes to complete the experiment. Figure 2 describes an outline of the study procedure.

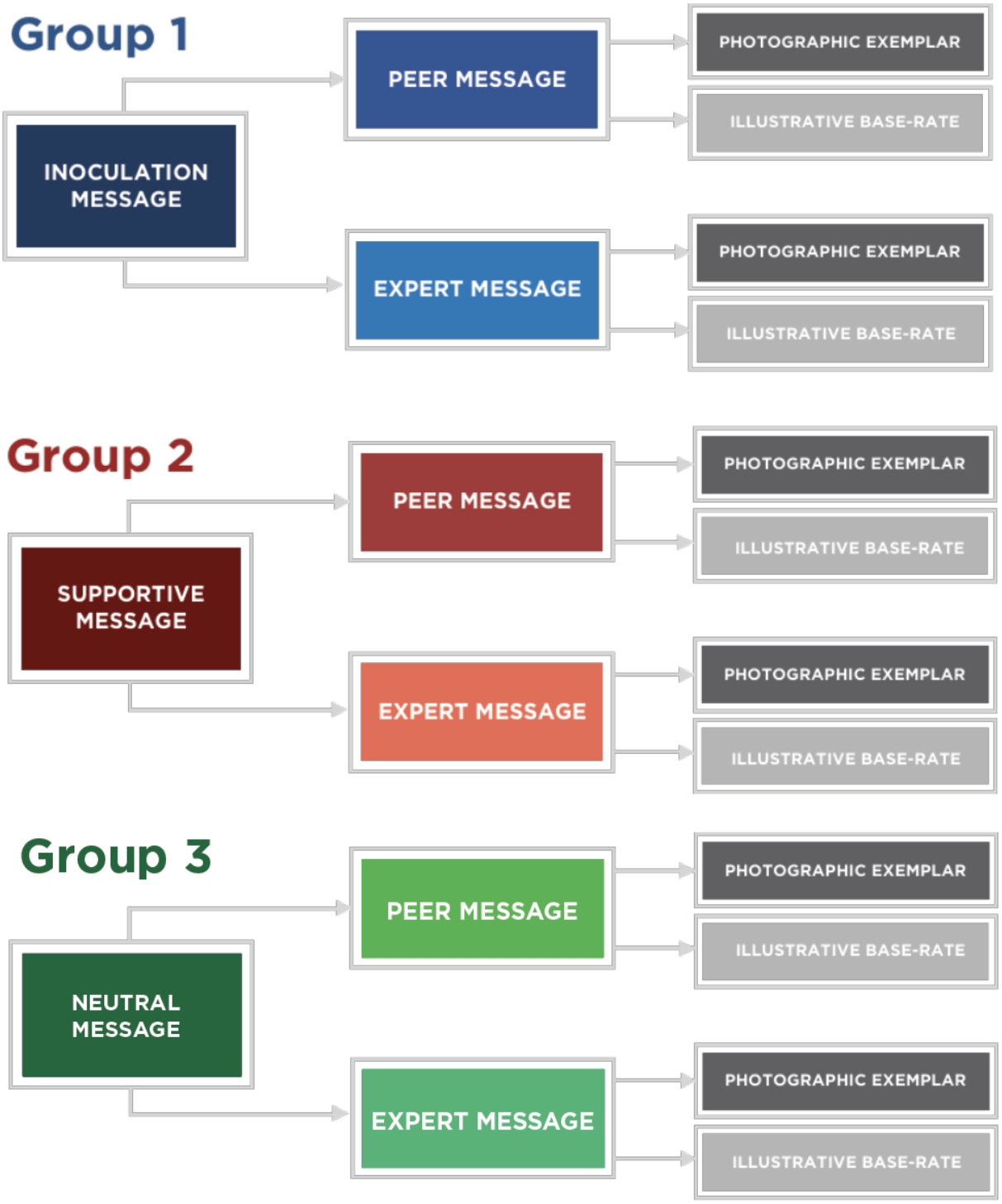


Figure 1. Message combination

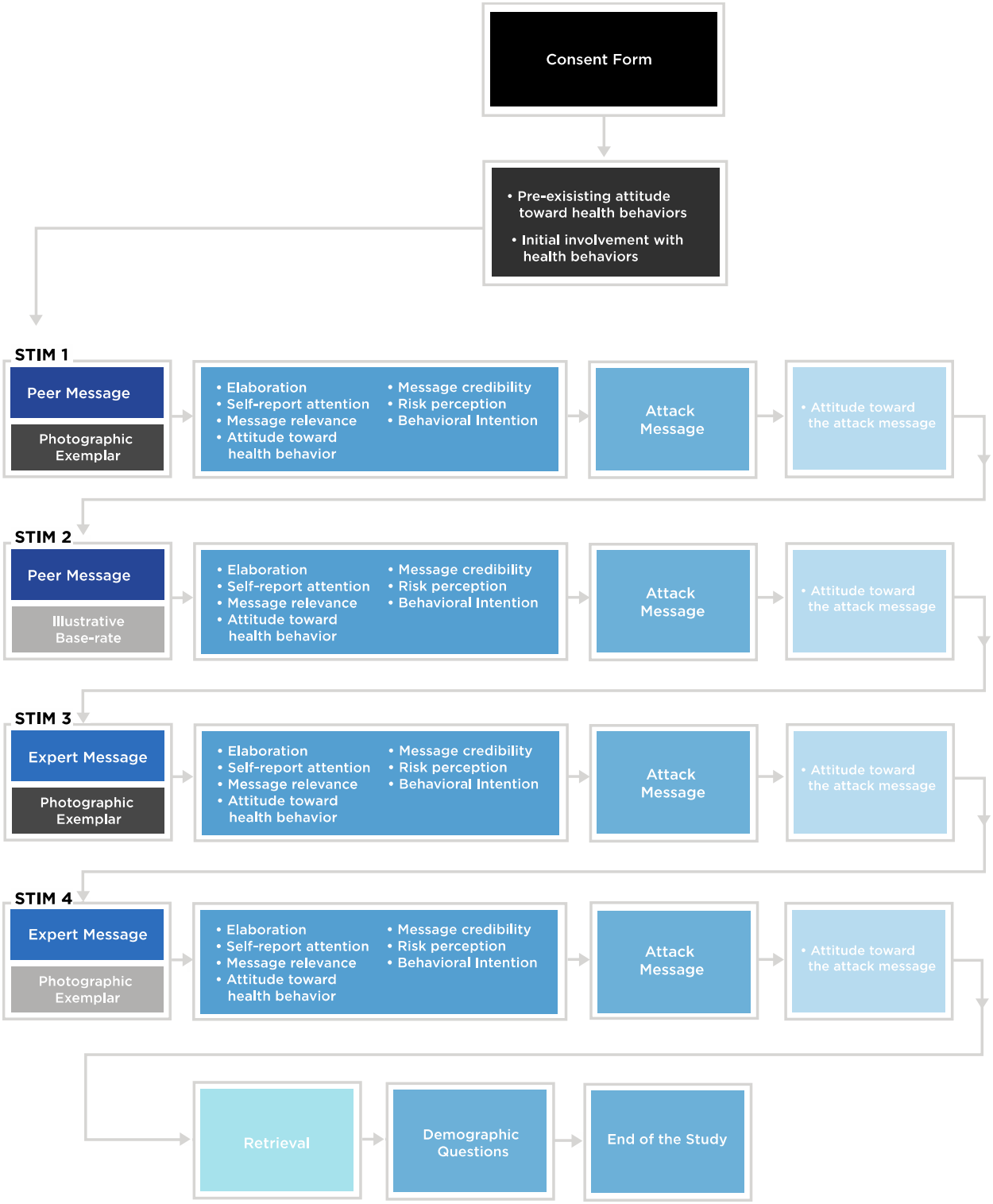


Figure 2. Experimental Procedure

Independent Variables

Message type. Inoculation message refers to a message that provides forewarning about possible conflicting yet persuasive information related to substance use behaviors, and refutation of that counterargument message. The current study employed one inoculation message condition, one supportive message condition, and one neutral message condition as three message types.

The inoculation treatment message began with a forewarning of an impending attack on the positive attitude toward substance use. Respondents were told that current research or survey results show that college students face increased peer pressure directed at their attitude toward negative health behaviors (i.e., non-medical use of stimulants, electronic cigarettes use, binge drinking, and cannabis use). Then, the forewarning message stated that as a result of peer pressure, many students have questioned and sometimes changed their current attitudes towards healthy behaviors. This forewarning message was concluded by informing the participants that they may not be as well prepared to defend their attitudes as they think they might be. The forewarning message should bolster inoculation's efficacy by generating threats among participants (McGuire, 1964).

Then, a counterargument paragraph mentioned commonly used reasons for not following healthy directions (A sample of the inoculation messages that were used in the study is included in Table 1). For instance, counterargument information included students' social pressure, social media influences, unavailability of resources when needed, expense, perceived benefits, the ineffectiveness of healthy behaviors to protect individuals from accidents, the temptation of readily available alcohol and drugs, and stress.

After, a refutation paragraph refuted each of the counterarguments systematically by using objective contents grounded in statistics, verifiable evidence, and research findings (e.g., Pfau et al., 2003, 2004, 2005). Lastly, the message concluded with the recommendation about healthy behavior and encourage participants to perform certain health behaviors in the future.

Conversely, the supportive message did not include additional information about possible conflicting messages that college students may encounter. In other words, a forewarning, counterarguments, and refutation messages were not be included as in the inoculation message. Instead, the supportive message focuses only on bolstering information about healthy behaviors. For instance, one of the supportive messages will emphasize the benefits of wearing helmets, noting that this behavior is a very effective and safe way to protect drivers. Supportive messages will follow the same style across multiple message topics. All of the messages are derived from the actual health campaigns by the National Institute of Health (on Alcohol Abuse and Alcoholism, on Drug Abuse, on Smoking and Tobacco Use), Center for Disease and Control (College Health and Safety tab), related peer-reviewed journals, and health news outlets to reflect the reality of the issues.

Across inoculation and supportive message types, all information will be conveyed in approximately the same format. The only exception was the components of the inoculation message: forewarning, counterargument, and refutation. The average number of words for supportive messages was 492 words. The average number of words for incoulation messages was 614 words.

Lastly, the neutral message was used as a control condition. Whereas inoculation message and supportive message were presented in the form as a health news story in a media platform, neutral message was presented in the form as a press release on current health- and

science-research findings (e.g., ScienceDaily). The neutral message was composed of date, source, author, summary, and the full story of the research findings. The average number of words for neutral messages was 390 words.

Table 1. Examples of Inoculation messages. Topic: Non-medical use of stimulant drugs

	Message Source	
	Peer	**Expert**
Headline	From the Labs: Don't tempted by "Smart Drugs"	From the Labs: Don't tempted by "Smart Drugs"
Introduction	Hi, I'm Devan Brown. I'm a senior at Penn State University. ADHD is a brain disorder that makes it difficult to concentrate and increases impulsive behavior. Stimulants help to reduce these symptoms. However, some students, including my friends, use these drugs for non-medical purposes to enhance their cognitive abilities even though they are not diagnosed with ADHD. The most common side effect of stimulants is insomnia. The drug also causes gastrointestinal problems, blurred vision, increased body temperature and irritability.	Hi, I'm Dr. Stephen Newman. I am the director of the Neurology Lab at Penn State University. Attention deficit hyperactivity disorder (ADHD) is a brain disorder that makes it difficult to concentrate and increases impulsivity. Stimulant drugs help to reduce these symptoms. However, some students use these drugs for non-medical purposes to enhance their cognitive abilities even though they are not diagnosed with ADHD. The most common side effect of stimulants is insomnia. The drug also causes gastrointestinal problems, blurred vision, increased body temperature and irritability.
Forewarning (threat manipulation)	However, you may already know or have seen some of your friends who have used these stimulants. My friends, too, have even encouraged me to use them because they said they would be helpful and that using them is pretty safe. I thought that using them for non-medical reasons could be dangerous. But seeing my friends and others like influencers on social media (like Instagram, Tiktok, and Facebook) using stimulant drugs made me think that maybe, it is okay to try them even if I'm not diagnosed with ADHD.	Nonetheless, we understand that peer pressure plays a massive role in the abuse of stimulant drugs. Even if students do not think of themselves as "drug users," seeing others utilize these substances may normalize their use and overestimate the safety of stimulant use. Suppose students see their friends' social media messages promoting the use. College students are uniquely vulnerable to the effects of what they see on social media, as this age group is highly susceptible to peer influences and pressure.
Counterargument	For example, if you search on TikTok with the hashtag #adderall, you can see a lot of videos from students our age using Adderall and tell their followers how much it's been helpful for them.	For example, if you search on TikTok with the hashtag #adderall, you can see a lot of videos from those who use Adderall and share non-medical testimonials how much it's been helpful for them.
Refutation	Some claims are obviously misleading, but I think seeing those type of posts consistently could possibly change my mind in the future. So I did some research on this topic. It turns out that most students never use stimulant drugs such as Adderall unless they have ADHD. The majority of students feel they'd be sacrificing their academic integrity by taking illegal substances to try to get a leg up.	In that case, students will be more likely to misuse stimulants. In reality, most students never use stimulants unless they have ADHD. The majority of students feel they'd be sacrificing their academic integrity by taking stimulants just to try to get good grades. They also know that these drugs can be risky when abused. Further, contrary to students' expectations, several

	They also know that these drugs can be addictive and risky when abused. Also, different from what my friends told me, several research studies have shown that stimulant drug does not make students smarter.	studies have shown taking the stimulant drug does not make students smarter or make studying any easier. you awake.
Research findings (refutation cont.)	As an example of how stimulant drugs affect college students, I can share one research study that I've found. This study was published in the Journal of Pharmacy. The study examined the impact of the prescription stimulant, Adderall, on college students who are not diagnosed with ADHD. In the study, 13 college students without ADHD participated in two five-hour sessions. In each session, the students received either Adderall or a placebo drug to allow the researchers to see if Adderall enhanced cognitive abilities reading comprehension, memory, and attention. After, the researchers analyzed the effects of Adderall compared to placebo. The findings showed that the standard 30 mg dose of stimulant drugs did improve one's attention and focus, compared to a 30 mg dose of placebo. However, the effect failed to translate to better performance on tasks that measured short-term memory, reading comprehension, and fluency. In addition, participants answered that they performed worse for their general cognitive ability and ability to self-regulate in daily activities after taking 30mg dose of stimulant drugs.	As an example of how stimulant drugs affect college students, I can share one of my research studies. This study was published in the Journal of Pharmacy. The study examined the impact of the prescription stimulant, Adderall, on college students who are not diagnosed with ADHD. In the study, 13 college students without ADHD participated in two five-hour sessions. In each session, the students received either Adderall or a placebo drug to allow the researchers to see if Adderall enhanced cognitive abilities reading comprehension, memory, and attention. The results showed that the standard 30 mg dose of stimulant drugs did improve one's attention and focus, compared to a 30 mg dose of placebo. However, the effect failed to translate to better performance on tasks that measured short-term memory, reading comprehension and fluency. Also, participants answered that they performed worse for their general cognitive ability and ability to self-regulate in daily activities after taking 30mg dose of stimulant drugs.
Recommendation	The major takeaway from this study is that stimulant drugs may have small to minimal effects on enhancing one's attention skills, but not as much as to do well in tasks that require cognitive ability. It is important to note that stimulant drugs actually impaired working memory performance relative to placebo. It also led participants to rate their task performance poorly. The good news is, if you want to get a boost academically, there are a lot of reliable ways: office hours, free tutors, talking and chatting with classmates, early bedtimes, and just plain hard work. Taking stimulant drugs isn't one of them.	The major takeaway from this study is that stimulant drugs may have small to minimal effects on enhancing one's attention skills, but not as much as to do well in tasks that require cognitive ability. It is important to note that stimulant drugs impaired working memory performance relative to placebo. It also led participants to rate their task performance poorly. The good news is, if you want to get a boost academically, there are a lot of reliable ways: office hours, free tutors, talking and chatting with classmates, early bedtimes, and

		just plain hard work. Taking stimulant drugs isn’t one of them.

Message sources. In addition to the message type, the current study employed one peer- and one expert-message source as another manipulation. The message source was operationalized as the news article's spokesperson who provides knowledge via trust built on either perceived expertise or similarity. There were two types of message sources: medical scientists for the high perceived expertise condition and college students for the high perceived similarity condition.

To be specific, the peer message source condition was written by a college student (e.g., Ian Hanley; a junior at a state university) and involved the person's personal experience to the relevant health issue. This manipulation of communication sources is conceptually similar to those used in past research (e.g., Petty et al., 1981; Clark et al., 2012). In the expert conditions, participants were told that the message's spokesperson is a medical scientist (e.g., Dr. Michelle Newman; a lab director of the Neurology Lab at a state university) who is currently conducting a project on health-behavior related experiments. All the information stated in the message manipulation stayed the same except for the tone of voice (due to different types of spokesperson; an intentionally manipulated variable).

Visual representations. Visual representations were operationalized as the graphic representation of reality through a vivid photograph or a symbolic illustration. The photographic visual representation depicted an episodic event of an individual, and the illustrative visual representation represented a large number of cases, such as statistical information from an experiemental study. For instance, in communicating the negative health effects of binge drinking, the photographic visual representation condition was a photograph of a young adult experiencing a hangover. The illustrative condition was a visualized statistical graph of the effects of alcohol on hippocampal volume. Figure 3 describes an example of the photographic

exemplar (upper) and illustrated base-rate (below) for the experimental stimuli on stimulant misuse.

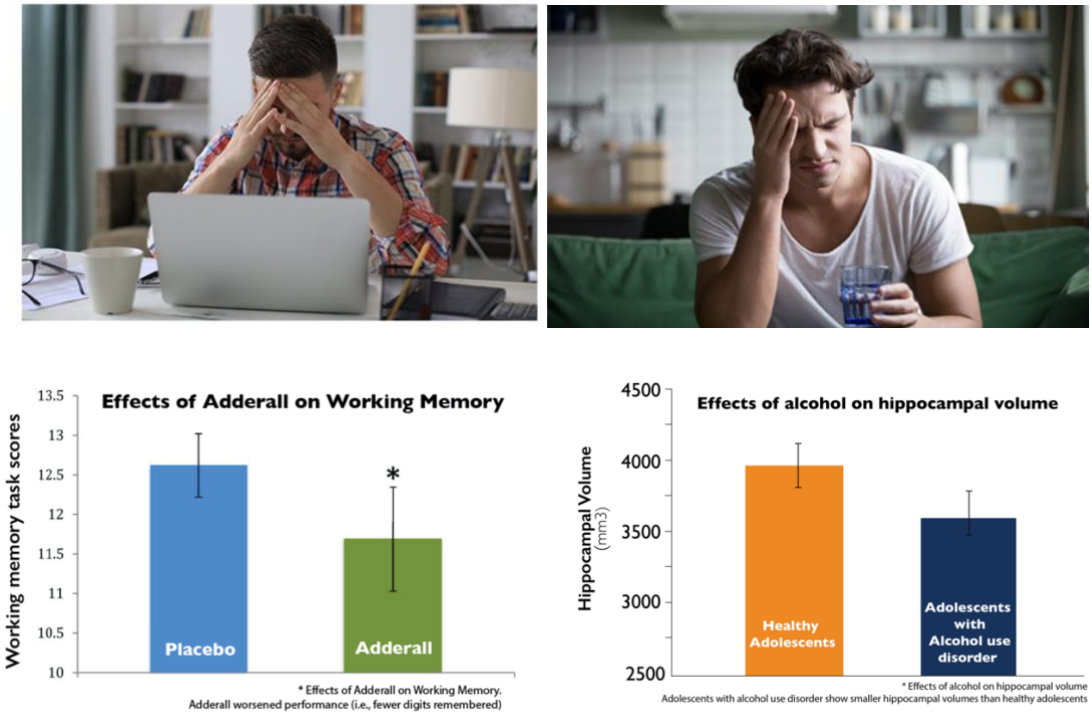


Figure 3. Examples of Visual Representations of Risk

Moderating Variables

Preexisting attitude toward health behaviors. Pre-existing attitudes toward health issues were measured using a six-item semantic differential scale with bipolar adjectives used in the previous inoculation research (Parker et al., 2012).

Participants read the statement: "Please indicate your thoughts on the health behavior below by selecting the number between the pairs of adjectives below. The closer the number is to an adjective, the more certain you are of your evaluation." The bipolar adjectives are: (1) negative/positive, (2) dislikable/likable, (3) bad/good, (4) unfavorable/favorable, (5) unacceptable/acceptable, and (6) undesirable/desirable. The scores from six items were averaged for a single score for prior attitude (Cronbach's $\alpha = .95$)

Issue involvement. Initial involvement with health behaviors was adopted and modified from previous research (Zaichkowsky, 1985; Parker et al., 2012) with a six-item semantic differential scale with bipolar adjectives. Each of the sales were preceded by a question asking for the respondent's sense of personal importance of the four issues regarding college students' health. Participants will read the statement: "Please indicate your thoughts on the health behavior below (i.e., non-medical use of stimulants, electronic cigarettes use, binge drinking, and cannabis use) by selecting the number between the pairs of adjectives below. The closer the number is to an adjective, the more certain you are of your evaluation." The bipolar adjectives are: (1) unimportant/important, (2) irrelevant/relevant, (3) nonessential/essential, (4) of no concern/of concern to me, (5) does not matter/matters to me, (6) useless/useful, and (7) trivial/fundamental. The scores from seven items were averaged for a single score for issue involvement (Cronbach's $\alpha = .93$)

Dependent Variables

This study involves a total number of nine dependent variables: (1) elaboration, (2) self-reported attention, (3) message relevance, (4) attitude toward health behaviors, (5) message credibility, (6) risk perception, (7) behavioral intention, (8) attitude toward the attack message, and (9) retrieval. All of these variables were measured by multiple-item measurements, as this method can achieve a more rigid assessment than by using a single-time item measure (Watt & Van der Berg, 1995).

Elaboration. Elaboration was measured by counting the number of message-relevant thoughts participants wrote down after viewing the message. After reading each news message, participants will be asked to list any thoughts that came to their mind while they were exposed to the message. Each thought unit was coded into whether the answer was related to the message.

Coding of thoughts. The thought-listing approach measures message elaboration as the sum of evaluative thoughts, which depends on coded cognitive responses. Two coderes received about two hours of training before they started coding randomly 10% of the data.

Coding procedures took place in three steps. First, the coders divided the data into psychological thought units. A thought unit was operationalized as "a simple sentence or independent clause in which the subject and predicate may be expressed or implied" (Hatfield & Weider-Hatfield, 1978, p. 46). Second, relevance and irrelevance of cognitive thoughts was coded. Thought units that were related to the mssage (i.e., content, spokesperson, visualization), addressing particular health issue, or the message advocacy were coded as relevant thoughts, while irrelevant thoughts were unrelated to the message. Third, the valence of cognitive thought unites was also coded either positive, negative, and neutral thoughts, adopted and revised from Shen & Seung (2018). Positive thoughts were defined as responses rexpressing liking toward the message, agreement with message, or message source, visualization, or if participants have some impact from messages, etc. On the other hand, negative thoughts were coded when the unites are about disliking toward the message, disagreement with message or message source, visualization, perceived message as irreleanvce, derogation of the source, etc. Neutral thoughts were defined as non-evaluativve responses to the mssage. A message elaboration index was created by taking the sum of positive, negative, and neutral thoughts.

Intercoder reliability was calculated by using Krippendorff's α_K (Hayes & Krippendorff, 2007). All variables established sufficient intercoder reliability coefficients which ranged from .81 to .90 (Elaboration $\alpha = .89$, Potivie valence $\alpha = .87$, Negative valence $\alpha = .90$, Neutral valence $\alpha = .81$).

Self-reported attention. Self-reported attention toward the message was measured by six items on a seven-point Likert scale ranging from 1 (*not at all) to* 7 (*very much*) (Laczniak, Muehling, & Grossbart, 1989). Items for measuring self-report attention will ask: (1) "How much attention did you pay to the written message in the news article?" (2) "How much did you concentrate on the written message in the news article?" (3) "How much thought did you put into evaluating the written message in the news article?" (4) "How much attention did you pay to the visual message in the news article?" (5) "How much did you concentrate on the visual message in the news article?" and (6) "How much thought did you put into evaluating the visual message in the news article?" The scores from seven items were averaged for a single score for self-reported attention (Cronbach's α = .77)

Message relevance. Participants rated their level of agreement with two statements regarding the perceived message relevance (Jensen et al., 2012) on a seven-point Likert scale ranging from 1 (*not at all agree*) to 7 (*strongly agree*). The two statements are: (1) "The news article seemed to be written personally for me'' and (2) ''The news article was very relevant to my situation.'' The scores from two items were averaged for a single score for message relevaent (Cronbach's α = .77)

Post-treatment attitude toward health behaviors. Post-treatment attitudes toward health issues will be measured using a six-item semantic differential scale with bipolar adjectives used in the previous inoculation research (Parker, Ivanov, & Compton, 2012). Participants will read the statement: "Please indicate your thoughts on the health behavior below by selecting the number between the pairs of adjectives below. The closer the number is to an adjective, the more certain you are of your evaluation." The bipolar adjectives are: (1) negative/positive, (2) dislikable/likable, (3) bad/good, (4) unfavorable/favorable, (5) unacceptable/acceptable, and (6)

undesirable/desirable. The scores from six items were averaged for a single score for post-treatment attitude toward health behaviors (Cronbach's α = .95).

Message credibility. Message credibility was measured by asking participants to rate how well certain adjectives describe the content (Sundar, 1999). Participants read the instruction "How well do the following adjectives describe the content you just read?" and answer for three items: (1) Accurate, (2) Authentic, and (3) Believable, ranging from 1 (*very poorly)* to 7 (*very well*). The scores from three items were averaged for a single score for message crediblity (Cronbach's α = .90).

Risk perception of health behaviors. Risk perception is operationalized as an individual's feelings on how harmful substance use behavior is (Zimmerman et al., 2003). The following items were asked to measure an individual's risk perception towards four health behaviors that are presented in the news article. ***Non-medical use of stimulants***: (1) "If I take stimulant drugs for nonmedical use, it would hurt my health and safety," (2) "If I use stimulant drugs for nonmedical purpose, I would develop brain activity problems," and (3) "If I use stimulant drugs for nonmedical purpose, I would easily get insomnia and other sleep disturbances." ***Electronic cigarettes***: (1) "If I smoke electronic cigarettes, it would hurt my health and safety"; (2) "If I smoke electronic cigarettes, I would develop breathing problems," and (3) "If I smoke electronic cigarettes, I might develop lung cancer"; ***Binge drinking****:* (1) "If I binge drink, it would hurt my health and safety," (2) "If I binge drink, I would be involved in an accident," and (3) "If I binge drink, I might get alcohol poisoning that needs medical attention." ***Cannabis use****:* (1) "If I smoke cannabis, it would hurt my health and safety"; (2) "If I smoke cannabis, I would develop breathing problems," and (3) "If I smoke cannabis, I might develop

lung cancer." The scores from three items were averaged for a single score for risk perception crediblity (Cronbach's α = .88).

Behavioral intention. Behavioral intention is operationalized as how likely the respondent will act on the advice that had been presented in the stimulus message (Hu & Sundar, 2010; Richards & Banas, 2015). It was measured with a single-item 100-point probability estimate of participant's likelihood of compliance with the health behavior presented in the news article (0 = extremely unlikely to 100 = extremely likely). Three statements that will be used to measure each health behavioral intention include: (1) "How likely would you be to use electronic cigarettes in the next 6 months? (2) **"**How likely would you be to use stimulants like Adderall to improve your academic performance in the next 6 months? (3) "How likely would you be to drink five or more alcoholic beverages in a single session in the upcoming 6 months?" (4) How likely would you be smoke cannabis in the next 6 months?

Attitude toward the attack message. Attitude toward the attack message was measured using a six-item semantic differential scale with bipolar adjectives used in the previous resistance research (Burgoon, Cohen, Miller, & Montgomery, 1978). Participants read the statement: "Please indicate your thoughts on the news message that you just read by selecting the number between the pairs of adjectives below. The closer the number is to an adjective, the more certain you are of your evaluation." The bipolar adjectives are: (1) foolish/wise, (2) unacceptable/acceptable, (3) wrong/right, (4) unfavorable/favorable, (5) bad/good, and (6) negative/positive. The scores from three items were averaged for a single score for attitude toward the attack message (Cronbach's α = .97).

Retrieval. Retrieval is operationalized as a free recall to measure the amount of information retrieved after the exposure to the messages. At the end of the experiment,

participants will be asked to write down all information that they recall from the messages that they have read during the experiment (i.e., "Please list anything you remember (i.e., verbal or non-verbal information) from the news articles that you've seen during this experiment."). Two coders will determine the number of correct answers from the amount of information participants retrieved to determine the level of free recall.

Manipulation Check

Threat. Threat is one of the major components of the inoculation message that needs to be assessed in order to determine the inoculation treatment's efficacy. This study measured two types of threat, (1) traditional threat and (2) motivational threat, as manipulation check variables.

