EXAMINING THE RELATIONSHIP BETWEEN MESSAGE REPETITION, MESSAGE FATIGUE, PSYCHOLOGICAL REACTANCE, AND BOOMERANG EFFECTS IN PUBLIC HEALTH MESSAGES

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ABSTRACT

This dissertation investigates how using an innovative text message-based approach to repeated public health messages can influence experiences of message fatigue, psychological reactance, and boomerang effects, as well as the mediating role that message fatigue plays between repetition and outcomes of psychological reactance and boomerang effects. Participants (N=179) were exposed to one of two health messages containing information related to either HPV or breast cancer risk, daily, over a four-day period by disseminating the message via text message. After each exposure, participants completed a survey measuring experiences of message fatigue, psychological reactance, and boomerang effects. Results indicate that message repetition leads to message fatigue, psychological reactance, and boomerang effects, although the rate at which these are impacted vary. Further, results suggest that message fatigue may act as a precursor, or warning sign, of additional unintended outcomes of psychological reactance and boomerang effects, and that message fatigue mediates the relationship between message repetition and experiences of reactance and boomerang effects. These data show that message fatigue provides a useful lens to further understand unintended effects of public health message repetition. Both implications for public health communication practice and communication theory are discussed, as well as future directions for this line of research.

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INTRODUCTION

In today's information environment, individuals are bombarded with different messages from various platforms, including more novel platforms such as social media and more traditional platforms such as print, radio, television, or billboards. Further, these messages often encompass a wide range of topics, including consumer advertising and political messaging. However, health messages are among the most salient type of messages seen in today's society, with commercial public health messages being ubiquitous. As science continues to inform our understanding of health and factors that can influence it, public health messages are likely to continue increasing to not only provide people with emerging health information but to promote prevention and risk reduction activities. Public health messages are often created and used to promote awareness, information retention, and other positive outcomes, which requires that individuals are exposed to a message or series of related messages over time (Silk et al., 2021).

However, there is limited understanding of the effects of this repetitive exposure to health messaging. Examination of the effects of public health messages are often limited to cross-sectional research, or at best, experimental designs employed with immediate or near-immediate post-test measurement to assess changes in individuals' attitudes, beliefs, and/or behaviors (Hofer, Wilkin, Mayers, Wolford, Butler, Beavers, & Zubieta, 2021; Egan, Wolfson, Lukacena, Zelaya, McLeary, & Helme, 2020). A clear need exists to measure and theorize about persuasive outcomes following exposure to a message or a series of messages longitudinally. Further, while repeated exposures to persuasive messages is a seemingly effective influence strategy at face-value, there is evidence and theorizing to suggest that at some point such message repetition may cease to be effective and may even result in negative outcomes such as message fatigue, where audience members feel exhausted and overwhelmed by repeated exposure (So, Kim, & Cohen,

2017). The current research reports findings from an experiment that examines the effects of repeated exposure of public health messages on message fatigue, and two adverse outcomes, psychological reactance and the boomerang effect.

Psychological reactance refers to a feeling that individuals experience when their free will to perform or conduct themselves how they wish is impeded (Brehm, 1966), whereas the boomerang effect occurs when individuals conduct themselves in a manner that is opposite to what is communicated in a message recommendation (Hovland, Jams, & Kelley, 1953). Although message designers strive to avoid both psychological reactance and boomerang effects as outcomes in response to health messages, message fatigue may contribute to the increased likelihood of these negative outcomes. This investigation into the possible