Traditional Threat. Traditional threat was operationalized as the respondent's awareness that a currently held position may be vulnerable to an impending attitudinal attack (Compton, 2009). Traditional threat was measured using a scale applied in previous inoculation studies (Nabi, 2003; Pfau & Van Bockern, 1994; Pfau et al., 2001). Participants reported their feelings concerning the possibility of counterarguments that they may encounter, which may cause them to rethink their position toward health behaviors (the four experimental issues). Threat manipulation was measured by five items on a seven-point rating scale with bipolar adjectives: (1) threatening/unthreatening, (2) risky/not risky, (3) harmful/not harmful, (4) intimidating/unintimidating, (5) dangerous/safe. The scores from five items were averaged for a single score for threat (Cronbach's $\alpha = .97$)

Motivational Threat. In addition to traditional threat, recent research findings (e.g., Banas & Richards, 2017) on inoculation theory have proposed a new way of measuring the threat variable. Whereas the traditional threat focuses on concepts related to physical safety instead of on motivation to defend one's attitudes, motivational threat asks the degree of one's motivation

to defend one's attitudes, thinking about why participants hold their current beliefs. Motivational threat was measured by four items on a seven-point rating scale; (1) "I want to defend my current attitudes from the information that promotes (a) non-medical use of stimulants; (b) e-cigarette use; (c) binge drinking, (d) non-medical use of cannabis," (2) "I want to counterargue misinformation about (a) non-medical use of stimulants; (b) e-cigarette use; (c) binge drinking, (d) non-medical use of cannabis," (3) "I feel motivated to think about why I hold the beliefs I do about (a) non-medical use of stimulants; (b) e-cigarette use; (c) binge drinking, (d) non-medical use of cannabis," (4) "I feel motivated to resist persuasive messages about alternative accounts of (a) non-medical use of stimulants; (b) e-cigarette use; (c) binge drinking, (d) non-medical use of cannabis." The scores from four items were averaged for a single score for motivational threat (Cronbach's $\alpha = .84$). Pretests were performed to ensure the inoculation message's inductions functioned as intended.

Pretest 1

A total of 14 graduate students participated in Pretest 1. Pretest 1 asked traditional threat questions only. Five items were used to assess the traditional inoculation threat manipulation check. A repeated-measures ANOVA was conducted on traditional threat. There was a significant main effect of message type on traditional threat, $F(2, 26) = 12.18$, $p < .001$, $\eta^2 = 44$. Participants reported higher traditional threat scores when they read the supportive message ($M_{\text{Supportive}} = 5.91$, $SD_{\text{Supportive}} = .76$), followed by neutral ($M_{\text{Neutral}} = 4.91$, $SD_{\text{Neutral}} = 1.63$) and inoculation messages. ($M_{\text{Inoculation}} = 4.04$, $SD_{\text{Inoculation}} = 1.41$). Since inoculation manipulation was not adequately manipulated, another pretest was conducted in Pretest 2.

Pretest 2

A total of 19 graduate students participated in Pretest 2. This time, motivational threat items were asked to participants along with traditional threat items. Also, preexisting attitude toward substance use was used as a covariate in the analysis. A repeated measures ANCOVA with preexisting attitude toward substances use was conducted.

The main effect of message type on threat was not statistically significant, F (2, 34) = 1.85, p = .173, η^2 = .098. Traditional threat score did not differ when participants read the health news story from neutral (M_{Neutral} = 3.42, SD_{Neutral} = 1.54), supportive ($M_{\text{Supportive}}$ = 3.62, $SD_{\text{Supportive}}$ = 1.64) and inoculation messages ($M_{\text{Inoculation}}$ = 3.53, $SD_{\text{Inoculation}}$ = 1.56).

The main effect of message type on motivational threat was not statistically significant either, F (2, 34) = .17, p = .85, η^2 = .010. Traditional threat score did not differ when participants read the health news story from neutral (M_{Neutral} = 4.55, SD_{Neutral} = .98), supportive (M_{Neutral} = 4.63, SD_{Neutral} = 1.13) and inoculation messages ($M_{\text{Inoculation}}$ = 4.04, $SD_{\text{Inoculation}}$ = 1.41). Since inoculation manipulation was not adequately manipulated, another pretest was conducted in Pretest 2 with the edited stimuli.

Pretest 3

A total of 23 participants participated in Pretest 3. 14 participants identified themselves as undergraduate students and 9 identified as graduate students. Preexisting attitude toward substance use was used as a covariate for the analysis, and both traditional threat and motivational threat items were asked.

A repeated measures ANCOVA test revelead a significant difference in traditional threat scores among inoculation, supportive, and neutral conditions, F (2, 42) = 5.11, p = .01, η^2 = .20. Participants rated supportive message as the highest traditional threat score ($M_{\text{Supportive}}$ = 4.10,

$SD_{\text{Supportive}}$ = 1.68), followed by inoculation messages ($M_{\text{Inoculation}}$ = 3.94, $SD_{\text{Inoculation}}$ = 1.60) and neutral (M_{Neutral} = 3.56, SD_{Neutral} = 1.41) messages.

The main effect of message type on motivational threat was not statistically significant, F (2, 42) = 2.33, p = .11, η^2 = .10. Motivational threat score did not differ when participants read the health news story from neutral (M_{Neutral} = 4.43, SD_{Neutral} = 1.07), supportive ($M_{\text{Supportive}}$ = 4.61, $SD_{\text{Supportive}}$ = 1.11) and inoculation messages ($M_{\text{Inoculation}}$ = 4.63, $SD_{\text{Inoculation}}$ = 1.02).

Additional analyses were conducted with only undergraduate participants, because this study targets the college student population as the main audience. A repeated measures ANCOVA test revealed approaching statistical significant difference in traditional threat score among neutral, supportive, and inoculation conditions, F (2, 24) = 3.11, p = .063, η^2 = .21. Participants rated supportive message as the highest traditional threat score ($M_{\text{Supportive}}$ = 4.10, $SD_{\text{Supportive}}$ = 1.44), followed by inoculation messages ($M_{\text{Inoculation}}$ = 3.92, $SD_{\text{Inoculation}}$ = 1.26) and neutral (M_{Neutral} = 3.56, SD_{Neutral} = 1.11) messages.

A repeated measures ANCOVA test revelead approaching statistical significant difference in motivational threat score among neutral, supportive, and inoculation conditions, F (2, 24) = 3.15, p = .061, η^2 = .21. Participants rated inoculation message as the highest motivational threat score ($M_{\text{Inoculation}}$ = 4.72, $SD_{\text{Inoculation}}$ = .72), followed by supportive messages ($M_{\text{Supportive}}$ = 4.69, $SD_{\text{Supportive}}$ = .90) and neutral (M_{Neutral} = 4.62, SD_{Neutral} = .69) messages.

There was no statistically significant effect of message type on traditional threat (F (2, 14) = 2.74, p = .1, η^2 = .29), nor on motivational threat (F (2, 14) = .22, p = .81, η^2 = .03) when analysis was conducted with graduate participants only.

Even though the results were only reaching the statistical significance with the undergraduate student population, since the motivational threat score was higher than the supportive and neutral messages, it was interpreted as that the results suggest a sufficient threat induction, and the study has proceeded to the main study.

Message equivalence. In accordance with O'Keefe (2003), the current study does not conduct manipulation checks to check three types of message variables (i.e., message type, message source, and visual representations). It is because they are intrinsic message features that are independent of the message recipient's perceptions or responses. However, because the news articles can have language variability and may affect the outcome of a message (Burgoon et al., 1978), this study will employ the Index of Contingency (Becker et al., 1961) to evaluate the readability of sentences, to assure consistency in writing style and readability of the stimulus messages.

The index is measured by calculating the number of nouns and a total number of words of each message in order to assess the comprehensibility of messages. A low index value represents a low frequency of occurrence of concept words, which renders a message more difficult to understand. A high index value indicates that concept words are repeated often, which makes a message easy to understand (Becker et al., 1961). Messages receiving similar index scores indicate equivalence. This measure has been used in a number of previous empirical studies on inoculation (Ivanov et al., 2017; Ivanov, Pfau, & Parker, 2009; Wan & Pfau, 2004).

Attack message. The attack messages were designed specifically for the target audience, college students, and attempt to tarnish the arguments that are presented in the stimulus messages. The attack messages will be structured to appear to be coming from a fellow college

student via social media and offer specific arguments highlighting negative attributes of following the health instructions that are presented in the stimulus messages.

The study tested 4 attack messages for each substance use topics. To ensure the equivalence of message wording and readability, the Index of Contingency (Becker et al., 1961) for measuring readability was employed.

Data and Samples

For extra credit, 498 undergraduate students enrolled in various classes at a major Midwestern university took part in the study. Students who are interested and qualified to the participant (18 years of age or older, those who use English as a primary language) received an link to the online survey for their participation. 44 outliers were detected and excluded. A total of 454 valid responses were used for the analysis (M_{age} = 19.84, SD = 2.79). The sample included 65.2% female, 33.9% male, and .9% others. 82.6% were White, 6.6% were Asian, 6.4% were Black or African American, 3.3% were others, .7 were American Indian or Alaska Native, and .4% were Native Hawaiian or Pacific Islander. Class standing of the sample included 38.5% freshmen, 29.3% sophomores, 18.7% juniors, 11.9% seniors, and 1.5% graduate students. 92.3% of the sample was 21 years old or younger, with 30 percent of the sample identifying as 19 years old. 7.7% of the sample identified as older than 22 years old.

In order to test proposed hypotheses and research questions, a series of 3 (message type: inoculation, supportive, neutral) x 2 (message source: peer vs. expert) x 2 (visual representation of risk: illustrative vs. photographic) repeated-measures analyses of variances (ANOVAs) were conducted on all outcome variables including attitude change toward substance use, attitude toward attack message, behavioral intention, self-reported attention, elaboration, retrieval, message credibility, and message relevance.

IV. Results

Effects of Message types: Inoculation, Supportive, and Neutral

Hypothesis 1a predicted that attitude change towards substance use will be greater when a health news story is presented through inoculation messages, compared to supportive and neutral messages. The main effect of message type was not statistically significant on attitude change, F (2, 451) = .33, p = .72, η^2 = .001. The attitude change toward substance use were not different a function of message types including inoculation message ($M_{\text{Inoculation}}$ = -.33, $SD_{\text{Inoculation}}$ = .86), supportive message ($M_{\text{Supportive}}$ = -.33, $SD_{\text{Supportive}}$ = .69), and neutral message (M_{Neutral} = -.27, SD_{Neutral} = .68). A follow-up pairwise comparison test revelead that there is no significant difference between supportive and inoculation messages (p = .99), between supportive and neutral messages (p = .49), and between inoculation and neutral messages (p = .48) on attitude change, which was not in line with the prediction. Thus, hypothesis 1a was not supported.

Hypothesis 1b predicted that attitude towards attack messages (i.e., persuasive messages that promote substance use behaviors) will be greater when a health news story is presented through inoculation messages, compared to supportive and neutral messages. There was no statistically significant main effect of message type on attitude towards attack message, F (2, 451) = .33, p = .72, η^2 = .001, and no significant differences were found among inoculation message ($M_{\text{Inoculation}}$ = 2.50, $SD_{\text{Inoculation}}$ = 1.09), supportive message ($M_{\text{Supportive}}$ = 2.52, $SD_{\text{Supportive}}$ = 1.05), and neutral message (M_{Neutral} = 2.59, SD_{Neutral} = 1.10) on attitude towards attack message. A follow-up pairwise comparison test revelead that there is no significant difference between supportive and inoculation messages (p = .89), between supportive and neutral messages (p = .54), and between inoculation and neutral messages (p = .44) on attitude

towards attack messages, which was not in line with the prediction. Therefore, hypothesis 1b was not supported.

Hypothesis 2 predicted that intention to follow the recommended health behaviors would be greater when a health news story is presented through inoculation messages, compared to supportive and neutral messages. There was no statistically significant main effect of message type on behavioral intention, F (2, 451) = 1.21, p = .30, η^2 = .005, showing no significant differences among inoculation message ($M_{\text{Inoculation}}$ = 22.34, $SD_{\text{Inoculation}}$ = 23.74), supportive message ($M_{\text{Supportive}}$ = 24.85, $SD_{\text{Supportive}}$ = 22.33), and neutral message (M_{Neutral} = 26.51, SD_{Neutral} = 24.98) on behavioral intention. A follow-up pairwise comparison test revelead that there is no significant difference between supportive and inoculation messages (p = .37), between supportive and neutral messages (p = .54), and between inoculation and neutral messages (p = .12) on behavioral intention, which was not in line with the prediction. Therefore, hypothesis 2 was not supported.

Hypothesis 3 predicted self-reported attention to the message will be greater when a health news story is presented through inoculation messages, compared to supportive and neutral messages. The main effect of message type was not statistically significant on self-reported attention, F (2, 451) = .30, p = .742, η^2 = .001, finding no significant differences among inoculation message ($M_{\text{Inoculation}}$ = 4.68, $SD_{\text{Inoculation}}$ = 1.06), supportive message ($M_{\text{Supportive}}$ = 4.70, $SD_{\text{Supportive}}$ = .98), and neutral message (M_{Neutral} = 4.76, SD_{Neutral} = .97) on self-reported attention. A follow-up pairwise comparison test revelead that there is no significant difference between supportive and inoculation messages (p = .82), between supportive and neutral messages (p = .61), and between inoculation and neutral messages (p = .45) on self-reported attention, which was not in line with the prediction. Therefore, hypothesis 3 was not supported.

Hypothesis 4 predicted that message elaboration will be greater when a health news story is presented through inoculation messages, compared to supportive and neutral messages. There was a significant main effect of message type on elaboration, F (2, 451) = 5.18, p = .006, η^2 = .022. In line with the prediction, participants reported more message-relevant thoughts when they read the news with inoculation message ($M_{\text{Inoculation}}$ = 2.94, $SD_{\text{Inoculation}}$ = 1.58), compared to supportive message ($M_{\text{Supportive}}$ = 2.81, $SD_{\text{Supportive}}$ = 1.56), and neutral message (M_{Neutral} = 2.42, SD_{Neutral} = 1.31). A follow-up pairwise comparison test revelead that there is no significant difference between supportive and inoculation messages (p = .44) on elaboraiton. However, there was a significant differences between supportive and neutral messages (p = .23), and between inoculation and neutral messages (p = .002) on elaboration. Therefore, hypothesis 4 was partially supported.

Additional analyses were performed on the valence of elaboration (positive, negative, and neutral thoughts). The main effect of message type was statistically significant on positive elaboration (i.e., liking toward the message, agreement with the message), F (2, 451) = 3.58, p = .029, η^2 = .016. Participants reported more positive message-relevant thoughts when they read the news with inoculation message ($M_{\text{Inoculation}}$ = 2.46, $SD_{\text{Inoculation}}$ = 1.51), compared to supportive ($M_{\text{Supportive}}$ = 2.42, $SD_{\text{Supportive}}$ = 1.52), and neutral (M_{Neutral} = 2.07, SD_{Neutral} = 1.20) messages. A follow-up pairwise comparison test revelead that there is no significant difference between supportive and inoculation messages (p = .82) on positive elaboration. However, there was a significant differences between supportive and neutral messages (p = .031), and between inoculation and neutral messages (p = .016) on elaboration.

However, neither the main effect of message type on negative elaboration (i.e., disliking toward the message, disagreement with the message), F (2, 451) = 1.41, p = .25, η^2 = .006, nor

the main effect of message type on neutral elaboration (i.e., non-evaluative responses to the message), F (2, 451) = 1.93, p = .15, η^2 = .008 was significant. Negative elaboration was similar after all message conditions: inoculation message ($M_{\text{Inoculation}}$ = .32, $SD_{\text{Inoculation}}$ = .83), compared to supportive ($M_{\text{Supportive}}$ = .27, $SD_{\text{Supportive}}$ = .70), and neutral (M_{Neutral} = .20, SD_{Neutral} = .37) messages on negative elaboration. A follow-up pairwise comparison test revelead that there is no significant difference between supportive and inoculation messages (p = .55), between supportive and neutral messages (p = .30), and between inoculation and neutral messages (p = .099) on negative elaboration.

Also, neutral elaboration did not differ as a function of message type including inoculation message ($M_{\text{Inoculation}}$ = .17, $SD_{\text{Inoculation}}$ = .34), compared to supportive ($M_{\text{Supportive}}$ = .12, $SD_{\text{Supportive}}$ = .26), and neutral (M_{Neutral} = .16, SD_{Neutral} = .35). A follow-up pairwise comparison test revelead that there is no significant difference between supportive and inoculation messages (p = .16), between supportive and neutral messages (p = .65), and between inoculation and neutral messages (p = .059) on neutral elaboration.

Hypothesis 5 predicted retrieval of the information will be greater when a health news story is presented through inoculation messages, compared to supportive and neutral messages. The main effect of message type on self-report attention was not statistically significant, F (2, 451) = .50, p = .61, η^2 = .022. There was no statistically significant difference in participants' retrieval of the message content among inoculation ($M_{\text{Inoculation}}$ = 1.15, $SD_{\text{Inoculation}}$ = .91), supportive message ($M_{\text{Supportive}}$ = 1.20, $SD_{\text{Supportive}}$ = 1.03), and neutral message (M_{Neutral} = 1.26, SD_{Neutral} = .92). A follow-up pairwise comparison test revelead that there is no significant difference between supportive and inoculation messages (p = .657), between supportive and

neutral messages (p = .594), and between inoculation and neutral messages (p = .32) on retrieval, which was not in line with the prediction. Therefore, hypothesis 5 was not supported.

Effects of Message source: Peer vs. Expert

Hypothesis 6 predicted that message credibility will be greater when health news featured peers as a message source than when they featured experts as a message source. There was a statistically significant main effect of message source found on message credibility, F (2, 451) = 1.53, $p < .001$, $\eta^2 = .025$. Contrary to the prediction, messages that featured an expert as a message source were evaluated as more credible (M_{Expert} = 5.63, SD_{Expert} = 1.08) than messages that featured a peer (M_{Peer} = 5.47, SD_{Peer} = 1.10). Therefore, hypothesis 6 was not supported.

Hypothesis 7 predicted that message relevance will be greater when a health news story featured peers as a message source than when they featured experts as a message source. The main effect of message source on message relevant was not statistically significant, F (2, 451) = 1.49, p = .223, $\eta^2 = .003$. Message relevance did not differ when participants read the health news story from peer source (M_{Peer} = 3.25, SD_{Peer} = 1.38) or from expert source news (M_{Expert} = 3.18, SD_{Expert} = 1.48). Therefore, hypothesis 7 was not supported.

Hypothesis 8 predicted that self-reported attention to the message would be greater when a health news story featured peers as a message source than when they featured experts as a message source. The main effect of message source on self-reported attention was not statistically significant, F (2, 451) = .003, p = .954, $\eta^2 = .00$. Participants' self-reported attention was similar after reading a health news story from peer source (M_{Peer} = 4.71, SD_{Peer} = 1.06) or from expert source (M_{Expert} = 4.72, SD_{Expert} = 1.09). Therefore, hypothesis 8 was not supported.

Interaction between Message type and Message source

Research question 1 asked how message type and message source interact to influence message credibility. The interaction between message type and message source was not statistically significant on message credibility, F (2, 451) = 12.53, p = .218, η^2 = .007. For instance, after reading a health news story from the neutral message type, participants reported the higher message credibility from peer featured news story ($M_{\text{Neutral-Peer}}$ = 5.62, $SD_{\text{Neutral-Peer}}$ = .97) and expert featured news story ($M_{\text{Neutral-Expert}}$ = 5.68, $SD_{\text{Neutral-Expert}}$ = .99). Participants reported higher message credibility in expert featured news story in both supportive ($M_{\text{Supportive-Expert}}$ = 5.68, $SD_{\text{Supportive-Expert}}$ = 1.00) and inoculation ($M_{\text{Inoculation-Expert}}$ = 5.62, $SD_{\text{Inoculation-Expert}}$ = 1.04) message types, compared to peer featured news story in supportive ($M_{\text{Supportive-Peer}}$ = 5.44, $SD_{\text{Supportive-Peer}}$ = 1.16) and inoculation ($M_{\text{Inoculation-Peer}}$ = 5.36, $SD_{\text{Inoculation-Peer}}$ = 1.16) message types. However, the result was not statistically significant.

Effects of Visual Representation of Risk

Research questions 3a and **3b** asked how visual representations of risk would influence participants' self-reported attention (RQ3a) and risk perception towards the health topic (RQ3b). There was a significant main effect of visual representation of risk on self-reported attention, F (1, 451) = 58.67, $p < .001$, η^2 = .12. Messages that featured an illustrative representation of risk resulted in higher self-reported attention ($M_{\text{Illustration}}$ = 4.88, $SD_{\text{Illustration}}$ = 1.09) than a photographic representation of risk messages (M_{Photo} = 4.56, SD_{Photo} = 1.11). However, the main effect of visual representation of risk was not statistically significant on risk perception, F (1, 451) = .61, p = .437, η^2 = .001. Participants' risk perception from an illustrative visual representation of risk messages ($M_{\text{Illustration}}$ = 5.54, $SD_{\text{Illustration}}$ = 1.12) did not differ from a photographic visual representation of risk messages (M_{Photo} = 5.50, SD_{Photo} = 1.12).

Interaction among Message type, Visual representation of risk, and Message source

Research question 4a asked how message type, visual representations of risk, and message sources interact to influence participants' self-reported attention. Neither the two-way interaction between message type and message source (F (2, 451) = .20, p = .33, η^2 = .001) nor the two-way interaction between message type and visual representation of risk (F (2, 451) = 1.15, p = .32, η^2 = .005) was statistically significant on self-reported attention. However, there was a statistically significant interaction effect between message source and visual representation of risk on self-reported attention, F (1, 451) = 6.73, p = .10, η^2 = .015. As shown in Figure 4, participants reported higher self-reported attention with illustrative visual representation of risk messages in peer ($M_{\text{Peer-Illustration}}$ = 4.83, $SD_{\text{Peer-Illustration}}$ = 1.09) and expert ($M_{\text{Expert-Illustration}}$ = 4.92, $SD_{\text{Expert-Illustration}}$ = 1.09) source messages, compared to photographic visual representation of risk messages in peer ($M_{\text{Peer-Photo}}$ = 4.60, $SD_{\text{Peer-Photo}}$ = 1.11) and expert ($M_{\text{Expert-Photo}}$ = 4.51, $SD_{\text{Expert-Photo}}$ = 1.11) source messages.

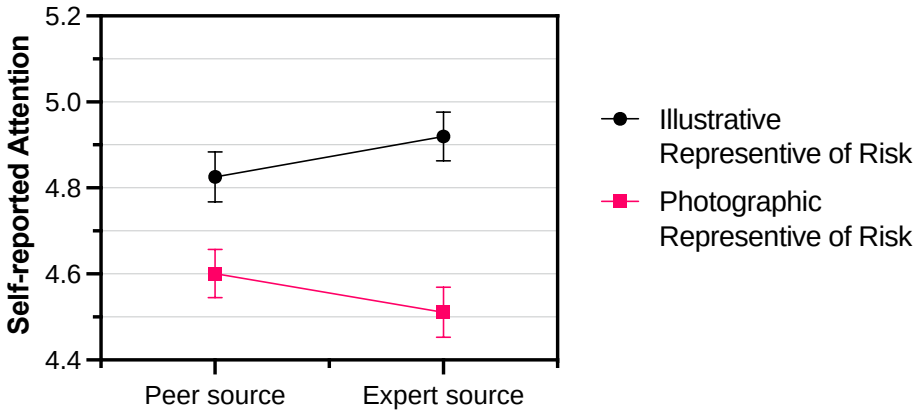


Figure 4. Two-way interaction effect between message source and visual representation of risk on self-reported attention with standard error means

The three-way—message type, message source, and visual representation of risk interaction on self-reported attention was statistically significant, (F (2, 297) = 3.93, p = .02, η^2 = .017). Overall, after reading a health news story with an illustrative representation of risk information, participants reported higher self-reported attention scores. In inoculation message condition, participants reported the highest self-reported attention when they read the news story from expert-featured news with an illustrative representation of risk ($M_{\text{Inoculation-Expert-Illustration}}$ = 4.86, $SD_{\text{Inoculation-Expert-Illustration}}$ = 1.22), followed by peer-featured news with an illustrative representation of risk ($M_{\text{Inoculation-Peer-Illustration}}$ = 4.80, $SD_{\text{Inoculation-Peer-Illustration}}$ = 1.30), peer-featured news with a photographic representation of risk ($M_{\text{Inoculation-Peer-Photo}}$ = 4.55, $SD_{\text{Inoculation-Peer-Photo}}$ = 1.32), and expert-featured news with a photographic representation of risk ($M_{\text{Inoculation-Expert-Photo}}$ = 4.50, $SD_{\text{Inoculation-Expert-Photo}}$ = 1.17). In supportive message condition, participants reported the highest self-reported attention when they read the news story from peer-featured news with an illustrative representation of risk ($M_{\text{Supportive-Peer-Illustration}}$ = 4.85, $SD_{\text{Supportive-Peer-Illustration}}$ = 1.13) followed by expert-featured news with an illustrative representation of risk ($M_{\text{Supportive-Expert-Illustration}}$ = 4.81, $SD_{\text{Supportive-Expert-Illustration}}$ = 1.27), peer-featured news with a photographic representation of risk ($M_{\text{Supportive-Peer-Photo}}$ = 4.60, $SD_{\text{Supportive-Peer-Photo}}$ = 1.10), and expert-featured news with a photographic representation of risk ($M_{\text{Supportive-Expert-Photo}}$ = 4.81, $SD_{\text{Supportive-Expert-Photo}}$ = 1.27). Lastly, in neutral message condition, participants reported the highest self-reported attention when they read the news story from expert-featured news with an illustrative representation of risk ($M_{\text{Neutral-Expert-Illustration}}$ = 5.10, $SD_{\text{Neutral-Expert-Illustration}}$ = 1.14) followed by peer-featured news with an illustrative representation of risk ($M_{\text{Neutral-Peer-}}$

$_{\text{Illustration}}$ = 4.83, $SD_{\text{Neutral-Peer-Illustration}}$ = 1.29), peer-featured news with a photographic representation of risk ($M_{\text{Neutral-Peer-Photo}}$ = 4.66, $SD_{\text{Neutral-Peer-Photo}}$ = 1.17), and expert-featured news with a photographic representation of risk ($M_{\text{Neutral-Expert-Photo}}$ = 4.46, $SD_{\text{Neutral-Expert-Photo}}$ = 1.27). These results are illustrated in Figure 5.

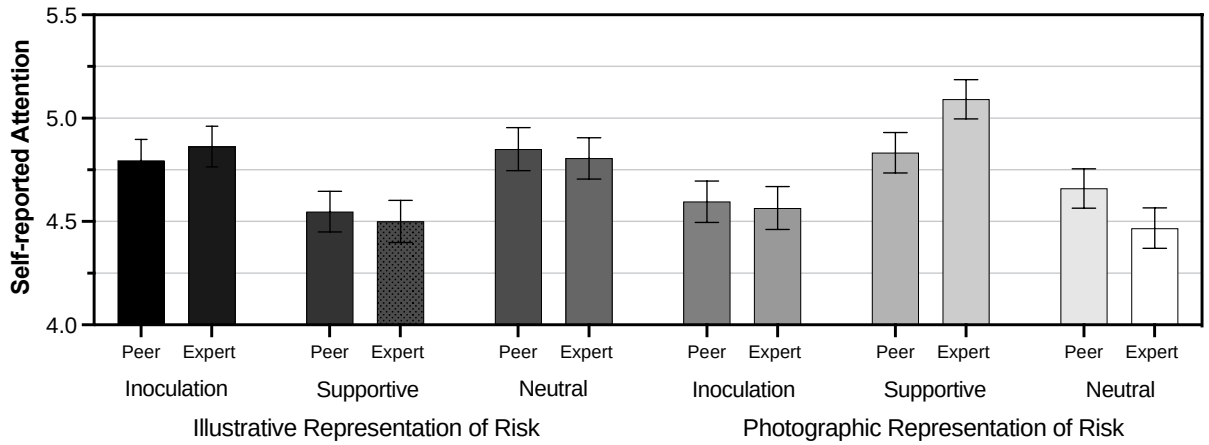


Figure 5. Three-way interaction effect among message type, message source, and visual representation of risk on self-reported attention with standard error means

Research question 4b asked how message type, message sources, and visual representations of risk interact to influence risk perception towards the health topic. The two-way interaction between message type and message source on risk perception was not statistically significant (F (2, 451) = .20, p = .33, η^2 = .001). The two-way interaction between message type and visual representation of risk was not statistically significant on risk perception (F (2, 451) = 1.15, p = .32, η^2 = .005). Lastly, the two-way interaction between message source and visual representation of risk was not statistically significant on risk perception (F (1, 451) = .40, p = .528, η^2 = .001). Further, the three-way interaction examining how message type, message source, and visual representation of risk interact to influence outcomes was not statistically significant for risk perception (F (2, 297) = 3.93, p = .02, $\eta^{2\,=}$ .017).

The Role of Individual Differences: Prior Attitude and Issue Involvement

In this particular section, in order to test research questions (RQ5a and RQ5b) which ask how individual difference variables interact with message variables, a 3 (message type) x 2 (message source) x 2 (visual representation of risk) x 3 (prior attitude toward substance use: low vs. neutral vs. high) repeated-measures ANOVAs for RQ5a and a 3 (message type) x 2 (message source) x 2 (visual representation of risk) x 3 (issue involvement with substance use: low vs. neutral vs. high) repeated-measures ANOVAs for RQ5b were performed respectively and their results are reported.

Prior Attitude as a moderator

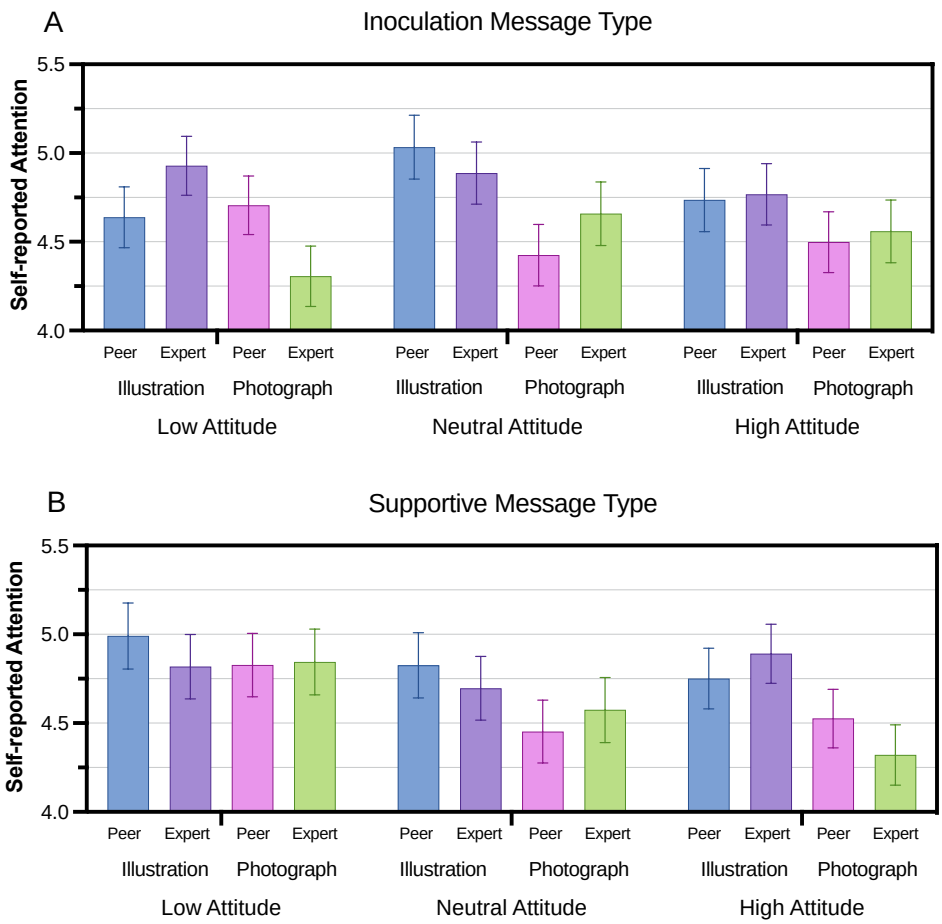
Research questions 5a asked how individuals' characteristic such as pre-existing attitude towards substance use interact with visual attention, risk perception, attitude, behavioral intention, and message credibility regarding college students' health news to influence outcome variables of interest.

Self-reported Attention. There was no statistically significant two-way interaction effect on self-reported attention with prior attitude as a moderating factor. The two-way interaction between message type and prior attitude was not statistically significant (F (4, 445) = .48, p = .747, η^2 = .001) on self-reported attention. The two-way interaction between message source and prior attitude was not statistically significant (F (2, 445) = .28, p = .753, η^2 = .001) on self-reported attention. Lastly, the two-way interaction between risk visualization and prior attitude was not statistically significant (F (2, 445) = 2.01, p = .136, η^2 = .009) on self-reported attention.

The three-way interaction among message type, visual representation of risk, and prior attitude was not statistically significant on self-reported attention (F (2, 445) = .78, p = .540, η^2 = .007). The three-way interaction among message source, visual representation of risk, and prior

attitude was not statistically significant on self-reported attention (F (2, 445) = 1.79, p = .168, η^2 = .008). The three-way interaction among message type, message source and prior attitude was not statistically significant on self-reported attention (F (2, 445) = .13, p = .972, η^2 = .001), either.

The four-way interaction effect among message type, message source, visual representation of risk, and prior attitude was statistically significant on self-reported attention, F (4, 445) = 4.58, p = .001, η^2 = .040), which is shown in Figure 6.



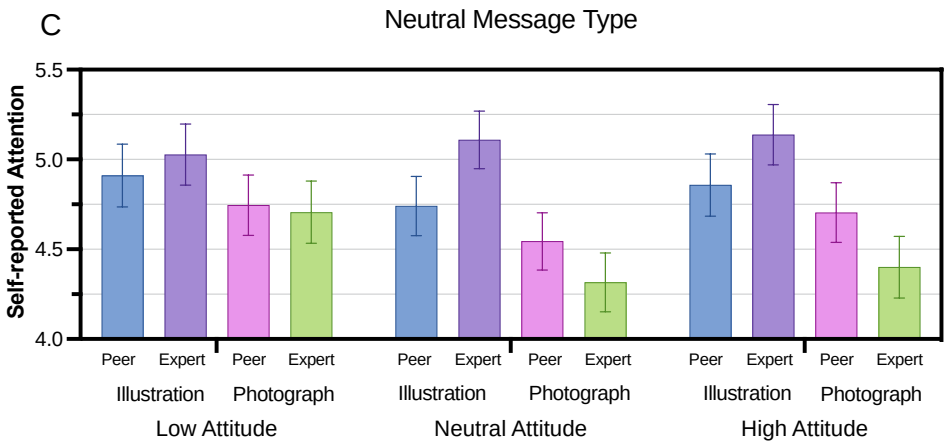


Figure 6. Four-way interaction effects among message type, message source, visual representation of risk, and prior attitude toward substance use on self-reported attention with standard error means

Risk perception. The two-way interaction effect between message type and prior attitude was approaching the statistical significance (F (4, 445) = 2.27, p = .061, η^2 = .020) on risk perception. Participants with less favorable attitude (low attitude) toward substance use reported the greatest risk perception in neutral message ($M_{\text{Low Att-Neutral}}$ = 6.14, $SD_{\text{Low Att-Neutral}}$ = 1.15), followed by inoculation ($M_{\text{Low Att-Inoculation}}$ = 6.05, $SD_{\text{Low Att-Inoculation}}$ = 1.22) and supportive ($M_{\text{Low Att-Supportive}}$ = 5.99, SD Low $_{\text{Att-Supportive}}$ = 1.28) messages. Participants with neutral attitude toward substance use reported the greatest risk perception in supportive message ($M_{\text{Neutral Att-Supportive}}$ = 5.67, SD Neutral $_{\text{Att-Supportive}}$ = *1.22*), followed by inoculation ($M_{\text{Neutral Att-Inoculation}}$ = 5.59, $SD_{\text{Neutral Att-Inoculation}}$ = 1.22), and neutral ($M_{\text{Neutral Att-Neutral}}$ = 5.20, $SD_{\text{Neutral Att-Neutral}}$ = 1.40) messages. Lastly, participants who had more favorable attitude (high attitude) toward substance use reported the greatest risk perception in supportive message ($M_{\text{High Att-Supportive}}$ = 5.26, SD High $_{\text{Att-Supportive}}$ = 1.45), followed by inoculation ($M_{\text{High Att-Inoculation}}$ = 4.98,

SD High $_{\text{Att-Inoculation}}$ = 1.52) and neutral (*M* $_{\text{High Att-Neutral}}$ = 4.91, *SD* $_{\text{High Att-Neutral}}$ = 1.52) messages. These results are illustrated in Figure 7.

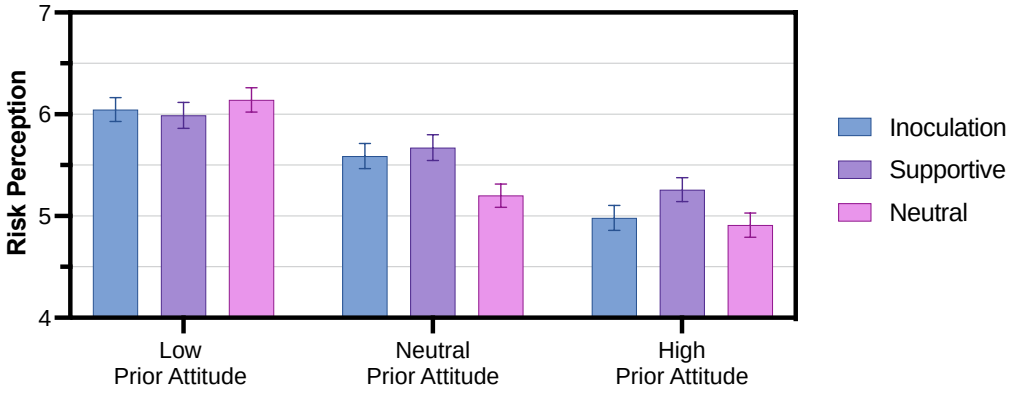


Figure 7. Two-way interaction effect between message type and prior attitude on risk perception with standard error means

The two-way interaction between message source and prior attitude was not statistically significant (F (2, 445) = .49, p = .616, η^2 = .002) on risk perception. The two-way interaction between risk visualization and prior attitude on risk perception was not statistically significant (F (2, 445) = 1.214, p = .298, η^2 = .005).

The three-way interaction among message type, visual representation of risk, and prior attitude on risk perception was statistically significant (F (4, 445) = 2.60, p = .036, η^2 = .023). Among participants who initially have low attitude (unfavorable) toward substance use, those who read neutral message type with a photograph (*M* $_{\text{Low Att-Neutral-Photo}}$ = 6.25, *SD* $_{\text{Low Att-Neutral-Photo}}$ = 1.09) reported the highest risk perception, compared to the news with an illustration (*M* $_{\text{Low Att-Neutral-Illustration}}$ = 6.03, *SD* $_{\text{Low Att-Neutral-Illustration}}$ = 1.21). For those who have low attitude and read inoculation message type, risk perception was higher for message condition with a photograph (*M* $_{\text{Low Att-Inoculation-Photo}}$ = 6.10, *SD* $_{\text{Low Att-Inoculation-Photo}}$ = 1.07), compared to an

illustration ($M_{\text{Low Att-Inoculation-Illustration}}$ = 5.99, $SD_{\text{Low Att-Inoculation-Illustration}}$ = 1.26). For those who have low attitude and read supportive message type, risk perception was higher for message condition with an illustration ($M_{\text{Low Att-Supportive-Illustration}}$ = 6.09, $SD_{\text{Low Att-Inoculation-Illustration}}$ = 1.26), compared to a photograph ($M_{\text{Low Att-Supportive-Photo}}$ = 5.89, $SD_{\text{Low Att-Supportive-Photo}}$ = 1.06).

Among participants who initially have a neutral attitude toward substance use, those who read supportive message type with an illustration ($M_{\text{Neutral Att-Supportive-Photo}}$ = 5.67, $SD_{\text{Neutral Att-Supportive-Photo}}$ = 1.51) reported the highest risk perception, compared to the news with a photograph ($M_{\text{Neutral Att-Supportive-Illustration}}$ = 5.67, $SD_{\text{Neutral Att- Supportive-Illustration}}$ = 1.21). For those who have neutral attitude and read inoculation message type, risk perception was rated higher after the message condition with an illustration ($M_{\text{Neutral Att-Inoculation-Illustration}}$ = 5.74, $SD_{\text{Neutral Att-Inoculation- Illustration}}$ = 1.19), compared to a photograph ($M_{\text{Neutral Att-Inoculation-Photograph}}$ = 5.44, $SD_{\text{Neutral Att-Inoculation- Photograph}}$ = 1.07). For those who have neutral attitude and read neutral message type, risk perception was rated higher for the message condition with an illustration ($M_{\text{Neutral Att-Neutral-Illustration}}$ = 5.29, $SD_{\text{Neutral Att- Neutral - Illustration}}$ =1.28) compared to a photograph ($M_{\text{Neutral Att- Neutral-Photo}}$ = 5.11, $SD_{\text{Neutral Att-Neutral-Photo}}$ = 1.51).

Lastly, for those who initially have a high attitude (favorable) toward substance use, those who read supportive message type with a photograph ($M_{\text{High Att-Supportive-Photo}}$ = 5.11, $SD_{\text{High Att- Supportive -Photo}}$ = 1.59) reported a higher risk perception, compared to the news with an illustration ($M_{\text{High Att-Supportive-Illustration}}$ = 5.41, $SD_{\text{High Att-Supportive-Illustration}}$ = 1.31). For those who have high attitude and read inoculation message type, risk perception was higher for the message condition with an illustration ($M_{\text{High Att-Inoculation-Illustration}}$ = 5.02, $SD_{\text{High Att-Inoculation-}}$

$_{\text{Illustration}}$ = 1.55), compared to a photograph ($M_{\text{High Att-Inoculation-Photograph}}$ = 5.95, $SD_{\text{High Att-Inoculation-Photograph}}$ = 1.31). For those who have high attitude and read neutral message type, risk perception was higher for the message condition with an illustration ($M_{\text{High Att-Neutral-Illustration}}$ = 5.05, $SD_{\text{High Att- Neutral-Illustration}}$ =1.47) compared to a photograph ($M_{\text{High Att-Neutral-Photo}}$ = 4.77, $SD_{\text{High Att-Neutral - Photo}}$ = 11.48). These results are also illustrated in Figure 8.

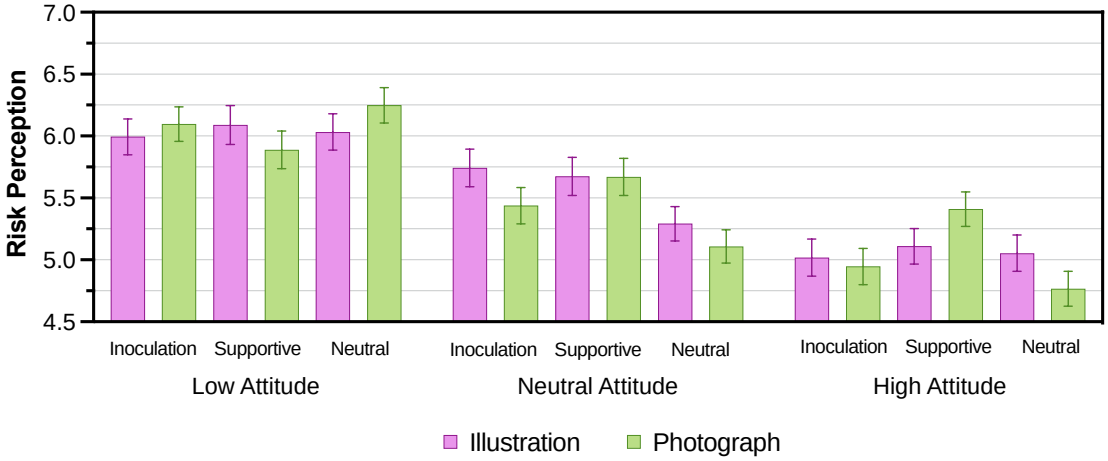


Figure 8. Three-way interaction effect among message type, visual representation of risk, and prior attitude on risk perception with standard error means

The three-way interaction among message source, visual representation of risk, and prior attitude on risk perception was not statistically significant (F (4, 445) = 2.00, p = .136, η^2 = .009) . The three-way interaction among message type, message source and prior attitude was not statistically significant on risk perception (F (2, 445) = .28, p = .892, η^2 = .002), either.

Lastly, the four-way interaction effect among message type, message source, visual representation of risk, and prior attitude was not statistically significant, F (4, 445) = 1.41, p = .231, η^2 = .012).

Behavioral intention. The two-way interaction between message type and prior attitude was statistically significant on behavioral intention (F (4, 445) = 2.66, p = .032, η^2 = .023).

Participants who initially have low (unfavorable) attitude toward substance use reported the lowest intention to use substances in the future with inoculation messages ($M_{\text{Low Att-Inoculation}}$ = 5.35, $SD_{\text{Low Att-Inoculation}}$ = 13.90), followed by neutral ($M_{\text{Low Att-Neutral}}$ = 9.00, $SD_{\text{Low Att-Neutral}}$ = 21.23) and supportive ($M_{\text{Low Att-Supportive}}$ = 10.12, $SD_{\text{Low Att-Supportive}}$ = 21.47) messages. Participants who have neutral attitude toward substance use also reported the lowest intention to use substances in the future with inoculation messages ($M_{\text{Neutral Att-Inoculation}}$ = 19.35, $SD_{\text{Neutral Att-Inoculation}}$ = 29.27), followed by neutral ($M_{\text{Neutral Att-Neutral}}$ = 23.73, $SD_{\text{Neutral Att-Neutral}}$ = 33.29) and supportive ($M_{\text{Neutral Att-Supportive}}$ = 26.39, $SD_{\text{Neutral Att-Supportive}}$ = 31.67). Lastly, participants who have a high (favorable) attitude toward substance use reported the lowest intention to use substances in the future with supportive messages, followed by inoculation and neutral messages. Please see Figure 9 for these results.

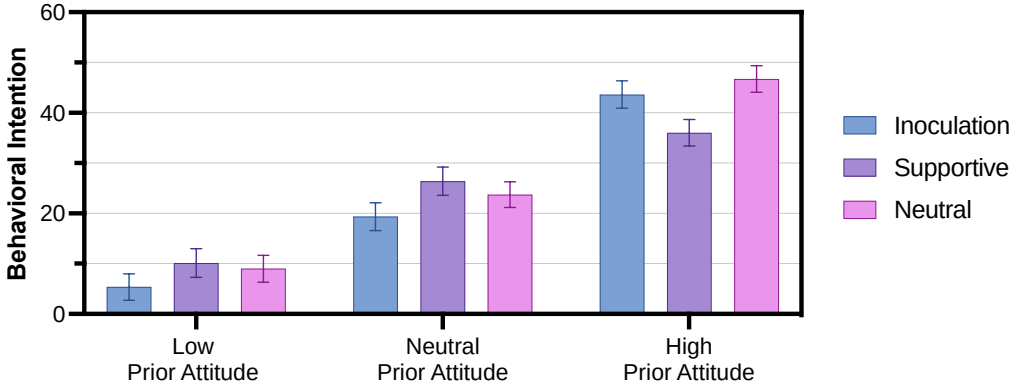


Figure 9. Two-way interaction effect between message type and prior attitude on the behavioral intention with standard error means

The two-way interaction between message source and prior attitude on behavioral intention was statistically significant (F (2, 445) = 2.66, p = .049, η^2 = .013). Participants who have a low (unfavorable) attitude toward substance use reported a lower intention to use

substances in the future with peer messages ($M_{\text{Low Att-Peer}}$ = 7.50, $SD_{\text{Low Att-Peer}}$ = 16.98) than expert messages ($M_{\text{Low Att-Expert}}$ = 8.81, $SD_{\text{Low Att-Expert}}$ = 21.23). Participants who have a neutral attitude toward substance use also reported a lower intention to use substances in the future with peer messages ($M_{\text{Neutral Att-Peer}}$ = 22.61, $SD_{\text{Neutral Att-Peer}}$ = 30.86) than expert messages ($M_{\text{Neutral Att-Expert}}$ = 23.71, $SD_{\text{Neutral Att-Expert}}$ = 31.96). On the other hand, participants how have a high (favorable) attitude toward substance use reported a lower intention to use substances in the future with expert messages ($M_{\text{High Att-Expert}}$ = 39.83, $SD_{\text{High Att-Expert}}$ = 40.91) than peer messages ($M_{\text{High Att-Peer}}$ = 44.44, $SD_{\text{High Att-Peer}}$ = 40.01). Please see Figure 10 for these results.

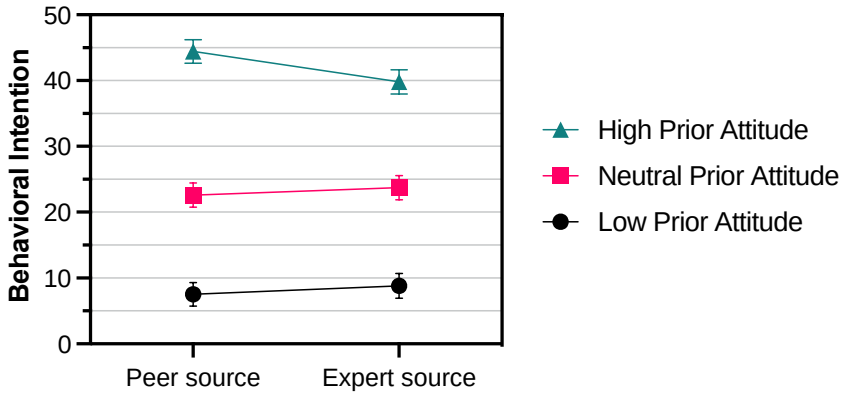


Figure 10. Two-way interaction effect between message source and prior attitude on the behavioral intention with standard error means

The two-way interaction between risk visualization and prior attitude was not statistically significant on behavioral intention (F (2, 445) = .19, p = .831, η^2 = .001).

The three-way interaction among message type, visual representation of risk, and prior attitude was not statistically significant on behavioral intention (F (4, 445) = .93, p = .448, η^2 = .008). The three-way interaction among message source, visual representation of risk, and prior

attitude was not statistically significant on behavioral intention (F (2, 445) = .50, p = .610, η^2 = .002). The three-way interaction among message type, message source and prior attitude was not statistically significant on behavioral intention (F (4, 445) = .36, p = .835, η^2 = .003), either.

Lastly, the four-way interaction effect among message type, message source, visual representation of risk, and prior attitude was not statistically significant on behavioral intention, F (4, 445) = 1.20, p = .312, η^2 = .011).

Message Credibility. The two-way interaction effect on message credibility with prior attitude as a moderating factor. The two-way interaction between message type and prior attitude was not statistically significant on message credibility (F (4, 445) = .63, p = .642, η^2 = .006). The two-way interaction between message source and prior attitude was not statistically significant on message credibility (F (2, 445) = 1.62, p = .199, η^2 = .007). Lastly, the two-way interaction between risk visualization and prior attitude on behavioral intention was not statistically significant (F (2, 445) = 1.49, p = .226, η^2 = .007).

The three-way interaction among message type, visual representation of risk, and prior attitude was not statistically significant on behavioral intention (F (2, 445) = .88, p = .473, η^2 = .008). The three-way interaction among message source, visual representation of risk, and prior attitude was not statistically significant on behavioral intention (F (2, 445) = .61, p = .546, η^2 = .003). The three-way interaction among message type, message source and prior attitude was not statistically significant on behavioral intention (F 4, 445) = .64, p = .635, η^2 = .006), either.

The four-way interaction effect among message type, message source, visual representation of risk, and prior attitude on behavioral intention was not statistically significant, F (4, 445) = 1.928, p = .105, η^2 = .017).

Table 2. Summary of main effects and interaction effects of 3 (message type) x 2 (message source) x 2 (visual representation) x 3 (prior attitude toward substance use)

DV	IV	Df	F	P	η^2
Self-reported Attention	Message type	2, 445	.30	.738	.001
	Message source	1, 445	.004	.952	.004
	Risk visualization	1, 445	57.22	<.001	.114
	Prior attitude	2, 445	.53	.590	.004
	Message type x Message source	2, 445	.33	.721	.001
	Message type x Risk visualization	2, 445	2.01	.135	.005
	Message type x Prior attitude	4, 445	.48	.747	.004
	Message source x Risk visualization	1, 445	5.88	.016	.013
	Message source x Prior attitude	2, 445	.28	.753	.001
	Risk visualization x Prior attitude	2, 445	2.01	.136	.009
	Message type x Risk visualization x Prior attitude	4, 445	.78	.540	.007
	Message source x Risk visualization x Prior attitude	2, 445	1.79	.168	.008
	Message type x Message source x Prior attitude	4, 445	.13	.972	.001
	Message type x Message source x Risk visualization	2, 445	4.29	.014	.019
	Message type x Message source x Risk visualization x Prior Attitude	4, 445	4.58	.001	.040
Risk Perception	Message type	2, 445	2.27	.076	.011
	Message source	1, 445	.29	.588	.001
	Risk visualization	1, 445	.78	.378	.002
	Prior attitude	2, 445	154.091	<.001	.191
	Message type x Message source	2, 445	.49	.616	.002
	Message type x Risk visualization	2, 445	.52	.594	.002
	Message type x Prior attitude	4, 445	2.27	.061	.020
	Message source x Risk visualization	1, 445	.44	.506	.001
	Message source x Prior attitude	2, 445	.49	.616	.002
	Risk visualization x Prior attitude	2, 445	1.21	.298	.005
	Message type x Risk visualization x Prior attitude	4, 445	2.59	.036	.023
	Message source x Risk visualization x Prior attitude	2, 445	2.00	.136	.009
	Message type x Message source x Prior attitude	4, 445	.28	.892	.002
	Message type x Message source x Risk visualization	2, 445	.32	.730	.001
	Message type x Message source x Risk visualization x Prior Attitude	4, 445	1.41	.231	.012

Behavioral Intention	Message type	2, 445	1.49	.226	.007
	Message source	1, 445	.43	.514	.001
	Risk visualization	1, 445	.57	.453	.001
	Prior attitude	2, 445	119.90	<.001	.350
	Message type x Message source	2, 445	.83	.435	.004
	Message type x Risk visualization	2, 445	.58	.558	.003
	Message type x Prior attitude	4, 445	2.66	.032	.023
	Message source x Risk visualization	1, 445	1.00	.317	.002
	Message source x Prior attitude	2, 445	3.04	.049	.013
	Risk visualization x Prior attitude	2, 445	.19	.831	.001
	Message type x Risk visualization x Prior attitude	4, 445	.93	.448	.008
	Message source x Risk visualization x Prior attitude	2, 445	.50	.610	.002
	Message type x Message source x Prior attitude	4, 445	.36	.835	.003
	Message type x Message source x Risk visualization	2, 445	.29	.752	.001
	Message type x Message source x Risk visualization x Prior Attitude	4, 445	1.20	.312	.011
Message Credibility	Message type	2, 445	1.40	.248	.006
	Message source	1, 445	11.48	<.001	.025
	Risk visualization	1, 445	5.82	.016	.013
	Prior attitude	2, 445	2.48	.085	.011
	Message type x Message source	2, 445	1.62	.199	.007
	Message type x Risk visualization	2, 445	.60	.553	.003
	Message type x Prior attitude	4, 445	.63	.642	.006
	Message source x Risk visualization	1, 445	1.73	.189	.004
	Message source x Prior attitude	2, 445	1.62	.199	.007
	Risk visualization x Prior attitude	2, 445	1.49	.226	.007
	Message type x Risk visualization x Prior attitude	4, 445	.88	.473	.008
	Message source x Risk visualization x Prior attitude	2, 445	.61	.546	.003
	Message type x Message source x Prior attitude	4, 445	.64	.635	.006
	Message type x Message source x Risk visualization	2, 445	.82	.441	.004
	Message type x Message source x Risk visualization x Prior Attitude	4, 445	1.93	.105	.017

Issue involvement as a moderator

Research questions 5b asked how individuals' characteristic such as issue involvement (RQ5b) interacts message variables to influence outcome variables of interest including visual attention, risk perception, attitude, behavioral intention, and message credibility regarding college students' health news.

Self-reported Attention. There was no statistically significant two-way interaction effect on self-reported attention with issue involvement as a moderating factor. The two-way interaction between message type and issue involvement was not statistically significant on self-reported attention (F (4, 445) = 1.21, p = .307, η^2 = .011). The two-way interaction between message source and issue involvement was not statistically significant on self-reported attention (F (2, 445) = .56, p = .573, η^2 = .002). Lastly, the two-way interaction between risk visualization and issue involvement was not statistically significant on self-reported attention (F (2, 445) = 2.59, p = .076, η^2 = .019).

The three-way interaction among message type, visual representation of risk, and issue involvement was not statistically significant on self-reported attention (F (2, 445) = 2.16, p = .072, η^2 = .019). The three-way interaction among message source, visual representation of risk, and issue involvement was not statistically significant on self-reported attention (F (2, 445) = .43, p = .653, η^2 = .002). Lastly, the three-way interaction among message type, message source and prior attitude was not statistically significant on self-reported attention (F (4, 445) = 1.12, p = .348, η^2 = .010), either.

The four-way interaction effect among message type, message source, visual representation of risk, and issue involvement on self-reported attention was not statistically significant, (F (4, 445) = .54, p = .706, η^2 = .005).

Risk perception. The two-way interaction between message type and issue involvement on risk perception was not statistically significant (F (4, 445) = 1.19, p = .315, η^2 = .011). The two-way interaction between message source and issue involvement on risk perception was not statistically significant (F (2, 445) = .64, p = .527, η^2 = .003). Lastly, the two-way interaction between risk visualization and issue involvement on risk perception was approaching the statistical significance (F (2, 445) = 2.97, p = .053, η^2 = .013). Participants with low involvement with substance use reported a higher risk perception with an illustrated representation of risk ($M_{\text{Low Involve-Illustration}}$ = 5.83, $SD_{\text{Low Involve-Illustration}}$ = 1.38) compared to photographic representation of risk ($M_{\text{Low Involve-Photo}}$ = 5.71, $SD_{\text{Low Involve-Photo}}$ = 1.43). Participants with neutral involvement with substance use reported a higher risk perception with an illustrated representation of risk ($M_{\text{Neutral Involve-Illustration}}$ = 5.49, $SD_{\text{Neutral Involve-Illustration}}$ = 1.37) compared to photographic representation of risk ($M_{\text{Neutral Involve-Photo}}$ = 5.32, $SD_{\text{Neutral Involve-Photo}}$ = 1.46). On the other hand, participants with low involvement with substance use reported a higher risk perception with a photographic representation of risk ($M_{\text{Low Involve-Illustration}}$ = 5.50, $SD_{\text{Low Involve-Illustration}}$ = 1.39) compared to an illustrated representation of risk ($M_{\text{Low Involve-Photo}}$ = 5.36, $SD_{\text{Low Involve-Photo}}$ = 1.32). See Figure 11.

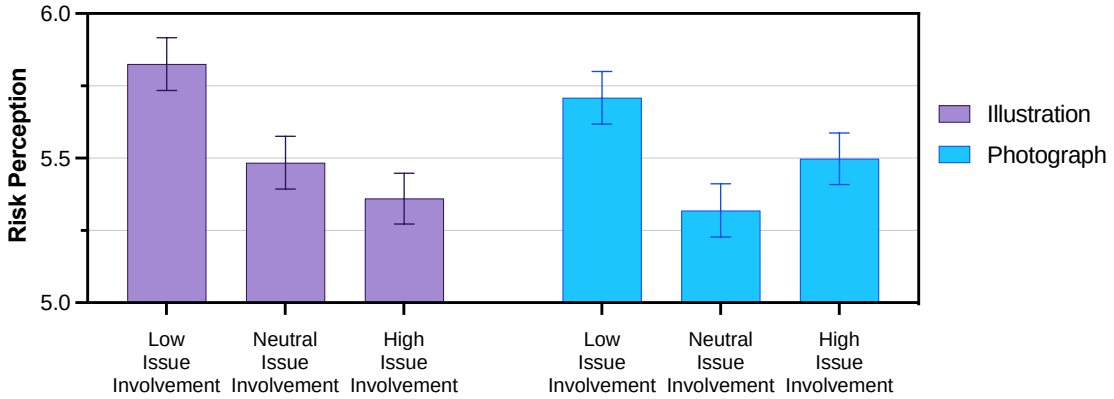


Figure 11. Two-way interaction effect between risk visualization and issue involvement on risk perception with standard error means

The three-way interaction among message type, visual representation of risk, and issue involvement on risk perception was not statistically significant (F (2, 445) = .73, p = .570, η^2 = .007). The three-way interaction among message source, visual representation of risk, and issue involvement was not statistically significant on risk perception (F (2, 445) = 1.30, p = .274, η^2 = .006). Lastly, the three-way interaction among message type, message source and issue involvement was not statistically significant on risk perception (F (4, 445) = .99, p = .411, η^2 = .009), either.

The four-way interaction effect among message type, message source, visual representation of risk, and issue involvement on risk perception was not statistically significant, F (4, 445) = .91, p = .457, η^2 = .008).

Behavioral intention. The two-way interaction between message type and issue involvement on behavioral intention was not statistically significant (F (4, 445) = .43, p = .784, η^2 = .004). The two-way interaction between message source and issue involvement on behavioral intention was not statistically significant (F (2, 445) = .49, p = .615, η^2 = .002). Lastly, the two-way interaction between risk visualization and issue involvement on behavioral intention was not statistically significant (F (2, 445) = .96, p = .386, η^2 = .004).

The three-way interaction among message type, visual representation of risk, and issue involvement on behavioral intention was not statistically significant (F (4, 445) = .87, p = .480, η^2 = .008) . The three-way interaction among message source, visual representation of risk, and issue involvement was not statistically significant on behavioral intention (F (2, 445) = 1.49, p = .226, η^2 = .007). Lastly, the three-way interaction among message type, message source and

issue involvement was not statistically significant on behavioral intention (F (4, 445) = .58, p = .678, η^2 = .005), either.

The four-way interaction effect among message type, message source, visual representation of risk, and issue involvement on behavioral intention was not statistically significant, F (4, 445) = .108, p = .980, η^2 = .001).

Message credibility. The two-way interaction between message type and issue involvement on message credibility was not statistically significant (F (4, 445) = 1.83, p = .122, η^2 = .016). The two-way interaction between message source and issue involvement on message credibility was not statistically significant (F (2, 445) = 1.68, p = .199, η^2 = .007). Lastly, the two-way interaction between risk visualization and issue involvement on message credibility was not statistically significant (F (2, 445) = .37, p = .694, η^2 = .002).

The three-way interaction among message type, visual representation of risk, and issue involvement on message credibility was not statistically significant (F (4, 445) = .83, p = .509, η^2 = .007). The three-way interaction among message type, visual representation of risk, and issue involvement was not statistically significant on message credibility (F (2, 445) = .020, p = .98, η^2 = .000). Lastly, the three-way interaction among message type, message source and issue involvement was statistically significant on message credibility (F (4, 445) = 3.18 p = .014, η^2 = .028).

Among participants who have low involvement with substance use, expert source messages were rated as more credible, regardless of the message types. Participants who read neutral message type with an expert source ($M_{\text{Low Involve-Neutral-Expert}}$ = 6.05, $SD_{\text{Low Involve-Expert}}$ = 1.17) reported the higher message credibility, compared to the news with a peer source ($M_{\text{Low Involve-Neutral-Peer}}$ = 5.74, $SD_{\text{Low Involve-Neutral-Peer}}$ = 1.42). Among those who have low

involvement and read inoculation message type, higher message credibility was rated for the message condition with an expert ($M_{\text{Low Involve-Inoculation-Expert}}$ = 5.50, $SD_{\text{Low Involve-Inoculation-Expert}}$ = 1.37), compared to a peer source ($M_{\text{Low Involve-Inoculation-Peer}}$ = 5.42, $SD_{\text{Low Involve-Inoculation-Peer}}$ = 1.34). Among those who have low involvement and read supportive message type, higher message credibility was rated for the message condition with an expert ($M_{\text{Low Involve-Supportive- Expert}}$ = 5.38, $SD_{\text{Low Involve-Supportive- Expert}}$ = 1.62), compared to a peer source ($M_{\text{Low Involve-Supportive- Peer}}$ = 5.31, $SD_{\text{Low Involve-Supportive- Peer}}$ = 1.50).

Among those who have neutral involvement with substance use, participants who read supportive message type with an expert source ($M_{\text{Neutral Involve-Supportive-Expert}}$ = 5.61, $SD_{\text{Neutral Involve- Supportive -Expert}}$ = 1.17) reported the higher message credibility, compared to the news with a peer ($M_{\text{Neutral Involve- Supportive -Peer}}$ = 5.57, $SD_{\text{Neutral Involve- Supportive -Peer}}$ = 1.42). The participants who have neutral involvement and read inoculation message type rated higher message credibility for the message condition with an expert ($M_{\text{Neutral Involve-Inoculation-Expert}}$ = 5.47, $SD_{\text{Neutral Involve-Inoculation- Expert}}$ = 1.17), compared to a peer ($M_{\text{Neutral Involve-Inoculation-Peer}}$ = 5.36, $SD_{\text{Neutral Involve-Inoculation- Peer}}$ = 1.20). The participants who have neutral involvement and read neutral message type reported the same level of message credibility for an expert source message ($M_{\text{Neutral Involve-Neutral- Expert}}$ = 5.46, $SD_{\text{Neutral Involve- Neutral - Expert}}$ =1.15) and a peer source message ($M_{\text{Neutral Involve- Neutral - Peer}}$ = 5.46, $SD_{\text{Neutral Involve- Neutral - Peer}}$ = 1.07).

Lastly, among those who have high involvement with substance use, participants who read inoculation message type with an expert ($M_{\text{High Involve-Inoculation-Expert}}$ = 5.90, $SD_{\text{High Involve-Inoculation -Expert}}$ = .91) reported message credibility compared to the news with a peer (M_{High}

Involve- Inoculation -Peer = 5.31, *SD* High Involve- Inoculation -Peer = 1.39). The participants who have high involvement and read supportive message type reported a greater message credibility for the message condition with an expert (*M* High Involve-Supportive-Expert = 5.74, *SD* High Involve-Supportive-Expert = 1.23), compared to a peer source (*M* High Involve-Supportive-Peer = 5.45, *SD* High Involve-Supportive- Peer = 1.37). The participants who have high involvement and read neutral message type reported a greater message credibility for the message condition with a peer (*M* High Involve-Neutral-Peer = 5.66, *SD* High Involve- Neutral - Peer =1.42) compared to an expert source (*M* High Involve- Neutral-Expert = 5.55, *SD* High Involve- Neutral- Expert = 1.19). See figure 12.

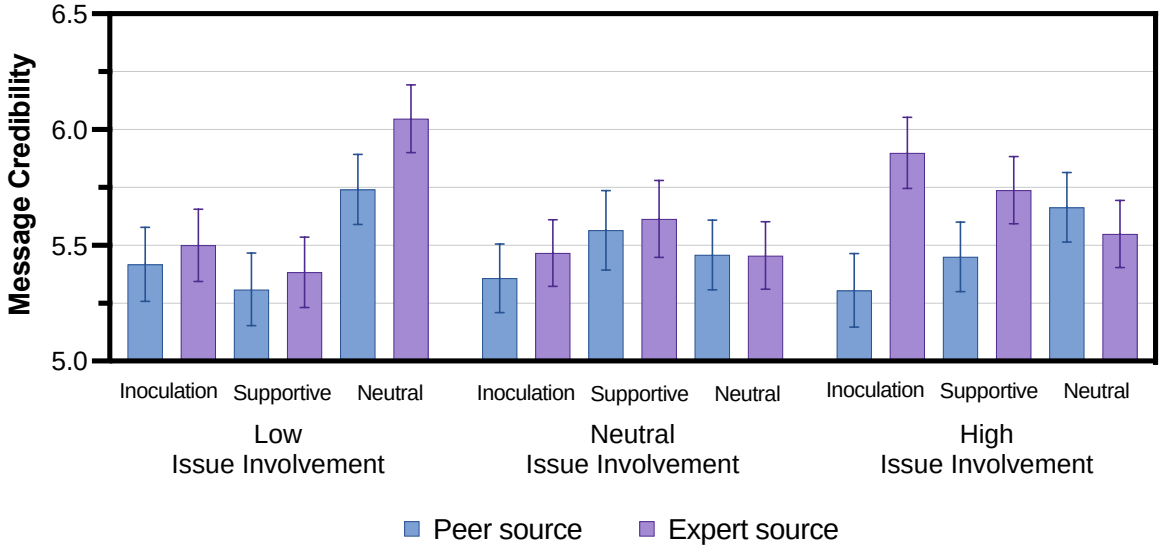


Figure 12. Three-way interaction effect among message type, message source, and issue involvement on message credibility with standard error means

The four-way interaction effect among message type, message source, visual representation of risk, and issue involvement on message credibility was not statistically significant, F (4, 445) = .31, p = .874, η^2 = .003).

Table 3. Summary of main effects and interaction effects of 3 (message type) x 2 (message source) x 2 (visual representation) x 3 (issue involvement of substance use)

DV	IV	Df	F	*p*	η^2
Self-report Attention	Message type	2, 445	.32	.727	.001
	Message source	1, 445	.004	.948	.000
	Risk visualization	1, 445	60.07	<.001	.119
	Issue involvement	2, 445	21.21	.307	.011
	Message type x Message source	2, 445	.42	.659	.002
	Message type x Risk visualization	2, 445	1.16	.315	.005
	Message type x Issue involvement	4, 445	1.21	.307	.011
	Message source x Risk visualization	1, 445	6.37	.012	.014
	Message source x Issue involvement	2, 445	.56	.573	.002
	Risk visualization x Issue involvement	2, 445	2.59	.076	.011
	Message type x Risk visualization x Issue involvement	4, 445	2.16	.072	.019
	Message source x Risk visualization x Issue involvement	2, 445	.43	.653	.002
	Message type x Message source x Issue involvement	4, 445	1.12	.348	.010
	Message type x Message source x Risk visualization	2, 445	3.95	.020	.017
	Message type x message source x Risk visualization x Issue involvement	4, 445	.54	.706	.005
Risk Perception	Message type	2, 445	2.18	.115	.010
	Message source	1, 445	.45	.502	.001
	Risk visualization	1, 445	.74	.390	.002
	Issue involvement	2, 445	1.19	.315	.011
	Message type x Message source	2, 445	.55	.576	.002
	Message type x Risk visualization	2, 445	.52	.598	.002
	Message type x Issue involvement	4, 445	1.19	.315	.011
	Message source x Risk visualization	1, 445	.28	.596	.001
	Message source x Issue involvement	2, 445	.64	.527	.003
	Risk visualization x Issue involvement	2, 445	2.97	.053	.013
	Message type x Risk visualization x Issue involvement	.732	.73	.570	.007

	Message source x Risk visualization x Issue involvement	2, 445	1.30	.274	.006
	Message type x Message source x Issue involvement	4, 445	.99	.411	.009
	Message type x Message source x Risk visualization	2, 445	.28	.757	.001
	Message type x message source x Risk visualization x Issue involvement	4, 445	.91	.457	.008
Behavioral Intention	Message type	2, 445	1.38	.254	.006
	Message source	1, 445	.57	.451	.001
	Risk visualization	1, 445	.43	.513	.001
	Issue involvement	2, 445	.43	.784	.004
	Message type x Message source	2, 445	.63	.535	.003
	Message type x Risk visualization	2, 445	.53	.591	.002
	Message type x Issue involvement	4, 445	.43	.784	.004
	Message source x Risk visualization	1, 445	.90	.343	.002
	Message source x Issue involvement	2, 445	.49	.615	.002
	Risk visualization x Issue involvement	2, 445	.96	.386	.004
	Message type x Risk visualization x Issue involvement	4, 445	.87	.480	.008
	Message source x Risk visualization x Issue involvement	2, 445	1.49	.226	.007
	Message type x Message source x Issue involvement	4, 445	.58	.678	.005
	Message type x Message source x Risk visualization	2, 445	.29	.748	.001
	Message type x message source x Risk visualization x Issue involvement	4, 445	.11	.980	.001
Message Credibility	Message type	2, 445	1.29	.276	.006
	Message source	1, 445	11.37	<.001	.025
	Risk visualization	1, 445	5.41	.021	.012
	Issue involvement	2, 445	.55	.576	.002
	Message type x Message source	2, 445	1.66	.192	.007
	Message type x Risk visualization	2, 445	.71	.491	.003
	Message type x Issue involvement	4, 445	1.83	.122	.016
	Message source x Risk visualization	1, 445	1.87	.172	.004
	Message source x Issue involvement	2, 445	1.68	.199	.007

	Risk visualization x Issue involvement	2, 445	.37	.694	.002
	Message type x Risk visualization x Issue involvement	4, 445	.83	.509	.007
	Message source x Risk visualization x Issue involvement	2, 445	.02	.98	.000
	Message type x Message source x Issue involvement	4, 445	3.18	.014	.028
	Message type x Message source x Risk visualization	2, 445	.66	.519	.003
	Message type x message source x Risk visualization x Issue involvement	4, 445	.31	.874	.003

V. Discussion

The purpose of the current study was to explore how the message type, message source, and visual representation of information about risks affected newsreaders' cognitive, attitudinal, and behavioral responses related to substance use behavior. Specifically, this study used the framework of the inoculation theory of resistance to persuasion (McGuire, 1961) to examine whether presenting research findings about substance use is effective in changing attitudes toward substance use behavior and attitudes toward attack messages (i.e., messages on social media that promote substance use behavior). Overall, the current study demonstrates that the impact of inoculation messages may not be effective in promoting attitudinal changes related to substance use among college students, yet it encourages readers to think more (in agreement with the message) about the health information that is presented in the news article. In addition, the results showed that readers evaluated the health information as more credible and reported attitudes that were less favorable toward substance use behavior when the health news was delivered by a source with high expertise, such as a medical scientist.

Interpretation of Results

The findings of this study explain how to disseminate and communicate research to guide the substance use behaviors of college students. In line with the prediction, the results of this study found that participants did report more message-relevant thoughts and were more engaged in effortful thought processes when they read the inoculation messages. The interpretation is that the inoculation message invited more participants to scrutinize the message content than a supportive or neutral message type did because the inoculation message's specific two-sided component (presenting a counterargument as well as a refutation of that counterargument) motivated readers to think that the message was a logic- or fact-based argument compared to a

one-sided message. Findings from previous research studies have supported that the logical characteristics of inoculation messages are likely to help shift the attention of message audiences from a more heuristic, surface-level of information processing to a deeper level of information processing (Cook et al., 2017).

In addition, the voluntary nature of the disclosure of the counterargument in the inoculation message could have been perceived as novel and unexpected by the audience, compared to traditional messages, and may have motivated participants to think more about the arguments while giving them the impression that the message was transparent.

Cognitive elaboration is especially important in health communication messages because higher elaboration means that the audience is making meaningful connections between previous health information that was already held in their memory and new information that they learned from the message (Tremayne & Dunwoody, 2001). Specifically, because the health topics covered in this study are the most frequently discussed substance use behaviors among college students, and because these topics are often perceived as boring and even exhausted, the results allow health communicators to compose novel promotional messages to engage the targeted population. Besides, previous research findings found that increased elaboration drives more information searching (Clear et al., 2021; Schmidt & Spreng, 1996). In future work, it may be useful to investigate whether the participants' increased cognitive elaboration also leads to an increased likelihood of the participants' relevant information seeking behaviors.

Additional analysis of the valence of the elaboration revealed that inoculation messages resulted in the participants having more favorable thoughts about the message. This finding supports the theoretical claim that audiences generally view this type of message more credibly

and hence more positively because of the perceived trustworthiness of the message, compared to a supportive message, which does not provide an alternative perspective of the discussed topic.

Conversely, the impacts an inoculation message had on participants' attitudes toward substance use behavior and their attitudes toward attack messages (i.e., persuasive messages that promote substance use behavior) have been found to be statistically insignificant. However, despite the statistically insignificant results, the findings from both outcome measures suggested that the correct patterns were drawn from the hypotheses. In fact, a priori power analysis results and the final sample size showed that the study had enough participants. Hence, there could be several reasons for these results; for example, the threat manipulation may have not been effective enough for the inoculation message types. Previous studies have mentioned that generating a traditional threat, as well as a motivational threat, is necessary for the inoculation effect. However, in this study, only motivational threat measures appeared to be successfully manipulated.

In addition, McGuire (1964) suggested that a delay is necessary between the inoculation treatment and following attitudinal attack messages. In line with McGuire's arugment, findings from previous studies (Godbold & Pfau, 2000; Zerback et al., 2021) have indicated that a time delay (e.g., 2 weeks) between the exposure to the inoculation message and the attack message was necessary to provide individuals the opportunity to generate arguments to defend their attitude (Banas & Rains, 2010), just as inoculation stimulates the body's immune system to build up defenses against a viral attack. Some scholars, on the other hand, have found that delay between inoculation treatment and attack exposure may result in inoculation treatments decay or decreased effectiveness over time (Pfau et al., 1990; Pryor & Steinfatt, 1978). Even though there is no consensus on the optimal time gap between inoculation treatment and attack, the findings

from this current study implies that the exposure to the attack message immediately after inoculation treatment may not be effective enough to have inoculation treatments to confer resistance against attack messages.

Hence, conducting multi-stage longitudinal study will be ideal to draw sufficient insights about the inoculation effect, and also the time effect needs to be considered to observe sufficient inoculation message effect. Because of the amount of time required and the cost of the subjects' research participation, this study could not be conducted as a multiple-stage longitudinal study. Future studies of inoculation theory and the dissemination of scientific research findings should be undertaken with a longer time delay to investigate the effects of inoculation messages more accurately.

Regarding the impact of inoculation messages on self-reported attention, the results were neither statistically significant nor did they present the correct pattern. Inoculation message types did not result in higher attention scores. One possible reason for this result can be the length of the inoculation message. For the manipulation, inoculation messages tend to appear longer than the other two types of messages because inoculation messages are composed of multiple message elements (forewarning, counterargument, and refutation) that are not included in supportive and neutral messages. When individuals experience cognitive overload from lengthy messages, it may lead to a reduction of their attention span (Szpak et al., 2015). Hence, even if the readers found the inoculation message interesting and paid attention in the beginning of the message to where the forewarning, counterargument, and refutation were presented, it may be possible that they did not pay attention to the end of the message, or they did not perceived themselves paying attention. Furthermore, this study utilized a self-reported assessment of the participants' attention to the message. In addition to self-reported attention measures, biometric

measures such as eye-movement tracking could be used to systemtatically investigate whether or how visual attention varies as a function of the different characteristics of the message element (e.g., counterargument, refutation, or evidence) during message processing.

Lastly, although it has been predicted that the retrieval of the message information will be greater for inoculation messages because greater elaboration will lead to improved recall of the information, the results of this study did not show any statistically significant differences in information retrieval among the different message types. Although it is difficult to explain this result, it might be related to the type of measurement that was used for this study. In this study, free recall was used as a measure of retrieval; participants were asked to list as much information as they remembered from the health messages. Even though free recall is a common task in the psychological study of memory, complementary memory tasks such as measuring recognition through multiple choice or dichotomous (true/false) questions could have been used given that free recall tests (i.e., recalling information without any cues) are more difficult and less successful than cued recall tests are (i.e., recalling information with cues) because providing retrieval cues that were encoded at the time of the message exposure can help participants retrieve more facts (Paivio et al., 1994; Tulving & Thomson, 1971). Also, information recall in this study was interested in examing the impact of inoculation messages in short-term memory recall as the memory tasks were shown at the end of the study, which is a relatively short interval between the stimuli presentation and the task. In the future study, the memory tasks can be operated after a long delay between the message exposure and the task, such as after a few days, or even weeks afterward to test the impact of inoculation messages to an individual's long-term memory.

In testing the effects of message sources on outcome variables, only message credibility appeared to be statistically significant. Contrary to the prediction, participants rated the expert source messages as more credible than peer source messages. Even though college students are more likely to perceive their peer group as their significant reference group, and they are more influenced by their peers than other age groups, disseminating and communicating research findings to college students through peer-sourced information was not effective. These results are likely to be related to the context of the information presented in the message. Because the current study focused on persuasive health communication and the dissemination of scientific research findings—including the background of the study, the procedures and detailed methods of the research studies related to substance use, and the interpretation of the results—maintaining the scientists' identity as a message source and communicating to the target population appeared to be more persuasive and effective. As long as the health information was provided in full research reports with adequate reading levels for comprehension, presenting the scientists' identity increased the richness of the health information.

Another implication of the findings can be used to dispute health misinformation on social media. Because misleading health information is spread more easily than scientific knowledge is through social media (Vosoughi et al., 2018), the roles of health professionals and researchers in combating health misinformation have received much attention from the general audience. The findings of the study show that although everyday peer-like social media voices (e.g., micro-influencers) have been found effective (Kostygina et al., 2020) in health campaigns, when dealing with scientific information, scientists should strongly maintain their identities to make messages more persuasive. In this study two different situations can be compared: when a peer spokesperson introduced a research study that he or she had found and when experts

introduced research that they had worked on. The second kind of information source should also give the social media users the opportunity to interact with the experts about the research as well as with related questions about other health topics.

The tests of message relevance and self-reported attention to the message did not result in significant differences between peer-sourced and expert-sourced messages. A possible explanation for this might be that the source effects were not more pronounced than the effects of the content of the message. Because the information was about substance use behavior and its associated risks and was derived from empirical research findings, participants perceived both messages similarly in terms of relevance—that is, participants paid attention to the messages regardless of the type of spokesperson.

This study also found that using illustrative risk visualizations, such as bar graphs that demonstrate the results of the empirical study (e.g., a bar graph that shows the different working memory tasks scores among participants who were not diagnosed with ADHD and either took Adderall or a placebo), were effective in grabbing the reader's attention. Even though information visualization does have some limitations, such as the inability to illustrate personal and societal beliefs and abstract concepts like emotions, it has been found to be effective in explaining scientific concepts, including the results of a t-test comparison from a medical experimental study, if the purpose of using the visualization is grabbing the audience's attention. However, even if it has been found useful in grabbing the attention of readers, the impact of information visualization did not lead readers to process enough information to generate a higher risk perception of substance use.

Nonetheless, as discussed above, drawing attention to important information is one of the greatest challenges in science communication. The results suggest that when communicating and

disseminating research findings about health, methods for illustrating risk information such as graphs do lead to higher attention, instead of avoiding the information because they assume that the information would be uninteresting and difficult “science” jargon.

Findings about how the interaction between the message source and visual representation of risk affects attention showed that when experts communicate their research findings, presenting an illustrative representation of risk information is more effective than a photograph that depicts the risk of substance use behavior. A possible explanation for these results might be that illustrative risk information is associated with expert sources because quantitative data visualization is a vital tool that scientists use to organize and present or publish their data effectively. The public may perceive scientists as concerning with numerical data (“numbers”) and graphs and charts. Hence, when experts communicate their research findings of health information, using base-rate, illustrative information, the congruency between the message source and information visualization type, helps grab the audience’s attention. Participants did not become distant to those quantitative data-based visualizations, but instead, they paid more attention to the message.

Lastly, there were two moderating factors, a prior attitude toward substance use behavior and having prior issue involvement with substance use behavior. Participants who had a neutral attitude toward substance use generally reported greater attention when the message was presented with illustrative information. Specifically, when an expert presented research findings using a neutral message type (i.e., a conventional research report in a press release format) with an illustration, participants in this group paid more attention. However, when participants from this group read other types of persuasive messages (i.e., inoculation and supportive messages), illustrations by a peer grabbed more attention.

Further, among those participants who had an unfavorable preexisting attitude toward substance use behavior, the differences among the four message source and information visualization conditions were not distinct. However, participants paid the most attention when an inoculation message was presented by an expert and included an illustrated visualization.

Regarding risk perceptions of substance use behavior, participants who had low preexisting attitudes toward substance use generally reported a greater risk perception compared to those with neutral or high prior attitudes. Specifically, participants in neutral and high prior attitude groups reported a greater risk perception when the information was delivered by a supportive message that only focused on the risks and harms related to the substance use behavior.

Another interesting finding is that for those who had a high (favorable) preexisting attitude toward substance use, expert source messages with illustrated visualizations led participants to report that they were less likely to use substances, compared to the neutral and low prior attitude groups. When communicating research findings to this group, having a peer as a message source was not effective, which is probably because their close peers were using the substance. Furthermore, this group showed the least likelihood of using the substance when the information was presented by the supportive message type, whereas low- and neutral-attitude groups reported the least intention to use when they read messages of the inoculation type.

When issue involvement (i.e., the degree to which participants were involved with substance use behavior) was examined as a moderator, a few interesting findings were discovered as well. Participants who were highly involved with substance use behavior reported a higher risk perception when they read the message with a photographic visualization of risk, whereas low- and neutral-issue involvement groups reported a greater risk perception of the

message with an illustrated visualization. This result may be explained by the fact that substance users are less inclined to peruse the graphs that depict the risk information because more cognitive effort is required to understand the diagrams and graphs of illustrated risk information than to understand a photograph. The low- and neutral-issue involvement groups may have had more motivation and ability to comprehend the graphs because their risk perception was increased.

In terms of the message credibility, participants with low issue involvement rated the neutral message with an expert (followed by a peer source) as the most credible information. In contrast, those with high issue involvement rated the inoculation message by an expert as the most credible information. Those who have high issue involvement with substance use behavior may have found the inoculation messages to be more credible because inoculation messages explicitly mention the other side of the promotional message (e.g., that peer pressure and social media use among college students may affect their behavior and that such a situation is difficult to handle). When experts explain contextual information and acknowledge college students' situations (e.g,. peer pressure, social media use) related to substance use behavior, the information may make the message spokesperson appear not only more worthy of their empathy but also more trustworthy because of their in-depth knowledge of in-group situations. Using an expert as a message source has consistently been found to be more credible than peer-sourced messages.

Theoretical Implications of the Study

Even though the predictions regarding the effects of inoculation messages in conferring resistance were not supported, the results suggested the expansion of research on the characteristics of the inoculation messages because there is still much to be learned about the

nuances and mechanisms of inoculation theory. This study attempted to explore the impacts of message sources and information visualization on inoculation messages because far too little attention has been paid to message sources in inoculation research, despite the importance of persuasion studies. Besides, to the best of our knowledge, this study is the first to investigate risk visualization as a part of the "refutation" message in inoculation research.

Inoculation messages were found to stimulate more message-relevant thoughts in the readers. This finding supports the argument of inoculation theory that when participants receive a forewarning of an impending persuasive message, they develop counterarguments that lead them to be less influenced by the persuasive attack that follows. Additionally, when those counterarguments are refuted, participants may generate positive thoughts about the message. Although statistically insignificant, the interaction effects between message type, message source, message credibility, topic attitude, and attitude toward the attack message show that inoculation efficacy can be enhanced as a function of the message source.

The efficacy of inoculation via peripheral message elements (i.e., message source and risk visualization) needs further investigation. For instance, which component of the resistance process affects message readers' perception of attention and elaboration? Research needs to examine the further relationships between message credibility, threat, counterargumentation, and refutation within the inoculation message. It seems that among the two credibility dimensions (expertise and similarity), perceived expertise and trustworthiness play more significant roles in the inoculation process when it comes to communicating and disseminating the research findings of health science.

Furthermore, self-reported attention to messages may be more profound when an expert and an illustration are included. Such two-sided messages may provide enough stimulation to

generate a high level of attention because they seem novel compared to the usual persuasive messages. This research showed that such an effect is more enhanced when it is presented by an expert source and an illustration, which add credibility and expertise. The use of illustrated visualizations of risk messages and expert sources together increased the level of congruency within the message and, overall, was shown to be more effective. Studies have shown that the juxtaposition of related photographs and text affects the audience's issue perception of health (e. g., Gibson & Zillmann, 2000). In addition, the use of congruent infographics with a news text appears to be effective in decreasing the audience's risk perception of technology and its impact on human health (Lee et al., 2020). The present study extends previous findings by showing that the use of illustrated visualizations of risk information is especially helpful in disseminating science research findings.

Moreover, this study confirms a limitation of past inoculation studies—namely, in inoculation research, pretests have been required to confirm that only subjects who agree with the communicator's message position are exposed to the inoculation messages (i.e., neutral and opposing attitude participants have not been extensively tested), even though mass media researchers need to know what the effects will be on all audience members (Wood, 2007). Hence, the current study examined whether the levels of prior attitude and issue involvement related to substance use would vary when the inoculation message was processed, and the results include several significant interaction effects that depend on different levels of moderators. The study supports the claim of the elaboration likelihood model (ELM) related to inoculation messages and found that message types work together with news readers' prior attitudes and issue involvement to shape the audience's information processing. For those who have a low motivation to read health messages that promote the associated risks of using substances,

cognitively demanding methods such as inoculation messages (because of their length and multiple message components) and illustrated information visualization (for its complexity) appear to be less effective.

Practical Implications of the Study and Its Findings

In a practical sense, the findings from this research also carry important implications for health and science communication professionals. The study shows that the consideration of individual difference factors contributes to the achievement of desirable communication goals by tailoring messages to the audience members' psychological backgrounds and motivations to process information. The results showed that inoculation messages do generate more message-relevant thoughts and more perceptions of the message as important and interesting. In addition, this study showed that inoculation messages may not be solely effective in changing attitudes toward substance use but may work in conjunction with other peripheral cues such as message source and risk visualization.

Research on health and science communication makes it clear that the effectiveness of any message depends heavily on the audience's trust in and perception of the credibility of its sources (Brewer & Ley, 2013; Druckman, 2001). Findings from the study showed that perceptions about competence, expertise, and empathy (e. g., experts understanding social situations in which college students may feel pressure to use substances) from the peripheral factors do add credibility to the message and grab attention. When it comes to science, scientists are the most direct and knowledgeable sources of information. They also have the knowledge and credibility to counter misinformation and misconceptions. Experts are well trained in their specialized areas, and they often communicate with other experts, but they often lack the training needed to effectively communicate science to the layperson and general public (Milkman &

Berger, 2014). Instead of "dumbing down" the scientific research and assuming that the public cannot understand the topic, the current study investigated possible message strategies that do not remove interesting information yet still reach the target audience—college students. Instead of presenting research findings in a press release style (the neutral condition here), the study found that persuasive message techniques (e.g., inoculation and support) could serve as effective health science communication strategies.

Limitations

This study has several limitations. First, it was an online study with a college student population. The quality of data derived from university subject pools in an online setting could result in decreased validity and reliability. Students may not put forth the same effort and attention for an online study as they would for a lab-based study. However, for an online study with Qualtrics, there was no mechanism to sustain the attention among participants. Paying monetary compensation instead of extra credits may enhance the quality of the data. Furthermore, even though college students were given the topical characteristics of the study, I recognize that issues remain with respect to the potential generalizability of our findings to other demographic groups.

Another limitation may be the format of the stimulus messages. Although the author of this study tried to compose realistic health news articles and attack messages on social media, the fact that a researcher composed the message and a professional editor examined the content may constitute a limitation. Future studies could hire real-life medical scientists and college students to devise the experimental stimuli for external validity. Lastly, while the most valid procedure to measure one's behavioral responses would be conducting longitudinal studies followed immediately by the measurement of the actual behavior, this procedure is seldom feasible. For

this reason, this study asked participant's behavioral intentions related to substance use behavior. Future studies with multi-stage longitudinal stage experimental design could ask for actual behavior questionnaires related to health behavior.

Appendices

Appendix A.

Complete list of stimuli messages

Supportive Messages

1a. Experiental Topic: Non-medical use of stimulants; Message source: Peer with a Photograph

SCIENCE NEWS
October 9, 2020
From the Labs: Don't be tempted by "Smart Drugs"

Author
Ian Hanley, Undergraduate Student

Hi, I'm Ian Hanley. I'm a junior at Oregon State University. ADHD is a brain disorder that makes it difficult to concentrate and increases impulsive behavior. Stimulants help to reduce these symptoms. However, some students, including my friends, use these drugs for non-medical purposes even though they are not diagnosed with ADHD.

Around three-quarters of stimulant-abusers use the drug for academic purposes—to help them stay awake and focus. However, ADHD medications do not make students smarter but instead, it might help them focus and stay awake. Every drug comes with risks, and Adderall and other ADHD drugs have more risks than many other commonly used medications.

Besides, researchers found that the drug caused gastrointestinal problems, blurred vision, increased body temperature, blood pressure, heart rate, and irritability. While these effects are minor for most young people, if a student has a heart condition, Adderall could be deadly. In rare cases, Adderall can cause hallucinations, cardiac arrests, and even death for people with a heart condition.

As an example of how stimulant drugs affect college students, I can share one research study that I've found. This study was published in the Journal of Pharmacy. The study examined the impact of the prescription stimulant, Adderall, on college students who are not diagnosed with ADHD. In the study, 13 college students without ADHD participated in two five-hour sessions. In each session, the students received either Adderall or a placebo drug to allow the researchers to see if Adderall enhanced cognitive abilities reading comprehension, memory, and attention.

After, the researchers analyzed the effects of Adderall compared to placebo. The findings showed that the standard 30 mg dose of stimulant drugs did improve one's attention and focus,

compared to a 30 mg dose of placebo. However, the effect failed to translate to better performance on tasks that measured short-term memory, reading comprehension, and fluency. In addition, participants answered that they performed worse for their general cognitive ability and ability to self-regulate in daily activities after taking 30mg dose of stimulant drugs.

The major takeaway from this study is that stimulant drugs may have small to minimal effects on enhancing one's attention skills, but not as much as to do well in tasks that require cognitive ability. It is important to note that stimulant drugs actually impaired working memory performance relative to placebo. It also led participants to rate their task performance poorly. The good news is, if you want to get a boost academically, there are a lot of reliable ways: office hours, free tutors, talking and chatting with classmates, early bedtimes, and just plain hard work. Taking stimulant drugs isn't one of them.

1b. Experiental Topic: Non-medical use of stimulants; Message source: Peer with an Illustration

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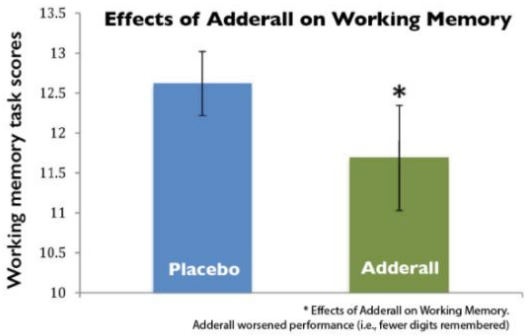

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SCIENCE NEWS

October 9, 2020

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Author

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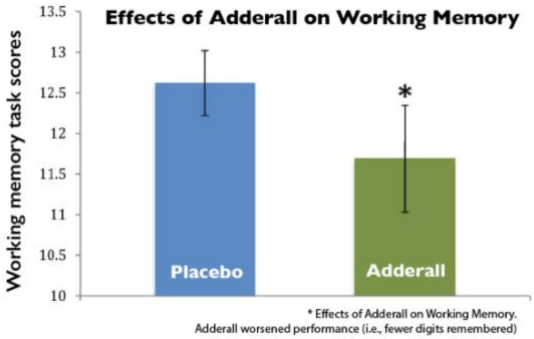

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3a. Experiental Topic: E-cig use; Message source: Peer with a Photograph

SCIENCE NEWS
October 2, 2020
From the Labs: How Safe is Vaping?

Author
Jeff Carpenter, Undergraduate Student

Hi, I'm Jeff Carpenter. I'm a junior at Illinois State University. E-cigs are devices that operate by heating a liquid solution to produce an inhaled aerosol. Using an e-cig is sometimes called "vaping." A recent U.S. survey found that more students are vaping, especially Juul-ing, than ever before on campus.

Youth and young adults are also uniquely at risk for long-term, long-lasting effects of exposing their developing brains to nicotine. These risks include nicotine addiction, mood disorders, and permanent lowering of impulse control. Nicotine also can harm parts of the brain that control attention and learning.

In addition, it affects your brain. Until about age 25, the brain is still growing. Each time a new memory is created or a new skill is learned, stronger connections – or synapses – are built between brain cells. Young people's brains build synapses faster than adult brains. Because addiction is a form of learning, adolescents can get addicted more easily than adults. The nicotine in e-cigarettes and other tobacco products can also prime the adolescent brain for addiction to other drugs such as cocaine. Lastly, it increases the risk of nicotine addiction among young people.

I have an example from an actual research study, published in "Tobacco Control." In this study, the researchers at Illinois State University assessed the impact of e-cigs on college students by systematically assess the results of previous research findings. The study found that among college students who ever used tobacco, those who said that their first tobacco product was flavored had a 13 percent higher prevalence of current tobacco use a year later. The findings add to the evidence that flavored tobacco products may attract young adult users and serve as starter products to establish tobacco use.

Additionally, among those older adults who ever used tobacco, those who said that their first tobacco product was flavored had a 32 percent higher prevalence rate of current tobacco use a year later. Because some participants in the study were asked to provide blood and urine samples, researchers can measure the exposure to harmful chemicals experienced by people (1) who only use e-cigs, (2) only use cigarettes, (3) use both products, and those (4) who have never used tobacco. The study found that exclusively e-cig users were exposed to known toxicants (such as nicotine), but at lower levels than cigarette smokers. Additionally, flavorings that are used in e-cig flavors, such as diacetyl, has been found as a chemical linked to serious lung disease.

Maybe, vaping should be viewed as a lesser of evils for current cigarette smokers. Still, it's clear that there is a lot about vaping we don't know. The aforementioned study shows vaping is

harmful to human health. Additionally, the added flavorings in e-cigs are a major reason that college students might be willing to try the e-cigs, which can quickly lead to becoming addicted to e-cigs. So what I would like to recommend you is, until we know more, think twice about vaping. Maybe we shouldn't be surprised that lung problems develop in people who vape: our lungs were meant to inhale clean air and nothing else. It took many years to recognize the damage cigarettes can cause. We could be on a similar path with vaping.

3b. Experiental Topic: E-cig use; Message source: Peer with an Illustration

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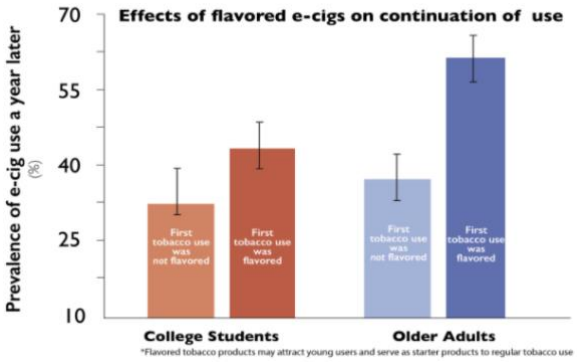

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SCIENCE NEWS
October 2, 2020
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Author
Jonathan King, M.D., Ph.D.

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No matter how it's delivered, nicotine is harmful to youth and young adults. E-cigarettes typically contain nicotine as well as other chemicals that are known to damage health. For example, users risk exposing their respiratory systems to potentially harmful chemicals in e-cigarettes.

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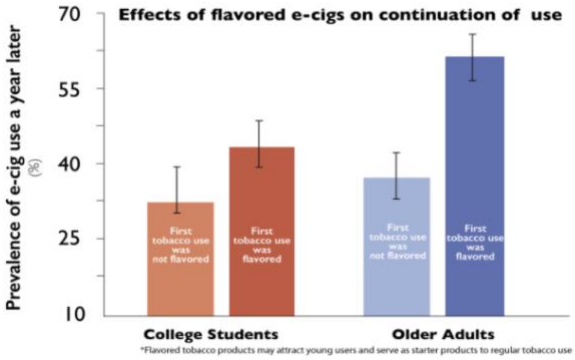

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5a. Experiental Topic: Binge drinking; Message source: Peer with a Photograph

SCIENCE NEWS

October 2, 2020

From the Labs: When Does Social Drinking Become 'Problem Drinking'?

Author

Lonnie Dockter, Undergraduate Student

Hi, I'm Lonnie Dockter. I'm a senior at Illinois State University. I've had many chances to go to parties and drink with my friends in college. I think that binge drinking, or drinking a lot of alcohol in a short amount of time, has become the social norm at college parties. Binge drinking means drinking 4 or more drinks for women and 5 or more drinks for men during a single drinking session.

College students between the ages of 18 and 24 are more likely than those who do not attend college to drink excessively. Drinking too much too often can lead to physical tolerance, alcohol dependence, addiction, and internal damage, especially to the liver. Also, excessive alcohol consumption can affect a student's academics. Drinking may even become a priority over attending classes, completing homework, and studying for exams.

For those who struggle with depression or anxiety, alcohol consumption can cause life-threatening effects. Students who face extreme mental instabilities are most at risk of attempting to commit suicide or other acts of self-harm. Alcohol can significantly alter a person's mind, which can make them act irrationally. Binge drinking may have more detrimental effects on young adults, such as college students.

I have an example from a research study that was published in "Preventive Medicine." The study investigated the impact of alcohol on young adults by systematically assessing the results of previous research findings. They analyzed research articles published from 1990 through 2003, using search terms such as "college students," "binge drinking" "cognition" and "brain." The results yielded 1,371 research studies.

This is the summary of this research: Young adults, like college students, typically have less body mass than adults and have not developed a physiological or behavioral tolerance to alcohol and its effects. Thus, a small amount of drinks can make them become intoxicated. Specifically, since young adults' hippocampus (involved in the formation of new memories and is also associated with learning and emotions) is still developing, this region of the brain may be particularly susceptible to the effects of alcohol. In one study, magnetic resonance imaging (MRI) was used to measure the hippocampal volume in 12 young adults who are identified with alcohol use disorder. The study found that both left and right hippocampal volumes were significantly smaller (approximately 10%) in those with alcohol use disorder compared to young adults who do not drink alcohol.

Overall, the study shows that contrary to the common belief of many students that binge drinking is a normal part of college that won't result in lasting harm, binge drinking can actually cause severe negative effects such as brain damage and lasting neurocognitive deficits. Of course, we all understand that drinking can be fun and may help in socialization. The most important thing to remember is to drink in moderation and to be sure not to drink too fast. If you see some critical signs of alcohol overdose such as vomiting, seizures, slow breathing, and dulled responses from your friend or yourself, call 911 or help the person immediately. Do not wait for the person to have all the symptoms.

5b. Experiental Topic: Binge drinking; Message source: Peer with an Illustration

SCIENCE NEWS

October 2, 2020

From the Labs: When Does Social Drinking Become 'Problem Drinking'?

Author

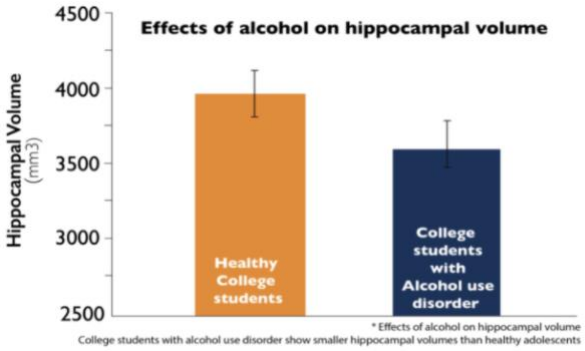
Lonnie Dockter, Undergraduate Student

Hi, I'm Lonnie Dockter. I'm a senior at Illinois State University. I've had many chances to go to parties and drink with my friends in college. I think that binge drinking, or drinking a lot of alcohol in a short amount of time, has become the social norm at college parties. Binge drinking means drinking 4 or more drinks for women and 5 or more drinks for men during a single drinking session.

College students between the ages of 18 and 24 are more likely than those who do not attend college to drink excessively. Drinking too much too often can lead to physical tolerance, alcohol dependence, addiction, and internal damage, especially to the liver. Also, excessive alcohol consumption can affect a student's academics. Drinking may even become a priority over attending classes, completing homework, and studying for exams.

For those who struggle with depression or anxiety, alcohol consumption can cause life-threatening effects. Students who face extreme mental instabilities are most at risk of attempting to commit suicide or other acts of self-harm. Alcohol can significantly alter a person's mind, which can make them act irrationally. Binge drinking may have more detrimental effects on young adults, such as college students.

I have an example from a research study that was published in “Preventive Medicine.” The study investigated the impact of alcohol on young adults by systematically assessing the results of previous research findings. They analyzed research articles published from 1990 through 2003, using search terms such as "college students," "binge drinking" "cognition" and "brain." The results yielded 1,371 research studies.



This is the summary of this research: Young adults, like college students, typically have less body mass than adults and have not developed a physiological or behavioral tolerance to alcohol and its effects. Thus, a small amount of drinks can make them become intoxicated. Specifically, since young adults' hippocampus (involved in the formation of new memories and is also associated with learning and emotions) is still developing, this region of the brain may be particularly susceptible to the effects of alcohol. In one study, magnetic resonance imaging (MRI) was used to measure the hippocampal volume in 12 young adults who are identified with alcohol use disorder. The study found that both left and right hippocampal volumes were significantly smaller (approximately 10%) in those with alcohol use disorder compared to young adults who do not drink alcohol.

Overall, the study shows that contrary to the common belief of many students that binge drinking is a normal part of college that won't result in lasting harm, binge drinking can actually cause severe negative effects such as brain damage and lasting neurocognitive deficits. Of course, we all understand that drinking can be fun and may help in socialization. The most important thing to remember is to drink in moderation and to be sure not to drink too fast. If you see some critical signs of alcohol overdose such as vomiting, seizures, slow breathing, and dulled responses from your friend or yourself, call 911 or help the person immediately. Do not wait for the person to have all the symptoms.

6a. Experiental Topic: Binge drinking; Message source: Expert with a Photograph

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Author

Derek Brennan, M.D., Ph.D.

Hi, I'm Dr. Derek Brennan. I am the director of the Alcohol & Drug Prevention Lab at Michigan State University. My research team examines how excessive drinking of alcohol, or binge drinking, would impact college students’ health. Binge drinking refers to drink 4 or more drinks for women and 5 or more drinks for men during a single drinking session.

College students between the ages of 18 and 24 are more likely than their non-college peers to

drink excessively. Drinking too much too often can lead to physical tolerance, alcohol dependence, addiction, and internal damage, especially to the liver. Also, excessive alcohol consumption can affect a student's academics. Drinking may even become a priority over attending classes, completing homework, and studying for exams. Further, for those who struggle with depression or anxiety, alcohol consumption can cause life-threatening effects.

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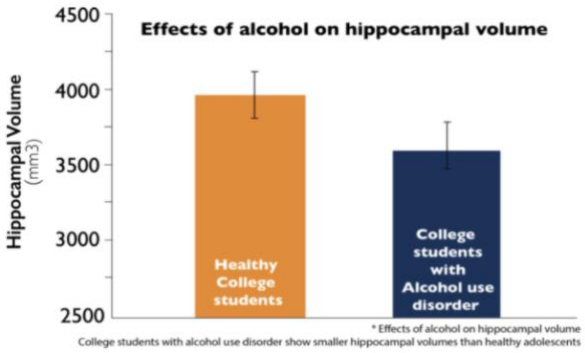

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7a. Experiental Topic: Non-medical use of Cannabis; Message source: Peer with a Photograph

SCIENCE NEWS
October 29, 2020
From the Labs: Is Cannabis As Safe As We Think?

Author
Chris Hartel, Undergraduate Student

Hi, I'm Chris Hartel. I'm a senior at Penn State University. Cannabis, which also be called weed or cannabis, is the dried flowers and leaves of the cannabis plant that contains mind-altering (e.g., psychoactive) compounds. As of 2020, the rate of cannabis use among college students is the highest in the last 35 years.

Cannabis has both short-and long-term effects on one's health. Cannabis smoke irritates the lungs, and people who smoke cannabis frequently can have the same breathing problems as those who smoke tobacco. These problems include daily cough, more frequent lung illness, and a higher risk of lung infections.

In addition, cannabis raises the heart rate for up to 3 hours after smoking. This effect may increase the chance of a heart attack. Also, regular, long-term cannabis use can lead to some people to develop Cannabinoid Hyperemesis Syndrome. This causes users to experience regular cycles of severe nausea, vomiting, and dehydration, sometimes requiring emergency medical attention.

I have an example from a research study that was published in “Proceedings of the National Academy of Sciences of the United States of America.” The study examined the impact of cannabis on one's cognitive ability, specifically on one's memory.

To test this effect, researchers recruited 64 college students. Some people were given cannabis and others were given a placebo. After, all underwent a variety of memory tests, including standardized and reliable word tests, all the way to relaying information after undergoing scenarios in virtual reality, including as an eyewitness and the perpetrator of a crime. A week later, misinformation was introduced through a combination of suggestive questions in a follow-up interview and a virtual co-witness. The results showed that participants who were given cannabis without knowing were more likely to experience "enhanced false-memory effects." In other words, those who took cannabis recalled more memories of nonexperience events and details, compared to those who took a placebo.

Altogether, the study shows that contrary to the belief by some of us that cannabis does not have much negative impact on one's health, there are actually are real negative effects of cannabis use, especially related to one's memory. Researchers said that it is because of how cannabis interacts with the hippocampus — a part of the brain associated with memory. Memory is critical to academic success. Our memory helps us learn, and do well on exams, but it also helps us develop our ideas, join in academic discussions, interview for jobs, and much more. So, what I suggest

you to is let's think one more time: we put a lot of effort into your academic success, and what we do in your leisure time may harm your academic efforts in the long run.

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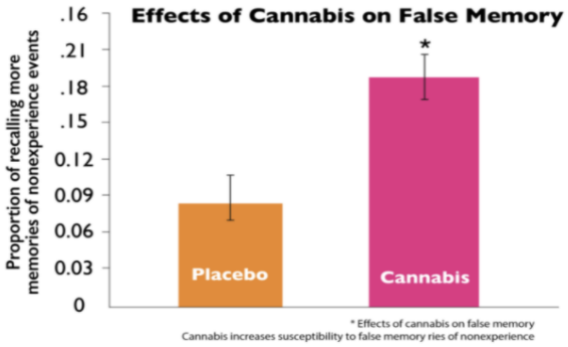

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SCIENCE NEWS

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Altogether, our study found that cannabis may impact on one's memory. We concluded that it is because of how cannabis interacts with the hippocampus — a part of the brain associated with memory—that cannabis has an impact on individuals to become more susceptible to false memories. Memory is critical to academic success. Your memory helps you learn, and do well on exams, but it also helps you develop your own ideas, join in academic discussions, interview for jobs, and much more. So, what I suggest you to is think one more time: you put a lot of effort into your academic success, and what you do in your leisure time may harm your academic efforts in the long run.

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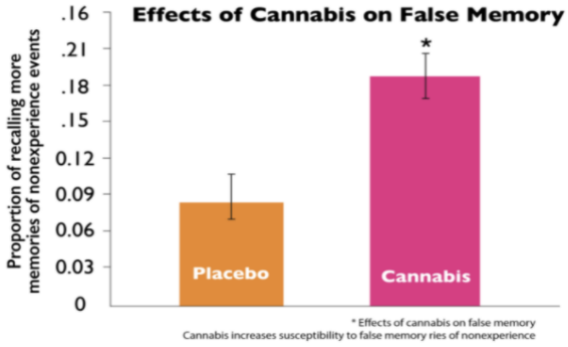

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Inoculation Messages

1a. Experiental Topic: Non-medical use of stimulants; Message source: Peer with a Photograph

SCIENCE NEWS

October 2, 2020

From the Labs: Don't be tempted by "Smart Drugs"

Author

Devan Brown, Undergraduate student

Hi, I'm Devan Brown. I'm a senior at Penn State University. ADHD is a brain disorder that makes it difficult to concentrate and increases impulsive behavior. Stimulants help to reduce these symptoms. However, some students, including my friends, use these drugs for non-medical purposes to enhance their cognitive abilities even though they are not diagnosed with ADHD.

The most common side effect of stimulants is insomnia. The drug also causes gastrointestinal problems, blurred vision, increased body temperature and irritability. However, you may already know or have seen some of your friends who have used these stimulants. My friends, too, have even encouraged me to use them because they said they would be helpful and that using them is pretty safe. I thought that using them for non-medical reasons could be dangerous. But seeing my friends and others like influencers on social media (like Instagram, Tiktok, and Facebook) using stimulant drugs made me think that maybe, it is okay to try them even if I'm not diagnosed with ADHD.

For example, if you search on TikTok with the hashtag #adderall, you can see a lot of videos from students our age using Adderall and tell their followers how much it's been helpful for them. Some claims are obviously misleading, but I think seeing those type of posts consistently could possibly change my mind in the future.
So I did some research on this topic. It turns out that most students never use stimulant drugs such as Adderall unless they have ADHD. The majority of students feel they'd be sacrificing their academic integrity by taking illegal substances to try to get a leg up. They also know that these drugs can be addictive and risky when abused. Also, different from what my friends told me, several research studies have shown that stimulant drug does not make students smarter.

As an example of how stimulant drugs affect college students, I can share one research study that I've found. This study was published in the Journal of Pharmacy. The study examined the impact of the prescription stimulant, Adderall, on college students who are not diagnosed with ADHD. In the study, 13 college students without ADHD participated in two five-hour sessions. In each session, the students received either Adderall or a placebo drug to allow the researchers to see if Adderall enhanced cognitive abilities reading comprehension, memory, and attention.

After, the researchers analyzed the effects of Adderall compared to placebo. The findings showed that the standard 30 mg dose of stimulant drugs did improve one's attention and focus, compared to a 30 mg dose of placebo. However, the effect failed to translate to better performance on tasks that measured short-term memory, reading comprehension, and fluency. In addition, participants answered that they performed worse for their general cognitive ability and ability to self-regulate in daily activities after taking 30mg dose of stimulant drugs.

The major takeaway from this study is that stimulant drugs may have small to minimal effects on enhancing one's attention skills, but not as much as to do well in tasks that require cognitive ability. It is important to note that stimulant drugs actually impaired working memory performance relative to placebo. It also led participants to rate their task performance poorly. The good news is, if you want to get a boost academically, there are a lot of reliable ways: office hours, free tutors, talking and chatting with classmates, early bedtimes, and just plain hard work. Taking stimulant drugs isn't one of them.

1b. Experiental Topic: Non-medical use of stimulants; Message source: Peer with an Illustration

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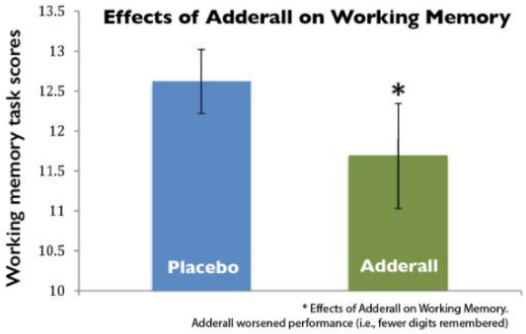

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2a. Experiental Topic: Non-medical use of stimulants; Message source: Expert with a Photograph

SCIENCE NEWS
October 12, 2020
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Stephen Newman, M.D., Ph.D.

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The most common side effect of stimulants is insomnia. The drug also causes gastrointestinal problems, blurred vision, increased body temperature and irritability. In rare cases, Adderall can cause hallucinations, cardiac arrests, and even death for people with a heart condition. Nonetheless, we understand that peer pressure plays a massive role in the abuse of stimulant drugs. Even if students do not think of themselves as "drug users," seeing others utilize these substances may normalize their use and overestimate the safety of stimulant use.

Suppose students see their friends' social media messages promoting the use. College students are uniquely vulnerable to the effects of what they see on social media, as this age group is highly susceptible to peer influences and pressure. For example, if you search on TikTok with the hashtag #adderall, you can see a lot of videos from those who use Adderall and share non-medical testimonials how much it's been helpful for them. In that case, students will be more likely to misuse stimulants.

In reality, most students never use stimulants unless they have ADHD. The majority of students feel they'd be sacrificing their academic integrity by taking stimulants just to try to get good grades. They also know that these drugs can be risky when abused. Further, contrary to students' expectations, several studies have shown taking the stimulant drug does not make students smarter or make studying any easier.

As an example of how stimulant drugs affect college students, I can share one of my research studies. This study was published in the Journal of Pharmacy. The study examined the impact of the prescription stimulant, Adderall, on college students who are not diagnosed with ADHD. In the study, 13 college students without ADHD participated in two five-hour sessions. In each session, the students received either Adderall or a placebo drug to allow the researchers to see if Adderall enhanced cognitive abilities reading comprehension, memory, and attention.

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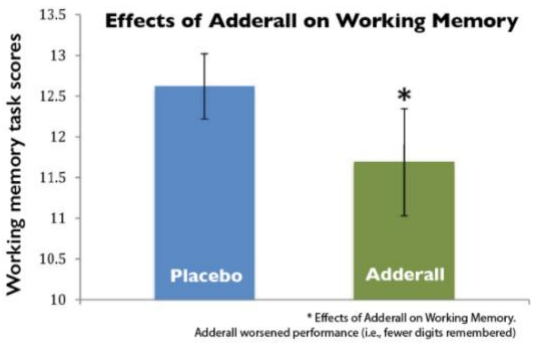

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The major takeaway from this study is that stimulant drugs may have small to minimal effects on enhancing one's attention skills, but not as much as to do well in tasks that require cognitive ability. It is important to note that stimulant drugs impaired working memory performance relative to placebo. It also led participants to rate their task performance poorly. The good news is, if you want to get a boost academically, there are a lot of reliable ways: office hours, free tutors, talking and chatting with classmates, early bedtimes, and just plain hard work. Taking stimulant drugs isn't one of them.

3a. Experiental Topic: E-cig use; Message source: Peer with a Photograph

SCIENCE NEWS

October 9, 2020

From the Labs: How Safe is Vaping?

Author

Sam Otero, Undergraduate Student

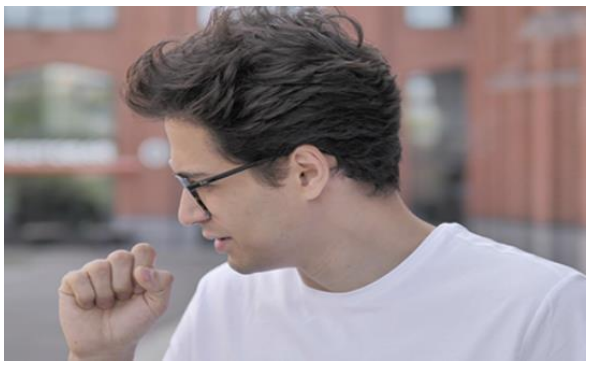
Hi, I'm Sam Otero. I am a junior at Washington State University. E-cigs are devices that operate by heating a liquid solution to produce an inhaled aerosol. And using an e-cig is sometimes called "vaping." A recent U.S. survey found that more students are vaping, especially Juul-ing, than ever before on campus.

No matter how it's delivered, nicotine is harmful to youth and young adults like us. You might get addicted to nicotine and get mood disorders. But I hear my friends and media tell me that e-cigarettes effectively reduce the health-related harms of tobacco smoking. Listening to such arguments makes me think that vaping is not as serious as I thought before, and maybe it's okay to try. If I see my close friends using e-cigs on social media, I am tempted to try those e-cigs with them. Specifically, seeing someone famous using e-cigs on social media may affect my decisions as well, although I think some of the claims are misleading. You can find related e-cigs information easily on social media (such as Instagram, TikTok) with hashtags #vaping or #ecigs.

You can find lots of information about it, ranging from e-cigs' effects on our health to newest e-cig flavors.

Actually, even though the long-term health effects of e-cigarettes are generally unknown, health professionals say e-cigs users' respiratory systems can still experience harm from vaping. Vaping nicotine can still lead to addiction, as certain devices, such as the popular Juul e-cigarette, deliver a particularly high dose of nicotine. And given that e-cigarettes vary more than conventional cigarettes in their chemical composition, we are asking medical science to do a huge, heavy lift to pinpoint health impacts across people.

I have an example from an actual research study, published in "Tobacco Control." In this study, the researchers at Illinois State University assessed the impact of e-cigs on young adults by systematically assess the results of previous research findings. The study found that among college students who ever used tobacco, those who said that their first tobacco product was flavored had a 13 percent higher prevalence of current tobacco use a year later. The findings add to the evidence that flavored tobacco products may attract young adult users and serve as starter products to establish tobacco use.



Additionally, among those older adults who ever used tobacco, those who said that their first tobacco product was flavored had a 32 percent higher prevalence rate of current tobacco use a year later. Because some participants in the study were asked to provide blood and urine samples, researchers can measure the exposure to harmful chemicals experienced by people (1) who only use e-cigs, (2) only use cigarettes, (3) use both products, and those (4) who have never used tobacco. The study found that exclusively e-cig users were exposed to known toxicants (such as nicotine), but at lower levels than cigarette smokers. Additionally, flavorings that are used in e-cig flavors, such as diacetyl, has been found as a chemical linked to serious lung disease.

Maybe, vaping should be viewed as a lesser of evils for current cigarette smokers. Still, there is a lot about vaping we don't know. The aforementioned study shows vaping is harmful to human health. Additionally, the added flavorings in e-cigs are a major reason that college students might be willing to try the e-cigs, which can quickly lead to becoming addicted to e-cigs. So what I would like to recommend you is, until we know more, think twice about vaping. Maybe we shouldn't be surprised that lung problems develop in people who vape: our lungs were meant to inhale clean air and nothing else. It took many years to recognize the damage cigarettes can cause. We could be on a similar path with vaping.

<u>3b. Experiental Topic: E-cig use; Message source: Peer with an Illustration</u>

SCIENCE NEWS

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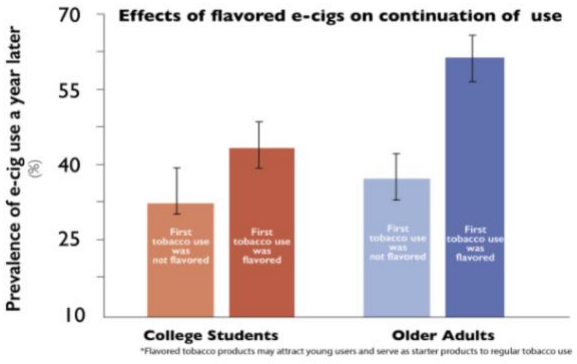

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SCIENCE NEWS
October 9, 2020
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No matter how it's delivered, nicotine is harmful to youth and young adults like us. Risks include nicotine addiction and permanent lowering of impulse control. Vaping could also lead to the 'renormalization' of smoking type behaviors.

Suppose someone tells you that smoking e-cigarettes does not cause any harm to your health. In that case, you might be more tempted to use the e-cigarettes even if you wouldn't smoke cigarettes, especially if the suggestions are from your close friends. Besides, seeing someone using e-cigs on social media may affect students' decisions, even though the information can be misleading. Social media users can find related e-cig medical advice and tips on social media (such as Instagram, TikTok) with a few hashtags such as #vaping and #ecigs. Users can find relevant information about it, ranging from e-cigs’ effects on our health to newest e-cig flavors.

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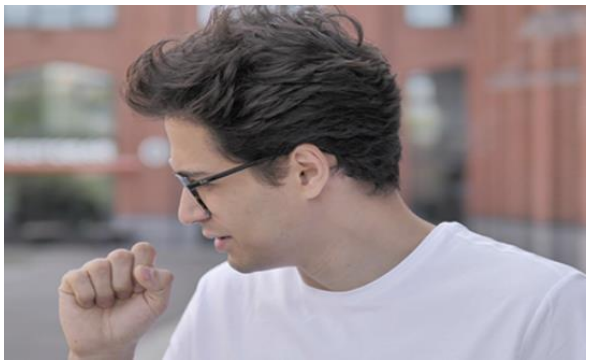

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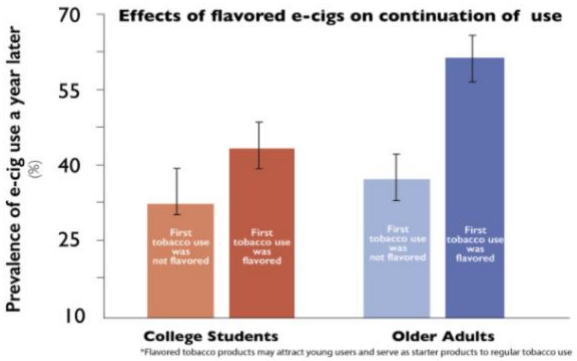

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5a. Experiental Topic: Binge drinking; Message source: Peer with a Photograph

SCIENCE NEWS
October 19, 2020
From the Labs: When Does Social Drinking Become 'Problem Drinking'?

Author
David Katz, Undergraduate student

Hi, I'm David Katz. I am a junior at Oregon State University. I've had many chances to go to parties and drink with my friends in college. I think that binge drinking, or drinking a lot of alcohol in a short amount of time, has become the social norm at college parties. Binge drinking means drink 4 or more drinks for women and 5 or more drinks for men during a single drinking session.

Binge drinking may have detrimental effects on young adults, such as alcohol dependence, and internal damage, especially to the liver. Since I have not drank much before, I try to keep certain limits. But honestly, hanging out with my friends sometimes makes it difficult for me to keep away from drinking alcohol beyond my limits. I understand that saying no to my friends won't ruin our relationship, but I just don't want to be the one that may ruin the atmosphere at the parties.

I've heard people say that getting used to it would make me get better at drinking. Especially on social media, like Instagram, some of my friends video themselves doing binge drinking challenges and tag others to complete the challenge. One time I was also tagged, and I felt some kind of pressure. Also, since we are younger than older adults, I think that the consequences of binge drinking would be simply vomiting or having a hangover.

At the same time, I sometimes hear that some of the people got alcohol poisoning from extreme binge drinking and some were even hospitalized. So I looked up some information on this, and actually, college students may be impacted by alcohol more than older adults. Binge drinking could lead to alcohol poisoning, which affects our central nervous system. If you are unlucky, you might get permanent brain damage.

This is an example from a research study that was published in “Preventive Medicine.” In this study, the researchers investigated the impact of alcohol on young adults by systematically assessing the results of previous research findings. They analyzed research articles published from 1990 through 2003, using search terms such as "college students," "youth" "binge drinking" "cognition" and "brain." The results yielded 1,371 research studies.

One of the conclusions from the study is that college students have less body mass than older adults and initially have not developed a physiological or behavioral tolerance to alcohol and its effects. They often do not need to drink very much to become intoxicated. Since young adults’ hippocampus (involved in the formation of new memories and associated with learning and emotions) is still developing, this region of the brain may be particularly susceptible to the effects of alcohol. For instance, in one study, magnetic resonance imaging (MRI) was used to measure the hippocampal volume in 12 college students who are identified with alcohol use disorder. The study found that both left and right hippocampal volumes were significantly smaller (approximately 10%) in those with alcohol use disorder compared to young adults who do not drink alcohol.

Overall, the study shows that contrary to the common belief of many students that binge drinking is a normal part of college that won't result in lasting harm, binge drinking can actually cause severe negative effects such as brain damage and lasting neurocognitive deficits. Of course, we all understand that drinking can be fun and may help in socialization. The most important thing to remember is to drink in moderation and to be sure not to drink too fast. If you see some critical signs of alcohol overdose such as vomiting, seizures, slow breathing, and dulled responses from your friend or yourself, call 911 or help the person immediately. Do not wait for the person to have all the symptoms.

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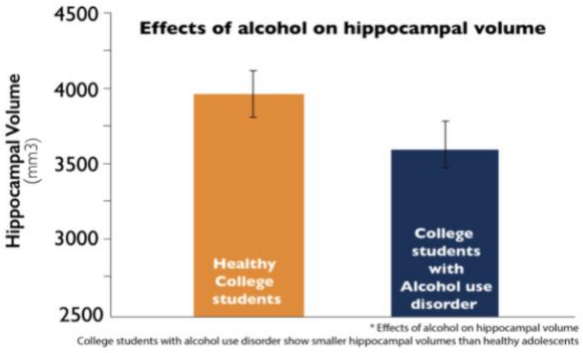

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6a. Experiental Topic: Binge drinking; Message source: Expert with a Photograph

SCIENCE NEWS

October 19, 2020

From the Labs: When Does Social Drinking Become 'Problem Drinking'?

Author

Derek Brennan, M.D., Ph.D.

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Binge drinking often can lead to physical tolerance, alcohol dependence, addiction, and internal damage, especially to the liver. We acknowledge that drinking alcohol is an essential aspect of social activities for many college students. Even if a student was disinterested in heavy drinking and has established a limit for their drinking behavior, hanging out with friends may change their alcohol consumption attitudes. The common idea that students may encounter is that "everyone binge drinks."

For instance, on Instagram, some students film themselves doing a binge drinking challenge and then posting it onto Instagram whilst also tagging their friends to complete the challenge. Students may feel pressure to drink excessively like their peers. Also, since they are younger than older adults, students may think that the consequences of binge drinking would be simply vomiting or having a hangover the day after.

Contrary to popular belief, binge drinking can lead to serious consequences. Binge drinking

would lead to alcohol poisoning, which affects our central nervous system. If you are unlucky, you might get permanent brain damage. Some students argue that because they are young compared to older adults, the effects of alcohol may not be as serious. However, in fact, binge drinking may have more detrimental effects on young adults, such as college students.

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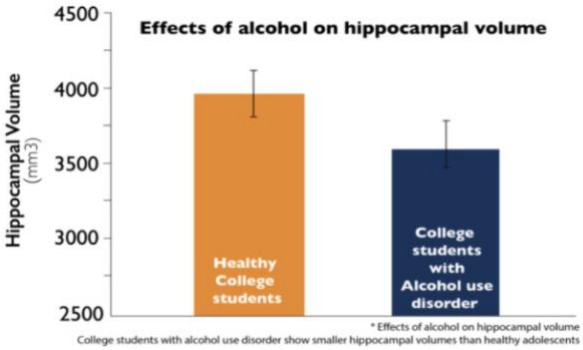

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7a. Experiental Topic: Non-medical use of cannabis; Message source: Peer with a Photograph

SCIENCE NEWS
October 30, 2020
From the Labs: Is Cannabis As Safe As We Think?

Author
James Bradford, Undergraduate Student

Hi, I'm James Bradford. I am the director of the Center for Medicinal Cannabis Research at Illinois State University. Cannabis, which also be called weed or marijuana, is the dried flowers and leaves of the cannabis plant that contains mind-altering (e.g., psychoactive) compounds. As of 2020, the rate of cannabis use for non-medical purposes is the highest in 35 years.

Cannabis has both short-and long-term effects on one's health. People who smoke cannabis can have the same breathing problems as those who smoke tobacco.Also, regular, long-term cannabis use can lead to some people to develop Cannabinoid Hyperemesis Syndrome. This causes users to experience regular cycles of severe nausea, vomiting, and dehydration, sometimes requiring emergency medical attention.

Lately, there is a lot of “medical advice” presented on social media about cannabis, and this can be easily found with a few related hashtags although some of the claims on social media on cannabis use can be misleading or inflated. We understand that if college students hear such information from their peers or others on social media, they will consider recreational cannabis use even if they previously believed it may negatively affect their health.

People say the acceptability and availability of cannabis in the United States imply its safety. Some also say that using cannabis helps ease social anxiety and increases comfort in specific

social settings. People can be more talkative. For those who have high anxiety, using cannabis may help them come down to an average functioning level instead of being aroused.

However, the legality of cannabis does not guarantee its safety. The reality is that research on the impact of cannabis on human health is still ongoing. Cannabis does not result in beneficial health effects for you necessarily unless your doctor recommends you to take it for specific medical purposes. Using cannabis at an early age, such as the age of college students, can lead to negative health consequences.

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Altogether, the study found that cannabis may impact on one's memory. The researchers concluded that it is because of how cannabis interacts with the hippocampus — a part of the brain associated with memory—that cannabis has an impact on individuals to become more susceptible to false memories. Memory is critical to academic success. Your memory helps you learn, and do well on exams, but it also helps you develop your ideas, join in academic discussions, interview for jobs, and much more. So, what I suggest you to is think one more time: you put a lot of effort into your academic success, and what you do in your leisure time may harm your academic efforts in the long run.

<u>7b. Experiental Topic: Non-medical use of cannabis; Message source: Peer with an Illustation</u>

SCIENCE NEWS
October 30, 2020
From the Labs: Is Cannabis As Safe As We Think?

Author
James Bradford, Undergraduate Student

Hi, I'm James Bradford. I am the director of the Center for Medicinal Cannabis Research at Illinois State University. Cannabis, which also be called weed or marijuana, is the dried flowers and leaves of the cannabis plant that contains mind-altering (e.g., psychoactive) compounds. As of 2020, the rate of cannabis use for non-medical purposes is the highest in 35 years.

Cannabis has both short-and long-term effects on one's health. People who smoke cannabis can have the same breathing problems as those who smoke tobacco.Also, regular, long-term cannabis use can lead to some people to develop Cannabinoid Hyperemesis Syndrome. This causes users to experience regular cycles of severe nausea, vomiting, and dehydration, sometimes requiring emergency medical attention.

Lately, there is a lot of “medical advice” presented on social media about cannabis, and this can be easily found with a few related hashtags although some of the claims on social media on cannabis use can be misleading or inflated. We understand that if college students hear such information from their peers or others on social media, they will consider recreational cannabis use even if they previously believed it may negatively affect their health.

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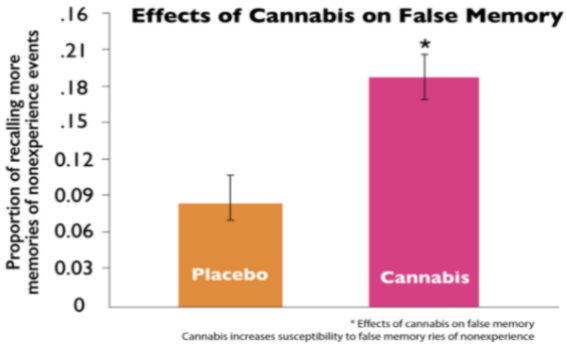

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8a. Experiental Topic: Non-medical use of cannabis; Message source: Expert with a Photograph

SCIENCE NEWS

October 30, 2020

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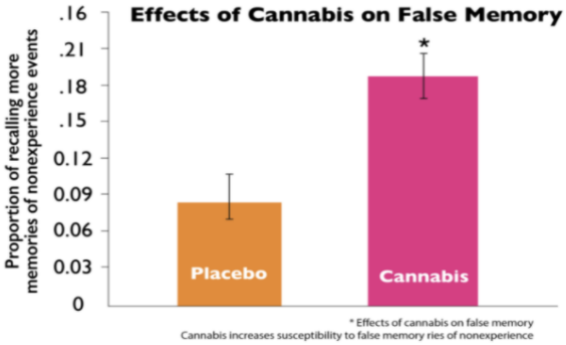

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Neutral Messages

1a. Experiental Topic: Non-medical use of stimulants; Message source: Peer with a Photograph

SCIENCE NEWS
From the Labs: Don't be tempted by "Smart Drugs"
Date: October 2, 2020
Source: Pennsylvania State University
Author: Chris Hartel, Junior student at Penn State University
Summary: A team of behavioral neuroscience researchers is providing a pilot study results on the impact of stimulant drugs to college students who were not diagnosed with ADHD. 13 college students without ADHD participated in the experiment. They found that stimulant drugs may enhance healthy college students' attention but impair cognitive abilities such as short-term memory and reading comprehension.

FULL STORY
ADHD is a brain disorder that makes it difficult to concentrate and increases impulsive behavior. Prescription stimulants, such as Adderall, help to reduce these symptoms. Many people use these drugs for non-medical purposes and without a prescription to enhance their cognitive abilities even though they are not diagnosed with ADHD. The researchers at Penn State University investigated whether using stimulant drugs would results in any risks to those who are not diagnosed with ADHD.
However, many people use these drugs for non-medical purposes and without a prescription, especially college students who buy them from a friend with a prescription. During the past few years, a large percentage of American students have misused prescription drugs to enhance their cognitive abilities, such as attention span, memory, and their capacity to stay awake, even though they are not diagnosed with ADHD.

The study examined the impact of one of the prescription stimulants, Adderall, on college students who are not diagnosed with ADHD. In their study, 13 college students who are not diagnosed with ADHD participated in two five-hour experimental sessions. In each session, the students received either Adderall or a placebo drug to examine if Adderall increased students' cognitive abilities such as reading comprehension, memory, and attention. The findings showed that the standard 30mg dose of stimulant drugs did increase one's attention and focus levels, compared to a 30mg dose of placebo. However, the effect did not lead to the performance on tasks that measured short-term memory, reading comprehension, and fluency. Lastly, participants answered that they did not perform well for their general cognitive ability and ability to self-regulate in daily activities after taking 30mg dose of stimulant drugs.

The primary finding of this study is that stimulant drugs may have small to minimal effects on enhancing one's attention skills, but the effect does not lead to a performance in tasks that require cognitive ability. It is important to note that stimulant drugs decreased working memory performance relative to placebo. Such effects appear somewhat discordant with drug

expectancies in healthy college students who use these drugs primarily for purposes of neurocognitive and academic enhancement.

1b. Experiental Topic: Non-medical use of stimulants; Message source: Peer with an Illustration

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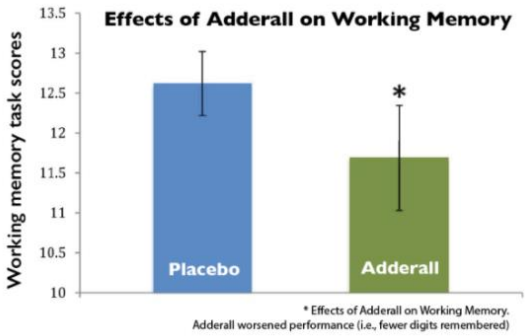

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From the Labs: Don't be tempted by "Smart Drugs"
Date: October 2, 2020
Source: Pennsylvania State University
Author: Stephen Newman, M.D., Ph.D. Director of the Neurology Lab at Penn State University
Summary: A team of behavioral neuroscience researchers is providing a pilot study results on the impact of stimulant drugs to college students who were not diagnosed with ADHD. 13 college students without ADHD participated in the experiment. They found that stimulant drugs may enhance healthy college students' attention but impair cognitive abilities such as short-term memory and reading comprehension.

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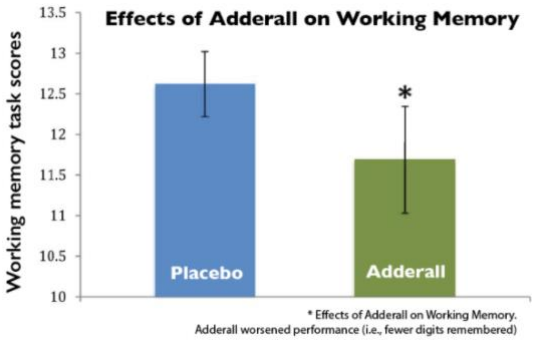

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3a. Experiental Topic: E-cig use; Message source: Peer with a Photograph

SCIENCE NEWS
From the Labs: Is Cannabis as Safe as We Think?
Date: October 20, 2020
Source: Oregon State University
Author: Lonnie Dockter, Junior student at Oregon State University
Summary: A team of researchers at the Center for the Study of Tobacco Products provides meta-analysis results on the impact of electronic cigarettes (e-cigs) on college students' health. They found that the use of e-cigs, especially flavored tobacco products, may attract college students and serve as starter products to establish tobacco addiction.

FULL STORY
E-cigarettes are devices that operate by heating a liquid solution to a high enough temperature so that it produces an aerosol that is inhaled. A recent survey found that more college students are vaping on campus. The sales of flavors (e.g., menthol, vanilla) have become popular although a number of states are banning the retail sales of such flavored tobacco products. In this study, the researchers at Oregon State University assessed the impact of e-cigs on college students by systematically assessing the results of previous research findings.

One study found that among college students who ever used tobacco, those who said that their first tobacco product was flavored had a 13 percent higher prevalence of current tobacco use a year later. The findings add to the evidence that flavored tobacco products may be related to college student users and serve as starter products to establish tobacco use. Additionally, among those older adults who ever used tobacco, those who said that their first tobacco product was flavored had a 32 percent higher prevalence rate of current tobacco use a year later. Because participants in the study were asked to provide blood and urine samples, researchers can measure the exposure to harmful chemicals experienced by people (1) who only use e-cigs, (2)

only use cigarettes, (3) use both products and those (4) who have never used tobacco. The study found that exclusively e-cig users were exposed to known toxicants (such as nicotine), but at lower levels than cigarette smokers.

The results of this study indicate that the added flavorings in e-cigs are a major reason that college students might be willing to try the e-cigs, which can quickly lead to becoming addicted to e-cigs.

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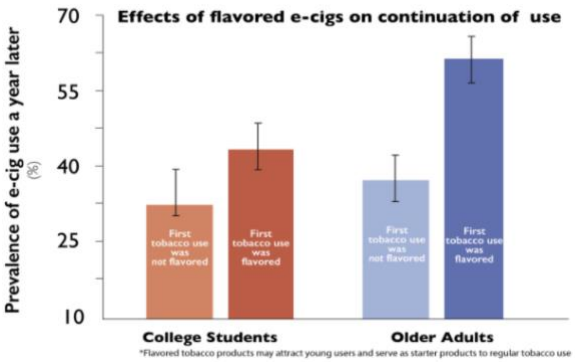

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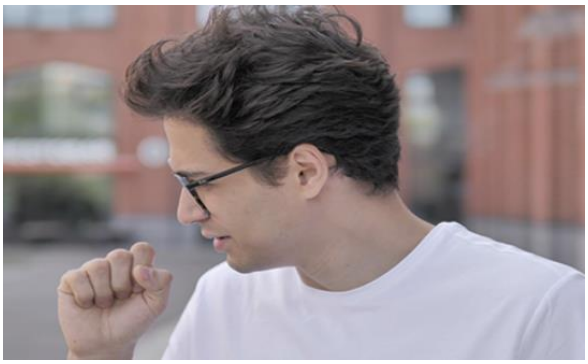

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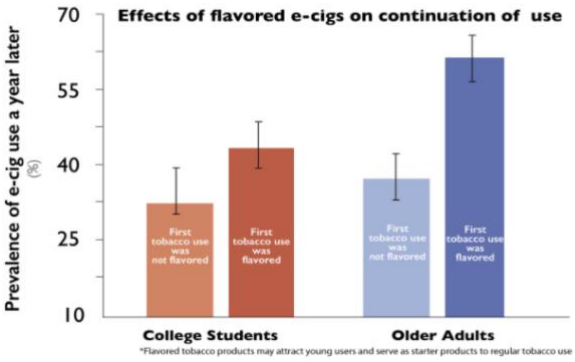

One study found that among college students who ever used tobacco, those who said that their first tobacco product was flavored had a 13 percent higher prevalence of current tobacco use a year later. The findings add to the evidence that flavored tobacco products may be related to college student users and serve as starter products to establish tobacco use. Additionally, among those older adults who ever used tobacco, those who said that their first tobacco product was flavored had a 32 percent higher prevalence rate of current tobacco use a year later. Because participants in the study were asked to provide blood and urine samples, researchers can measure the exposure to harmful chemicals experienced by people (1) who only use e-cigs, (2) only use cigarettes, (3) use both products and those (4) who have never used tobacco. The study found that exclusively e-cig users were exposed to known toxicants (such as nicotine), but at lower levels than cigarette smokers.

The results of this study indicate that the added flavorings in e-cigs are a major reason that college students might be willing to try the e-cigs, which can quickly lead to becoming addicted to e-cigs.

5a. Experiental Topic: Binge drinking; Message source: Peer with a Photograph

SCIENCE NEWS
From the Labs: When Does Social Drinking Become 'Problem Drinking'?

Date: October 12, 2020
Source: Michigan State University
Author: Ian Hanley, Senior student at Michigan State University
Summary: A team of behavioral neuroscience researchers conducted a meta-analysis on the effects of binge drinking on college students. They examined peer-reviewed scientific research articles published from 1990 to 2003. The team found that because the young adults' bodies are still in a developmental process, the effects of alcohol may be more impactful to their health compared to older adults. Specifically, binge drinking seems to affect young adult's brains and cognitive ability significantly compared to older adults.

FULL STORY
Binge drinking refers to drinking 4 or more drinking for women and 5 or more drinks for men during a single drinking session. In recent years, the rate of college students binge drink on campuses has increased. In this study, the researchers at Michigan State University investigated the impact of alcohol on college students by systematically assessing the results of previous research findings. They analyzed research articles published from 1990 through 2003, using search terms such as "college students" "binge drinking" "cognition" and "brain." The results yielded 1,371 research studies.

One of the conclusions from the study is that college students have less body mass than older adults and initially have not developed a physiological or behavioral tolerance to alcohol and its effects. They often do not need to drink very much to become intoxicated. Since young adults' hippocampus (involved in the formation of new memories and associated with learning and emotions) is still developing, this region of the brain may be particularly susceptible to the effects of alcohol. For instance, in one study, magnetic resonance imaging (MRI) was used to measure the hippocampal volume in 12 college students who are identified with alcohol use disorder. The study found that both left and right hippocampal volumes were significantly smaller (approximately 10%) in those with alcohol use disorder compared to young adults who do not drink alcohol.

Altogether, it was found that adolescent alcohol users are susceptible to neurodegeneration (progressive loss of structure or function of neurons), impairments in functional brain activity, and neurocognitive deficits. Memory also appears to be more strongly affected by alcohol use in college students than older adults.

<u>5b. Experiental Topic: Binge drinking; Message source: Peer with an Illustration</u>

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Source: Michigan State University
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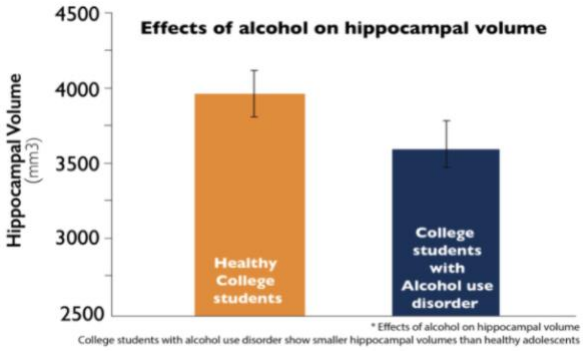

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<u>6a. Experiental Topic: Binge drinking; Message source: Expert with a Photograph</u>

SCIENCE NEWS

From the Labs: When Does Social Drinking Become 'Problem Drinking'?

Date: October 12, 2020

Source: Michigan State University

Author: Derek Brennan, M.D., Ph.D. Director of the Alcohol & Drug Prevention Lab at Michigan State University

Summary: A team of behavioral neuroscience researchers conducted a meta-analysis on the effects of binge drinking on college students. They examined peer-reviewed scientific research

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6b. Experiental Topic: Binge drinking; Message source: Expert with an Illustration

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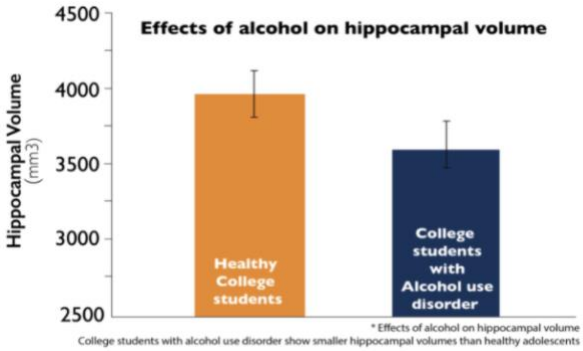

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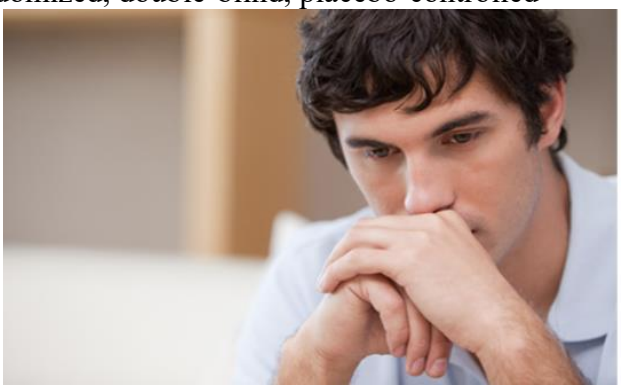
<u>7a. Experiental Topic: Non-medical use of cannabis; Message source: Peer with a Photograph</u>

SCIENCE NEWS
From the Labs: Is Cannabis as Safe as We Think?
Date: October 20, 2020
Source: Illinois State University
Author: Jeff Carpenter, Senior student at Illinois State University
Summary: A team of researchers at the Center for Medical Cannabis Research is providing research results on the impact of cannabis on college students' cognitive ability. The study found that cannabis seems to increase "false memory proneness," meaning that cannabis users may claim to remember something that was not there. Results showed that cannabis users are more prone to remember words that were not on the study task. In other words, cannabis users may also be more susceptible to "suggestion-based" false memories.

FULL STORY

In many states in the United States, people can legally use cannabis for a range of health benefits, including the treatment of chronic pain, anxiety, and nausea. The legality of cannabis does not guarantee its safety and research on the impact of cannabis on human health is still ongoing, especially for those who use cannabis for non-medical purposes. The researchers at Illinois State University examined the impact of cannabis on one's cognitive ability, specifically on one's memory with students who do not use cannabis for medical purposes.

Researchers recruited 64 college students for their randomized, double-blind, placebo-controlled trial. Some people were given cannabis and others were given a placebo. After, all underwent a variety of memory tests, including standardized and reliable word tests, relaying information after undergoing scenarios in virtual reality, including as an eyewitness of a crime. A week later, misinformation was introduced through a combination of suggestive questions in a follow-up interview and a virtual co-witness. The results showed that participants who were given cannabis without knowing were more likely to experience "enhanced false-memory effects." In other words, those who took cannabis recalled more memories of nonexperience events and details, compared to those who took a placebo.



Altogether, the study shows that cannabis may impact on one's memory. Researchers concluded that it is because of how cannabis interacts with the hippocampus — a part of the brain associated with memory—that cannabis has an impact on individuals to become more susceptible to false memories.

7b. Experiental Topic: Non-medical use of cannabis; Message source: Peer with an Illustration

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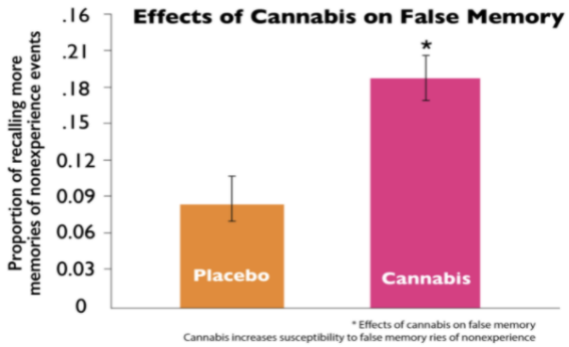

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8a. Experiental Topic: Non-medical use of cannabis; Message source: Expert with a Photograph

SCIENCE NEWS
From the Labs: Is Cannabis as Safe as We Think?
Date: October 20, 2020
Source: Illinois State University
Author: Isaac Thompson, M.D., Ph.D. Director of the Center for Medicinal Cannabis Research at Illinois State University
Summary: A team of researchers at the Center for Medical Cannabis Research is providing research results on the impact of cannabis on college students’ cognitive ability. The study found that cannabis seems to increase "false memory proneness," meaning that cannabis users may claim to remember something that was not there. Results showed that cannabis users are more prone to remember words that were not on the study task. In other words, cannabis users may also be more susceptible to "suggestion-based" false memories.

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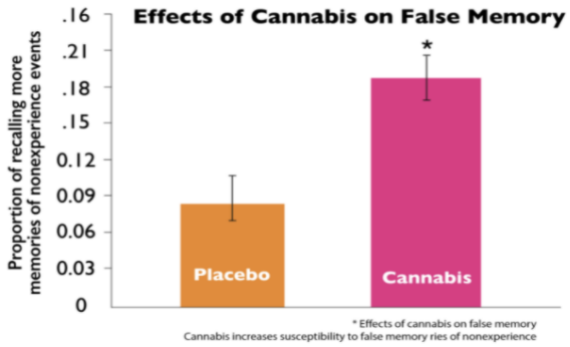

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Appendix B.
Study Instruments

Pre-existing attitude toward substance use
Please indicate your thoughts on the health behavior below by selecting the number between the pairs of descriptors below.

1. Non-medical use of Stimulant drugs (e.g., Adderall)
2. Electronic cigarette (E-cigs) use
3. Binge Drinking
4. Cannabis (also be called weed or marijuana) use

Negative	○ ○ ○ ○ ○ ○ ○	Positive
Dislikable	○ ○ ○ ○ ○ ○ ○	Likable
Bad	○ ○ ○ ○ ○ ○ ○	Good
Unfavorable	○ ○ ○ ○ ○ ○ ○	Favorable
Unacceptable	○ ○ ○ ○ ○ ○ ○	Acceptable
Undesirable	○ ○ ○ ○ ○ ○ ○	Desirable

Issue Involvement
Please indicate your thoughts on the health behavior below by selecting the number between the pairs of descriptors below.

1. Non-medical use of Stimulant drugs (e.g., Adderall)
2. Electronic cigarette (E-cigs) use
3. Binge Drinking
4. Cannabis (also be called weed or marijuana) use

Unimportant	○ ○ ○ ○ ○ ○ ○	Important
Irrelevant	○ ○ ○ ○ ○ ○ ○	Relevant
Nonessential	○ ○ ○ ○ ○ ○ ○	Essential
Of no concern	○ ○ ○ ○ ○ ○ ○	Of concern to me
Does not matter	○ ○ ○ ○ ○ ○ ○	Matters to me
Useless	○ ○ ○ ○ ○ ○ ○	Useful
Trivial	○ ○ ○ ○ ○ ○ ○	Fundamental

Message presentation

In the next page, you will view a health news article from a [science news portal vs. medical scientist vs. college student] that has to do with [*substance use behavior here*] among college students. After you read the message, you will be asked questions pertinent to the story. Please read the story very carefully.

When you are ready to proceed, please click the button below.

[message here]

[timer here]

Outcome Measures

Direction:
In the next page, you will be asked to provide your opinion regarding the health news you just read.

Elaboration
Please write down any thoughts you had after you read the message.
_____

Self-reported attention
Please indicate how much attention you paid attention to the news article you just read.

1. **How much attention did you pay** to the written message in the news article?
2. **How much did you concentrate** on the written message in the news article?
3. **How much thought did you put into evaluating** the written message in the news article?
4. **How much did you concentrate on** the visual element in the news article?
5. **How much thought did you put into evaluating** the visual element in the news article?

	1	2	3	4	5	6	7	
Not at all	○	○	○	○	○	○	○	**Very much**

Relevance
Below is a series of statements regarding **your opinion about the news article that you just read.**
Please **rate your agreement to each statement** carefully and choose one answer.

1. The news article seemed to be written personally for me.
2. The news article was very relevant to my situation.

Strongly disagree	Disagree	Somewhat disagree	Neither	Somewhat agree	Agree	Strongl agree

Post-attitude toward substance use

Please indicate your thoughts on the [*substance use here*] below by selecting the number between the pairs of descriptors below.

1. Non-medical use of Stimulant drugs (e.g., Adderall)
2. Electronic cigarette (E-cigs) use
3. Binge Drinking
4. Cannabis (also be called weed or marijuana) use

Negative	○ ○ ○ ○ ○ ○ ○	Positive
Dislikable	○ ○ ○ ○ ○ ○ ○	Likable
Bad	○ ○ ○ ○ ○ ○ ○	Good
Unfavorable	○ ○ ○ ○ ○ ○ ○	Favorable
Unacceptable	○ ○ ○ ○ ○ ○ ○	Acceptable
Undesirable	○ ○ ○ ○ ○ ○ ○	Desirable

Message Credibility

Please indicate how well the news article you just read reflects each descriptor below.

How well do the following adjectives describe the content you just read?

1. Accurate
2. Authentic
3. Believable

	1	2	3	4	5	6	7	
Very poorly	○	○	○	○	○	○	○	Very well

Risk perception

The following questions are about your perception of [_____]. Please read each question carefully and indicate your response.

Non-medical use of stimulants

1. **If I** take stimulant drugs for non-medical purposes**, it would hurt my health and safety.**
2. If I take stimulant drugs for non-medical purposes, I would develop brain activity issues.
3. If I take stimulant drugs for non-medical purposes, I would easily get insomnia and other sleep disturbances.

Electronic cigarettes:

1. If I smoke electronic cigarettes, it would hurt my health and safety.
2. If I smoke electronic cigarettes, I would develop breathing problems.
3. If I smoke electronic cigarettes, I might develop lung cancer.

Binge drinking:

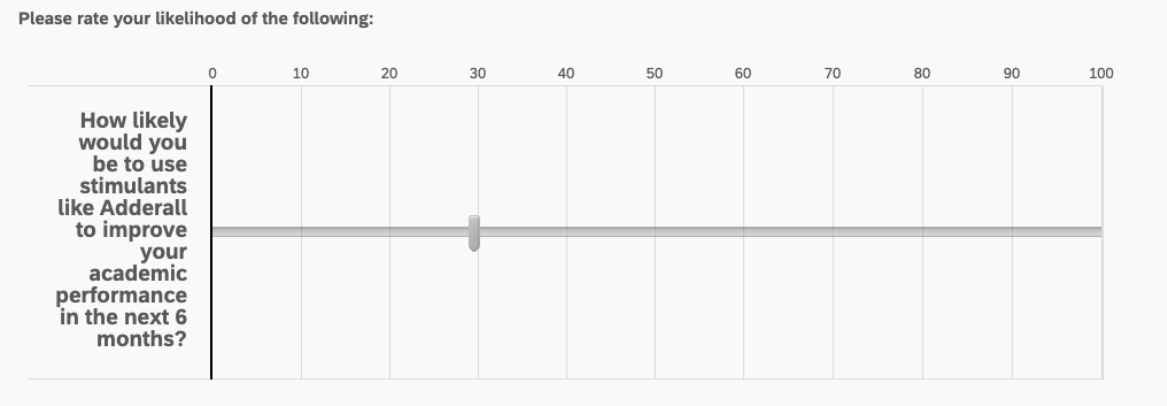
1. If I binge drink, it would hurt my health and safety.
2. If I binge drink, I would be involved in an accident.
3. If I binge drink, I might get alcohol poisoning that needs medical attention.

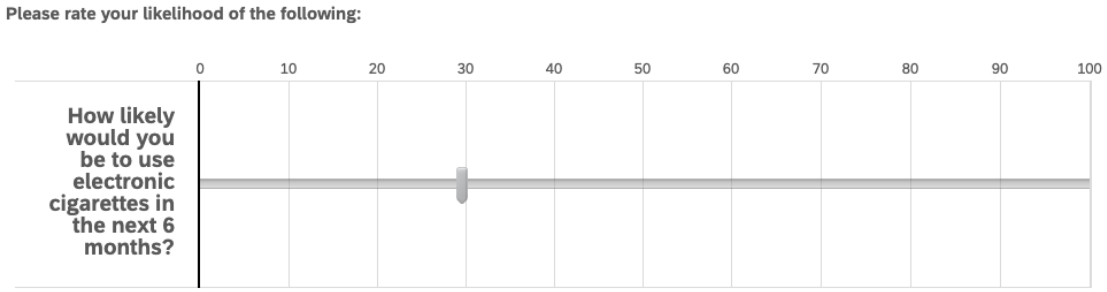
Non-medical use of cannabis

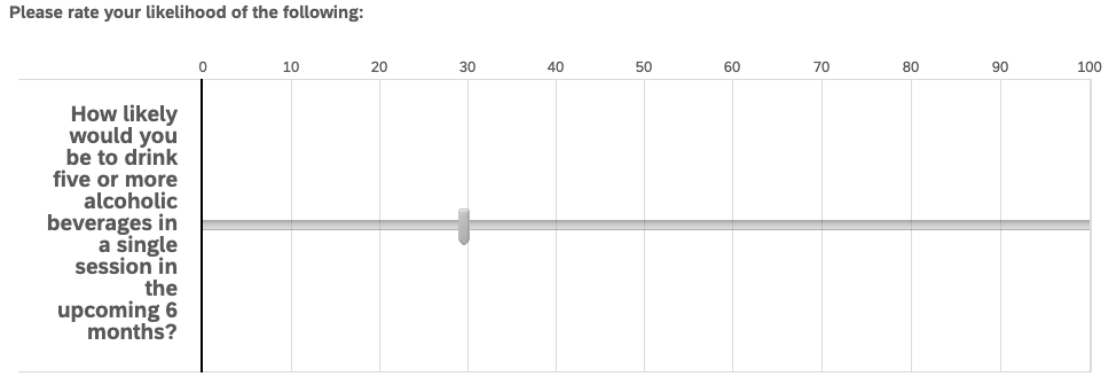
1. If I smoke cannabis for non-medical purposes, it would hurt my health and safety.
2. If I smoke cannabis for non-medical purposes, I would develop breathing problems.
3. If I smoke cannabis for non-medical purposes, I might develop lung cancer.

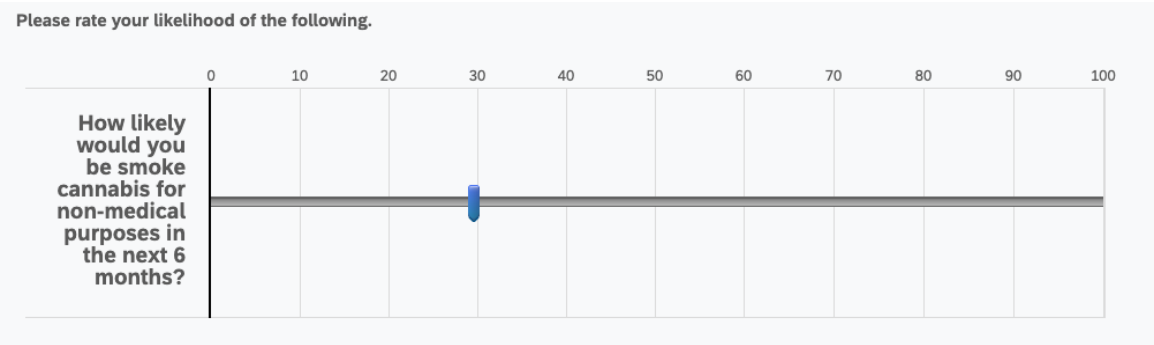
Behavioral Intention

The next question asks you how likely you will act on the advice that had been presented in the message you just read. 100 means that you are extremely likely to act on the advice. 0 means that you are extremely *un*likely to act on the advice. **Please rate your likelihood to follow the advice.**









Attack Messages

1/ Why not using smart drugs?

Hi, I'm Ashley.
I would like to share some of my recent thoughts with you on smart drugs.

You may already know or have seen some of your friends who have used these stimulants.
I've been using Adderall as a study aid since when I was a freshman. No, I am not diagnosed with ADHD, and I bought this from my friend, diagnosed with ADHD, and has prescribed Adderall. If stimulant drugs are used for ADHD, wouldn't it be useful for those who do not have ADHD?

In my opinion, using stimulants like Adderall is not all about easier learning most of the time. It's about just helping a person to study in the first place. You become much more focused on getting stuff done. That's why people take it to study because otherwise, they just wouldn't or would study less.

Also, you're basically losing out because many other students are using Adderall for study purposes. Search social media like Instagram and TikTok with hashtags #Adderall. You could find posts from students who are already using study drugs. Why would you NOT try it if it's useful and others are already using it?

Readability indices:

- Flesch Kincaid Reading Ease: 73.2
- Gunning Fog Score: 8.2
- SMOG Index: 6.9
- Coleman Liau Index: 10.1

2/ Binge drinking fun

Hi, I'm Lauren.
I want to share my experience with you on drinking.

If you are in college, you'd know that students drinking on campus is no surprise. Since I got into college, I've been to many parties (or I host ones) to hang out with my friends. Whenever we have parties and drink together, we sometimes binge drink alcohol to get drunk faster.

Even though sometimes I don't feel well, I still drink a lot to hang out with my friends and because I don't want to be "that one" to ruin the atmosphere. If someone stops drinking, they could make others feel awkward, in my opinion. Also, isn't it just fun to get tipsy or buzzed? I love that feeling.

Besides, we are young and healthy. Based on my friends' prior experience, the worst thing that can happen to us from binge drinking is just a hangover. I might feel a bit low the next day, but I will eventually be alright. I'd rather enjoy some important parts of the college experience with my friends. Search Instagram, TikTok or Twitter like the search terms #bingeDrink. You will find hundreds of fun posts from other college students like us.

Readability indices:

- Flesch Kincaid Reading Ease: 81.6
- Gunning Fog Score: 7.7
- SMOG Index: 5.8
- Coleman Liau Index: 9.5

3/ Got Cannabis?

Hi, It's Emily.
I want to share my experience with you on cannabis.

You might have heard about the news several years ago that it has become legal in many states. So that means that it is safe to use, right? Mostly, people use cannabis for their health, like chronic pain, anxiety, and nausea. In college, I see a lot of my friends use cannabis for recreational purposes instead of medical purposes. I guess it's still alright.

College-age adults, like us, are the biggest users of cannabis than any other age group. Based on my experience, I think cannabis overall can help me to adjust to college better. Some people become more talkative. Some of my friends who are anxious at parties become more relaxed and seem to enjoy the situation when they take cannabis.

Also, if we feel better and high from taking cannabis, that good mood helps us study better. It's legal in many states (which means safe), it helps you become more comfortable in social contexts, and maybe work better. Why don't you try using it sometime in the future? Find on Instagram or TikTok with hashtag #cannabis or #weed. You will find hundreds of posts from similar peers like college students using it.

Readability indices:

- Flesch Kincaid Reading Ease: 70.8
- Gunning Fog Score: 9
- SMOG Index: 7.1
- Coleman Liau Index: 10.6

4/ Try E-cigs

Hi, It's Dani.
I would like to share some of my recent thoughts with you on e-cigs.

You probably have seen others using electronic cigarettes (e-cigs) nowadays. Unlike cigarettes, vapors from e-cigs can have no smell at all, or it can smell like one of the many flavors of vape juice, like vanilla, fruits, and mint. Also, it's small and compact enough to carry in my pocket.

I've also heard that e-cigs can help people to quit smoking. Using e-cigs can prevent us from using cigarettes in the long run. The vaping from e-cigs should not be harmful to our health, either. Vaping also gives you full control over your nicotine dosage. E-cigs are available in a variety of strengths, ranging from nicotine-free to high-strength nicotine. You can choose exactly how much nicotine is in your vape.

Today you can find vapor products in your local convenience stores, gas stations, smoke shops, and of course, vape shops. The choice is yours, but trying just once wouldn't harm you as much, right? If you're still unsure, find on Instagram or TikTok with hashtag #ecigs or #juul. You will find how people like us are using e-cigs.

Readability indices:

- Flesch Kincaid Reading Ease: 76.2
- Gunning Fog Score: 8.4
- SMOG Index: 6.2
- Coleman Liau Index: 9.5

Attitude toward the attack message
Please indicate your thoughts on the message that you just read by selecting the pairs of descriptors below. The closer the number is to an adjective, the more certain you are of your evaluation.

Foolish	○	○	○	○	○	○	○	Wise
Unacceptable	○	○	○	○	○	○	○	Acceptable
Wrong	○	○	○	○	○	○	○	Right
Unfavorable	○	○	○	○	○	○	○	Favorable
Bad	○	○	○	○	○	○	○	Good
Negative	○	○	○	○	○	○	○	Positive

Retrieval
Please list anything you remember (i.e., verbal or non-verbal information) from the news articles that you've seen during this experiment.

_____

Appendix C.
Stimuli counterbalancing conditions

1. Supportive Condition

Counterbalancing

Group A
Illust — Peer — Stimluants
Illust — Doctor — Ecigs
Photo — Peer — Binge Drink
Photo — Doctor — Cannabis

Group B
Illust — Doctor — Stimluants
Illust — Peer — Ecigs
Photo — Doctor — Binge Drink
Photo — Peer — Cannabis

Group C
Photo — Peer — Stimluants
Photo — Doctor — Ecigs
Illust — Peer — Binge Drink
Illust — Doctor — Cannabis

Group D
Photo — Doctor — Stimluants
Photo — Peer — Ecigs
Illust — Doctor — Binge Drink
Illust — Peer — Cannabis

2. Inoculation Condition

Counterbalancing

Group A
Illust — Peer — Stimluants
Illust — Doctor — Ecigs
Photo — Peer — Binge Drink
Photo — Doctor — Cannabis

Group B
Illust — Doctor — Stimluants
Illust — Peer — Ecigs
Photo — Doctor — Binge Drink
Photo — Peer — Cannabis

Group C
Photo — Peer — Stimluants
Photo — Doctor — Ecigs
Illust — Peer — Binge Drink
Illust — Doctor — Cannabis

Group D
Photo — Doctor — Stimluants
Photo — Peer — Ecigs
Illust — Doctor — Binge Drink
Illust — Peer — Cannabis

3. Neutral Condition

Counterbalancing

Group A
Illust — Peer — Stimluants
Illust — Doctor — Ecigs
Photo — Peer — Binge Drink
Photo — Doctor — Cannabis

Group B
Illust — Doctor — Stimluants
Illust — Peer — Ecigs
Photo — Doctor — Binge Drink
Photo — Peer — Cannabis

Group C
Photo — Peer — Stimluants
Photo — Doctor — Ecigs
Illust — Peer — Binge Drink
Illust — Doctor — Cannabis

Group D
Photo — Doctor — Stimluants
Photo — Peer — Ecigs
Illust — Doctor — Binge Drink
Illust — Peer — Cannabis

References

Abelman, D. D. (2017). Mitigating risks of students use of study drugs through understanding motivations for use and applying harm reduction theory: A literature review. *Harm Reduction Journal*, *14*(1), 1–7. https://doi.org/10.1186/s12954-017-0194-6

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Ancker, J. S., Senathirajah, Y., Kukafka, R., & Starren, J. B. (2006). Design features of graphs in health risk communication: A systematic review. *Journal of the American Medical Informatics Association*, *13*(6), 608–618.

Anderson, J., Barnes, E., & Shackleton, E. (2011). *The Art of Medicine: Over 2,000 Years of Images and Imagination*. University of Chicago Press.

Anghelcev, G., & Sar, S. (2011). The influence of pre-existing audience mood and message relevance on the effectiveness of health psas: Differential effects by message type. *Journalism and Mass Communication Quarterly*, *88*(3), 481–501. https://doi.org/10.1177/107769901108800302

Appelman, A., & Sundar, S. S. (2016a). Measuring message credibility: Construction and validation of an exclusive scale. *Journalism and Mass Communication Quarterly*, *93*(1), 59–79. https://doi.org/10.1177/1077699015606057

Appelman, A., & Sundar, S. S. (2016b). Measuring message credibility: Construction and validation of an exclusive scale. *Journalism and Mass Communication Quarterly*, *93*(1), 59–79. https://doi.org/10.1177/1077699015606057

Apsler, R., & Sears, D. O. (1968). Warning, personal involvement, and attitude change. *Journal of Personality and Social Psychology*, *9*(2p1), 162.

Arria, A. M., & Dupont, R. L. (2010). Nonmedical prescription stimulant use among college students: Why we need to do something and what we need to do. *Journal of Addictive Diseases*, *29*(4), 417–426. https://doi.org/10.1080/10550887.2010.509273

Arria, A. M., Garnier-Dykstra, L. M., Caldeira, K. M., Vincent, K. B., Winick, E. R., & O'Grady, K. E. (2013). Drug use patterns and continuous enrollment in college: Results from a longitudinal study. *Journal of Studies on Alcohol and Drugs*, *74*(1), 71–83. https://doi.org/10.15288/jsad.2013.74.71

Austin, E. W., & Meili, H. K. (1994). Effects of interpretations of televised alcohol portrayals on children's alcohol beliefs. *Journal of Broadcasting & Electronic Media*, *38*(4), 417–435.

Avram, H. (2018). *Moving Images, Mobile Bodies: The Poetics and Practice of Corporeality in Visual and Performing Arts*. Newcastle upon Tyne, UK: Cambridge Scholars Publishing.

Banas, J. A., Rains, S. A., Banas, J. A., & Rains, S. A. (2010). *A Meta-Analysis of Research on Inoculation Theory A Meta-Analysis of Research on Inoculation Theory*. *7751*. https://doi.org/10.1080/03637751003758193

Banerjee, S. C., Greene, K., & Yanovitzky, I. (2011). Sensation seeking and dosage effect: An exploration of the role of surprise in anti-cocaine messages. *Journal of Substance Use*, *16*(1), 1–13.

Becker, S. W., Bavelas, A., & Braden, M. (1961). An index to measure contingency of English sentences. *Language and Speech, 4*(3), 139–145. doi:10.1177/002383096100400301

Behavioral health trends in the United States: results from the 2014 National Survey on Drug Use and Health. (2015). In *HHS Publication No. SMA 15-4927, NSDUH Series H-50*.

Berlo, D. K., Lemert, J. B., & Mertz, R. J. (1969). Dimensions for evaluating the acceptability of message sources. *Public Opinion Quarterly*, *33*(4), 563–576.

Berlyne, D. E. (1971). Aesthetics and psychobiology. In *Aesthetics and psychobiology.* Appleton-Century-Crofts.

Birnbaum, M. H., & Stegner, S. E. (1979). Source credibility in social judgment: Bias, expertise, and the judge's point of view. *Journal of Personality and Social Psychology*, *37*(1), 48.

Bizer, G. Y., Larsen, J. T., & Petty, R. E. (2011). Exploring the valence-framing effect: Negative framing enhances attitude strength. *Political Psychology*, *32*(1), 59–80. https://doi.org/10.1111/j.1467-9221.2010.00795.x

Bock, D. G., & Saine, T. J. (1975). The impact of source credibility, attitude valence, and task sensitization on trait errors in speech evaluation. *Communications Monographs*, *42*(3), 229–236.

Bocker, T. E. (2000). The failure of success: Challenges of disseminating effective substance abuse prevention programs. *Journal of Community Psychology*, *28*(3), 363–373.

Bohner, G., Einwiller, S., Erb, H. P., & Siebler, F. (2003). When Small Means Comfortable: Relations Between Product Attributes in Two-Sided Advertising. *Journal of Consumer Psychology*, *13*(4), 454–463. https://doi.org/10.1207/S15327663JCP1304_12

Börner, K., Bueckle, A., & Ginda, M. (2019). Data visualization literacy: Definitions, conceptual frameworks, exercises, and assessments. *Proceedings of the National Academy of Sciences of the United States of America*, *116*(6), 1857–1864. https://doi.org/10.1073/pnas.1807180116

Brosius, H.-B. (1999). Research note: The influence of exemplars on recipients' judgements: the part played by similarity between exemplar and recipient. *European Journal of Communication*, *14*(2), 213–224.

Brosius, H.-B., & Bathelt, A. (1994). The utility of exemplars in persuasive communications.

Communication Research, *21*(1), 48–78.

Brotherstone, H., Miles, A., Robb, K. A., Atkin, W., & Wardle, J. (2006). The impact of illustrations on public understanding of the aim of cancer screening. *Patient Education and Counseling*, *63*(3), 328–335.

Brown, S. A., McGue, M., Maggs, J., Schulenberg, J., Hingson, R., Swartzwelder, S., Martin, C., Chung, T., Tapert, S. F., & Sher, K. (2008). A developmental perspective on alcohol and youths 16 to 20 years of age. *Pediatrics*, *121*(Supplement 4), S290–S310.

Bruijnen, C. J. W. H., Dijkstra, B. A. G., Walvoort, S. J. W., Markus, W., VanDerNagel, J. E. L., Kessels, R. P. C., & DE Jong, C. A. J. (2019). Prevalence of cognitive impairment in patients with substance use disorder. *Drug and Alcohol Review*, *38*(4), 435–442. https://doi.org/10.1111/dar.12922

Burgoon, M., Miller, M. D., Cohen, M., & Montgomery, C. L. (1978). An empirical test of a model of resistance to persuasion. *Human Communication Research, 5*(1), 27-39. doi:10.1111/j.1468-2958.1978.tb00620.x

Cappella, J. N. (2006). Integrating message effects and behavior change theories: Organizing comments and unanswered questions. *Journal of Communication*, *56*(SUPPL.), 265–279. https://doi.org/10.1111/j.1460-2466.2006.00293.x

Carroll, A. E. (2019). Health facts aren't enough. Should persuasion become a priority. *New York Times*.

Chaiken, S. (1987). The heuristic model of persuasion. In M. P. Zanna, J. M. Olson, & C. P. Herman (Eds.), *Social influence: The Ontario symposium* (pp. 3–39). Hillsdale, NJ: Erlbaum

Chaiken, S., Liberman, A., & Eagly, A. H. (1989). Heuristic and systematic information

processing within and beyond the persuasion context.(In) JS Uleman & JA Bargh (Eds.), Unintended thought: Limits of awareness, intention, and control (pp. 212-252). *New York: Guilford*.

Chhabra, N., & Aks, S. E. (2017). Current opiate and opioid hazards in children and adolescents. *Clinical Pediatric Emergency Medicine*, *18*(3), 173–180.

Compton, Josh. (2013). Inoculation theory. *The Sage Handbook of Persuasion: Developments in Theory and Practice*, *2*, 220–237.

Compton, Josh, & Craig, E. A. (2019). Family Communication Patterns, Inoculation Theory, and Adolescent Substance-Abuse Prevention: Harnessing Post-Inoculation Talk and Family Communication Environments to Spread Positive Influence. *Journal of Family Theory and Review*, *11*(2), 277–288. https://doi.org/10.1111/jftr.12328

Compton, Josh, Jackson, B., & Dimmock, J. A. (2016). Persuading Others to Avoid Persuasion: Inoculation Theory and Resistant Health Attitudes. *Frontiers in Psychology*, *7*(February), 122. https://doi.org/10.3389/fpsyg.2016.00122

Compton, Joshua. (2009). Threat explication : What we know and don't yet know about a key component of inoculation theory. *STAM Journal*, *39*(Fall), 1–18.

Compton, Joshua, & Pfau, M. (2004). Use of inoculation to foster resistance to credit card marketing targeting college students. *Journal of Applied Communication Research*, *32*(4), 343–364.

Compton, Joshua, & Pfau, M. (2005). Inoculation Theory of Resistance to Influence at Maturity: Recent Progress In Theory Development and Application and Suggestions for Future Research. *Annals of the International Communication Association*, *29*(1), 97–146. https://doi.org/10.1080/23808985.2005.11679045

Cornelis, E., Cauberghe, V., & De Pelsmacker, P. (2013). Two-sided messages for health risk prevention: The role of argument type, refutation, and issue ambivalence. *Substance Use and Misuse*, *48*(9), 741–752. https://doi.org/10.3109/10826084.2013.787093

Cox, D. S., Cox, A. D., Sturm, L., & Zimet, G. (2010). Behavioral interventions to increase HPV vaccination acceptability among mothers of young girls. *Health Psychology, 29*(1), 29-39. doi:10.1037/a0016942

Crano, W. D., Alvaro, E. M., Tan, C. N., & Siegel, J. T. (2017). Social mediation of persuasive media in adolescent substance prevention. *Psychology of Addictive Behaviors*, *31*(4), 479.

Crowley, A. E., & Hoyer, W. D. (1994). An Integrative Framework for Understanding Two-Sided Persuasion. *Journal of Consumer Research*, *20*(4), 561. https://doi.org/10.1086/209370

de Wit, J. B. F., Das, E., & Vet, R. (2008). What Works Best: Objective Statistics or a Personal Testimonial? An Assessment of the Persuasive Effects of Different Types of Message Evidence on Risk Perception. *Health Psychology*, *27*(1), 110–115. https://doi.org/10.1037/0278-6133.27.1.110

Delp, C., & Jones, J. (1996). Communicating information to patients: the use of cartoon illustrations to improve comprehension of instructions. *Academic Emergency Medicine : Official Journal of the Society for Academic Emergency Medicine*, *3*(3), 264–270. https://doi.org/10.1111/j.1553-2712.1996.tb03431.x

Donohew, L., Palmgreen, P., & Duncan, J. (1980). An activation model of information exposure. *Communications Monographs*, *47*(4), 295–303.

Duchowski, A. T. (2007). Eye tracking methodology. *Theory and Practice*, *328*(614), 2–3.

Eisend, M. (2006). Two-sided advertising: A meta-analysis. *International Journal of Research in*

Marketing, *23*(2), 187–198. https://doi.org/10.1016/j.ijresmar.2005.11.001

Eisend, M. (2007). Understanding two-sided persuasion: An empirical assessment of theoretical approaches. *Psychology & Marketing, 24*(7), 615-640. doi:10.1002/mar.20176

Eisend, M. (2010). Understanding Two-Sided Persuasion: An Empirical Assessment of Theoretical Approaches. *Psychology & Marketing*, *30*(6), 461–469. https://doi.org/10.1002/mar

Englert, C., Koroma, D., Bertrams, A., & Martarelli, C. S. (2019). Testing the validity of the attention control video: An eye-tracking approach of the ego depletion effect. *PLoS ONE*, *14*(1), 1–12. https://doi.org/10.1371/journal.pone.0211181

Evagorou, M., Erduran, S., & Mäntylä, T. (2015). The role of visual representations in scientific practices: from conceptual understanding and knowledge generation to 'seeing' how science works. *International Journal of STEM Education*, *2*(1), 11. https://doi.org/10.1186/s40594-015-0024-x

Eveland, W. P., Cortese, J., Park, H., & Dunwoody, S. (2004). How website organization influences free recall, factual knowledge, and knowledge structure density. *Human Communication Research*, *30*(2), 208–233. https://doi.org/10.1111/j.1468-2958.2004.tb00731.x

Eyal, K., Rubin, A. M., Eyal, K., & Rubin, A. M. (2010). *Viewer Aggression and Homophily , Identification , and Parasocial Relationships With Television Characters Viewer Aggression and Homophily , With Television Characters*. *8151*(November 2014), 37–41. https://doi.org/10.1207/s15506878jobem4701

Feng, B., & MacGeorge, E. L. (2010). The influences of message and source factors on advice outcomes. *Communication Research*, *37*(4), 553–575.

https://doi.org/10.1177/0093650210368258

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behaviour: An introduction to theory and research*. Reading, MA: Addison-Wesley.

Freeman, H. E., & Scott, J. F. (1966). A critical review of alcohol education for adolescents. *Community Mental Health Journal*, *2*(3), 222–230.

Ginosar, Z., & Trope, Y. (1980). The effects of base rates and individuating information on judgments about another person. *Journal of Experimental Social Psychology*, *16*(3), 228–242.

Godbold, L. C., & Pfau, M. (2000). Conferring resistance to peer pressure among adolescents: Using inoculation theory to discourage alcohol use. *Communication Research*, *27*(4), 411–437. https://doi.org/10.1177/009365000027004001

Greenwald, A. G., & Leavitt, C. (1984). Audience involvement in advertising: Four levels. *Journal of Consumer Research*, *11*(1), 581–592.

Gregory, W. L., Cialdini, R. B., & Carpenter, K. M. (1982). Self-relevant scenarios as mediators of likelihood estimates and compliance: Does imagining make it so?. *Journal of personality and social psychology, 43*(1), 89-99. doi:10.1037/0022-3514.43.1.89

Griffin, K. W., & Botvin, G. J. (2010). Evidence-based interventions for preventing substance use disorders in adolescents. *Child and Adolescent Psychiatric Clinics of North America*, *19*(3), 505–526. https://doi.org/10.1016/j.chc.2010.03.005.Evidence-Based

Heesacker, M., Petty, R. E., & Cacioppo, J. T. (1983). Field dependence and attitude change: Source credibility can alter persuasion by affecting message-relevant thinking. *Journal of personality, 51*(4), 653-666. doi:10.1111/j.1467-6494.1983.tb00872.x

Hinyard, L. J., & Kreuter, M. W. (2007). Using narrative communication as a tool for health

behavior change: A conceptual, theoretical, and empirical overview. *Health Education and Behavior*, *34*(5), 777–792. https://doi.org/10.1177/1090198106291963

Hogg, M. A., & Smith, J. R. (2007). Attitudes in social context: A social identity perspective. *European Review of Social Psychology, 18*(1), 89–131. doi:10.1080/10463280701592070

Holmqvist, K., & Andersson, R. (2017). *Eyetracking: A comprehensive guide to methods, paradigms and measures*. *March*, 537. https://doi.org/0199697086

Hopfer, S. (2012). Effects of a narrative HPV vaccination intervention aimed at reaching college women: a randomized controlled trial. *Prevention Science, 13*(2), 173-182. doi:10.1007/s11121-011-0254-1

Houts, P. S., Doak, C. C., Doak, L. G., & Loscalzo, M. J. (2006). The role of pictures in improving health communication: a review of research on attention, comprehension, recall, and adherence. *Patient education and counseling, 61*(2), 173-190. doi:10.1016/j.pec.2005.05.004

Hovland, Carl I, & Weiss, W. (1951). The Influence of Source Credibility on Communication Effectiveness. *Public Opinion Quarterly*, *15*(4), 635–650. https://doi.org/10.1086/266350

Hovland, Carl Iver, Janis, I. L., & Kelley, H. H. (1953). *Communication and persuasion.*

Hu, Y., & Sundar, S. S. (2010). Effects of online health sources on credibility and behavioral intentions. *Communication Research*, *37*(1), 105–132. https://doi.org/10.1177/0093650209351512

Ivanov, B., Rains, S. A., Geegan, S. A., Vos, S. C., Haarstad, N. D., & Parker, K. A. (2017). Beyond Simple Inoculation: Examining the Persuasive Value of Inoculation for Audiences with Initially Neutral or Opposing Attitudes. *Western Journal of Communication*, *81*(1), 105–126. https://doi.org/10.1080/10570314.2016.1224917

Jensen, J. D. (2012). Addressing health literacy in the design of health messages. *Health Communication Message Design*, 171–174.

Just, M. A., & Carpenter, P. A. (1980). A theory of reading: From eye fixations to comprehension. *Psychological Review*, *87*(4), 329.

Kahneman, D., & Tversky, A. (1982). Variants of uncertainty. *Cognition, 11*(2), 143-157. doi:10.21236/ada099503

Kamins, M. A., & Assael, H. (1987). Two-sided versus one-sided appeals: A cognitive perspective on argumentation, source derogation, and the effect of disconfirming trial on belief change. *Journal of Marketing Research*, *24*(1), 29–39.

Kelman, H. C. (1961). Processes of Opinion Change. *Public Opinion Quarterly, 25*(1), 57-78. doi:10.1086/266996

Kessels, R. P. C. (2003). Patients' memory for medical information. *Journal of the Royal Society of Medicine*, *96*(5), 219–222.

King, A. J., Bol, N., Cummins, R. G., & John, K. K. (2019). Improving Visual Behavior Research in Communication Science: An Overview, Review, and Reporting Recommendations for Using Eye-Tracking Methods. *Communication Methods and Measures*, 1–29. https://doi.org/10.1080/19312458.2018.1558194

Küster, F., & Eisend, M. (2016). Time heals many wounds - Explaining the immediate and delayed effects of message sidedness. *International Journal of Advertising*, *35*(4), 664–681. https://doi.org/10.1080/02650487.2015.1052616

Lang, A. (2006). Using the limited capacity model of motivated mediated message processing to design effective cancer communication messages. *Journal of Communication*, *56*(SUPPL.), 57–80. https://doi.org/10.1111/j.1460-2466.2006.00283.x

Lee, S. J. (2019). The Role of Construal Level in Message Effects Research: A Review and Future Directions. *Communication Theory*, *29*(3), 231–250. https://doi.org/10.1093/ct/qty030

Lee, W., & Pfau, M. (1997). *The effectiveness of cognitive and affective inoculation appeals in conferring resistance against cognitive and affective attacks.* Paper presented at the annual conference of the International Communication Association, Jerusalem, Israel.

Ley, P. (1988). *Communicating with patients: Improving communication, satisfaction and compliance.* Croom Helm.

Linn, A. J., van Dijk, L., Smit, E. G., Jansen, J., & van Weert, J. C. M. (2013). May you never forget what is worth remembering: the relation between recall of medical information and medication adherence in patients with inflammatory bowel disease. *Journal of Crohn's and Colitis*, *7*(11), e543–e550.

Lipari, R., & Jean-Francois, B. (2016). Trends in perception of risk and availability of substance use among full-time college students. In *The CBHSQ Report*. Substance Abuse and Mental Health Services Administration (US).

Lipkus, I. M. (2007). Numeric, verbal, and visual formats of conveying health risks: suggested best practices and future recommendations. *Medical Decision Making*, *27*(5), 696–713.

Lipkus, I. M., & Hollands, J. G. (1999). The visual communication of risk. *JNCI Monographs*, *1999*(25), 149–163.

Littlefield, A. K., Gottlieb, J. C., Cohen, L. M., & Trotter, D. R. M. (2015). Electronic cigarette use among college students: Links to gender, race/ethnicity, smoking, and heavy drinking. *Journal of American College Health*, *63*(8), 523–529.

Lumsdaine, A. A., & Janis, I. L. (1953). Resistance to "Counterpropaganda" Produced by One-

Sided and Two-Sided "Propaganda" Presentations. *Public Opinion Quarterly*, *17*(3), 311. https://doi.org/10.1086/266464

MacInnis, D. J., & Jaworski, B. J. (1989). Information processing from advertisements: Toward an integrative framework. *Journal of Marketing*, *53*(4), 1–23.

McCabe, S. E., Knight, J. R., Teter, C. J., & Wechsler, H. (2005). Non-medical use of prescription stimulants among US college students: prevalence and correlates from a national survey. *Addiction*, *99*, 96–106. https://doi.org/10.1111/j.1360-0443.2004.00944.x

McClelland, D. C., Atkinson, J. W., Clark, R. A., & Lowell, E. L. (1953). *Century psychology series. The achievement motive. Appleton-Century-Crofts*.

McGuire, W. J. (1961). Resistance to persuasion conferred by active and passive prior refutation of the same and alternative counterarguments. *Journal of Abnormal and Social Psychology*, *63*(2), 326–332. https://doi.org/10.1037/h0048344

McGuire, William J. (1964). Some Contemporary Approaches. *Advances in Experimental Social Psychology*, *1*(C), 191–229. https://doi.org/10.1016/S0065-2601(08)60052-0

Mekonen, T., Fekadu, W., Mekonnen, T. C., & Workie, S. B. (2017). Substance Use as a Strong Predictor of Poor Academic Achievement among University Students. *Psychiatry Journal*, *2017*, 1–9. https://doi.org/10.1155/2017/7517450

Miller-Day, M. A., Alberts, J., Hecht, M. L., Trost, M. R., & Krizek, R. L. (2014). *Adolescent relationships and drug use*. Psychology Press.

Miller, C. H., Ivanov, B., Sims, J., Compton, J., Harrison, K. J., Parker, K. A., Parker, J. L., & Averbeck, J. M. (2013). Boosting the Potency of Resistance: Combining the Motivational Forces of Inoculation and Psychological Reactance. *Human Communication Research*, *39*(1), 127–155. https://doi.org/10.1111/j.1468-2958.2012.01438.x

Moore, D. L., Hausknecht, D., & Thamodaran, K. (1986). Time compression, response opportunity, and persuasion. *Journal of Consumer Research, 13*(1), 85-99. doi:10.1086/209049

Morgan, H. G., & Hayward, A. (1976). The effects of drug talks to school children. *British Journal of Addiction to Alcohol & Other Drugs*, *71*(3), 285–288.

Moyer-Gusé, E. (2008). Toward a theory of entertainment persuasion: Explaining the persuasive effects of entertainment-education messages. *Communication Theory*, *18*(3), 407–425. https://doi.org/10.1111/j.1468-2885.2008.00328.x

Nabi, R. L. (2003). "Feeling" Resistance: Exploring the Role of Emotionally Evocative Visuals in Inducing Inoculation. *Media Psychology*, *5*(2), 199–223. https://doi.org/10.1207/S1532785XMEP0502

Niederdeppe, J., Kuang, X., Crock, B., & Skelton, A. (2008). Media campaigns to promote smoking cessation among socioeconomically disadvantaged populations: what do we know, what do we need to learn, and what should we do now? *Social Science & Medicine*, *67*(9), 1343–1355.

O'Keefe, D. J. (2003). Message properties, mediating states, and manipulation checks: Claims, evidence, and data analysis in experimental persuasive message effects research. *Communication Theory, 13*(3), 251-274. doi:10.1111/j.1468-2885.2003.tb00292.x

O'Reilly, K., MacMillan, A., Mumuni, A. G., & Lancendorfer, K. M. (2016). Extending Our Understanding of eWOM Impact: The Role of Source Credibility and Message Relevance. *Journal of Internet Commerce*, *15*(2), 77–96. https://doi.org/10.1080/15332861.2016.1143215

Paek, H. J., Hove, T., Ju Jeong, H., & Kim, M. (2011). Peer or expert? The persuasive impact of YouTube public service announcement producers. *International Journal of Advertising, 30*(1), 161-188. doi:10.2501/ija-30-1-161-188

Paivio, A. (1991). Dual coding theory: Retrospect and current status. *Canadian Journal of Psychology/Revue Canadienne de Psychologie*, *45*(3), 255.

Paivio, A. (2007). *Mind and its evolution: A dual coding theoretical approach.*

Palmer, R. S., McMahon, T. J., Moreggi, D. I., Rounsaville, B. J., & Ball, S. A. (2012). College student drug use: Patterns, concerns, consequences, and interest in intervention. *Journal of College Student Development*, *53*(1), 1–10. https://doi.org/10.1353/csd.2012.0014.College

Papageorgis, D., & McGuire, W. J. (1961). The generality of immunity to persuasion produced by pre-exposure to weakened counterarguments. *The Journal of Abnormal and Social Psychology*, *62*(3), 475.

Parker, K. A., Ivanov, B., & Compton, J. (2012). Inoculation's efficacy with young adults' risky behaviors: Can inoculation confer cross-protection over related but untreated issues? *Health Communication*, *27*(3), 223–233. https://doi.org/10.1080/10410236.2011.575541

Peregrin, T. (2010). Picture this: visual cues enhance health education messages for people with low literacy skills. *Journal of the American Dietetic Association, 110*(5), S28-S32. doi: 10.1016/j.jada.2010.02.019

Petty, R. E., & Cacioppo, J. T. (1986). Message Elaboration versus Peripheral Cues. In *Communication and Persuasion* (pp. 141–172).

Petty, R. E., & Wegener, D. T. (1998). Matching versus mismatching attitude functions: Implications for scrutiny of persuasive messages. *Personality and Social Psychology Bulletin*, *24*(3), 227–240.

Pfau, M., Bockern, S. Van, & Rang, J. G. (1992). Use of inoculation to promote resistance to smoking initiation among adolescents. *Communication Monographs*, *59*(3), 213–230. https://doi.org/10.1080/03637759209376266

Pryor, B., & Steinfatt, T. M. (1978). The effects of initial belief level on inoculation theory and its proposed mechanisms. *Human Communication Research*, *4*(3), 217–230.

Radatz, D. L., Vandenberg, A. L., & Sample, L. L. (2015). Predictors of methamphetamine use among adolescents: Findings from a Midwestern sample. *Journal of Drug Issues*, *45*(2), 100–117.

Reinhardt, A., Weber, W., & Rossmann, C. (2018). Effects of exemplars and base-rate information on online physician rating sites. *SCM Studies in Communication and Media*, *6*(4), 420–443.

Richards, A. S., & Banas, J. A. (2015). Inoculating Against Reactance to Persuasive Health Messages. *Health Communication*, *30*(5), 451–460. https://doi.org/10.1080/10410236.2013.867005

Robalino, J. D., & Macy, M. (2018). Peer effects on adolescent smoking: Are popular teens more influential? *PloS One*, *13*(7), e0189360.

Rockafellow, B. D., & Saules, K. K. (2006). Substance use by college students: The role of intrinsic versus extrinsic motivation for athletic involvement. *Psychology of Addictive Behaviors*, *20*(3), 279–287. https://doi.org/10.1037/0893-164X.20.3.279

Roser, C. (1990). Involvement, Attention, and Perceptions of Message Relevance in the Response to Persuasive Appeals. *Communication Research*, *17*(5), 571–600. https://doi.org/10.1177/009365090017005001

Salmon, C. T., & Atkin, C. (2003). Using media campaigns for health promotion. *Handbook of*

Health Communication, 449–472.

Scheltema, E., Reay, S., & Piper, G. (2018). Visual representation of medical information: the importance of considering the end-user in the design of medical illustrations. *Journal of Visual Communication in Medicine*, *41*(1), 9–17. https://doi.org/10.1080/17453054.2018.1405724

Sessa, F. M. (2007). Peer crowds in a commuter college sample: The relation between self-reported alcohol use and perceived peer crowd norms. *Journal of Psychology: Interdisciplinary and Applied*, *141*(3), 293–306. https://doi.org/10.3200/JRLP.141.3.293-306

Sherif, M., & Hovland, C. I. (1961). *Social judgment*. New Haven, CT: Yale University Press.

Shillington, A. M., Woodruff, S. I., Clapp, J. D., Reed, M. B., & Lemus, H. (2012). Self-reported age of onset and telescoping for cigarettes, alcohol, and cannabis across eight years of the national longitudinal survey of youth. *Journal of Child & Adolescent Substance Abuse*, *21*(4), 333–348. https://doi.org/10.1080/1067828X.2012.710026

Sinha, R. (2009). Chronic stress, drug use, and vulnerability to addiction. *Annals of the New York Academy of Sciences*, *1141*, 105–130. https://doi.org/doi:10.1196/annals.1441.030. Chronic

Skubisz, C., Reimer, T., & Hoffrage, U. (2009). Communicating quantitative risk information. *Annals of the International Communication Association*, *33*(1), 177–211.

Slutske, W. S., Hunt-Carter, E. E., Nabors-Oberg, R. E., Sher, K. J., Bucholz, K. K., Madden, P. A. F., Anokhin, A., & Heath, A. C. (2004). Do college students drink more than their non-college-attending peers? Evidence from a population-based longitudinal female twin study. *Journal of Abnormal Psychology*, *113*(4), 530–540. https://doi.org/10.1037/0021-843X.113.4.530

Southwell, B. G. (2001). Health message relevance and disparagement among adolescents. *Communication Research Reports*, *18*(4), 365–374. https://doi.org/10.1080/08824090109384817

Stainback, R. D., & Rogers, R. W. (1983). Identifying effective components of alcohol abuse prevention programs: Effects of fear appeals, message style, and source expertise. *Substance Use and Misuse*, *18*(3), 393–405. https://doi.org/10.3109/10826088309039356

Suerken, C. K., Reboussin, B. A., Sutfin, E. L., Wagoner, K. G., Spangler, J., & Wolfson, M. (2014). Prevalence of cannabis use at college entry and risk factors for initiation during freshman year. *Addictive Behaviors*, *39*(1), 302–307.

Sülflow, M., Schäfer, S., & Winter, S. (2019). Selective attention in the news feed: An eye-tracking study on the perception and selection of political news posts on Facebook. *New Media and Society*, *21*(1), 168–190. https://doi.org/10.1177/1461444818791520

Sundar, S. S., & Nass, C. (2001). Conceptualizing sources in online news. *Journal of Communication*. https://doi.org/10.1111/j.1460-2466.2001.tb02872.x

Sutfin, E. L., Reboussin, B. A., Debinski, B., Wagoner, K. G., Spangler, J., & Wolfson, M. (2015). The impact of trying electronic cigarettes on cigarette smoking by college students: a prospective analysis. *American Journal of Public Health*, *105*(8), e83–e89.

Thompson, D. V, & Malaviya, P. (2013). Consumer-generated ads: Does awareness of advertising co-creation help or hurt persuasion? *Journal of Marketing*, *77*(3), 33–47.

Tucker, J. S., Ewing, B. A., Miles, J. N. V, Shih, R. A., Pedersen, E. R., & D'Amico, E. J. (2015). Predictors and consequences of prescription drug misuse during middle school. *Drug and Alcohol Dependence*, *156*, 254–260.

Turchik, J. A., Garske, J. P., Probst, D. R., & Irvin, C. R. (2010). Personality, sexuality, and

substance use as predictors of sexual risk taking in college students. *Journal of Sex Research*, *47*(5), 411–419. https://doi.org/10.1080/00224490903161621

Turner, J. C., & Tajfel, H. (1986). The social identity theory of intergroup behavior. *Psychology of intergroup relations, 5*, 7-24.

Tversky, A., & Kahneman, D. (1973). Judgment Under Uncertainty: Heuristics and Biases. *Oregon Research Institute*, *185*(November), 1124–1131. https://doi.org/10.1007/978-94-010-1834-0_8

Ullman, W. R., & Bodaken, E. M. (1975). Inducing resistance to persuasive attack: A test of two strategies of communication. *Western Speech Communication*, *39*(4), 240–248.

Vraga, E., Bode, L., & Troller-Renfree, S. (2016). Beyond Self-Reports: Using Eye Tracking to Measure Topic and Style Differences in Attention to Social Media Content. *Communication Methods and Measures*, *10*(2–3), 149–164. https://doi.org/10.1080/19312458.2016.1150443

Walster, E., Aronson, E., & Abrahams, D. (1966). On increasing the persuasiveness of a low prestige communicator. *Journal of Experimental Social Psychology*, *2*(4), 325–342.

Wan, H. H., & Pfau, M. (2004). The relative effectiveness of inoculation, bolstering, and combined approaches in crisis communication. *Journal of Public Relations Research*, *16*(3), 301–328. https://doi.org/10.1080/1532-754X.2004.11925131

Wang, Z., Walther, J. B., Pingree, S., & Hawkins, R. P. (2008). Health information, credibility, homophily, and influence via the internet: Web sites versus discussion groups. *Health Communication*, *23*(4), 358–368. https://doi.org/10.1080/10410230802229738

Watt, J. H., & Van den Berg, S. A. (1995). *Research methods for communication science.* Allyn & Bacon.

Weiner, B. (2000). Attributional thoughts about consumer behavior. *Journal of Consumer Research*, *27*(3), 382–387.

Wong, N. C. H. (2016). "Vaccinations are Safe and Effective": Inoculating Positive HPV Vaccine Attitudes Against Antivaccination Attack Messages. *Communication Reports*, *29*(3), 127–138. https://doi.org/10.1080/08934215.2015.1083599

Wood, M. L. M. (2007). Rethinking the inoculation analogy: Effects on subjects with differing preexisting attitudes. *Human Communication Research*, *33*(3), 357–378. https://doi.org/10.1111/j.1468-2958.2007.00303.x

Yoo, W. (2016). The influence of celebrity exemplars on college students' smoking. *Journal of American College Health*, *64*(1), 48–60. https://doi.org/10.1080/07448481.2015.1074238

Yu, N., Ahern, L. A., Connolly-Ahern, C., & Shen, F. (2010). Communicating the risks of fetal alcohol spectrum disorder: Effects of message framing and exemplification. *Health Communication*, *25*(8), 692–699. https://doi.org/10.1080/10410236.2010.521910

Zaichkowsky, J. L. (1985). Measuring the involvement construct. *Journal of consumer research, 12*(3), 341-352. doi:10.1086/208520

Zillmann, D. (2002). Exemplification theory of media influence. *Media Effects: Advances in Theory and Research*, *2*, 19–41.

Zillmann, D., Gibson, R., & Sargent, S. L. (1999). Effects of photographs in news-magazine reports on issue perception. *Media Psychology*, *1*(3), 207–228.

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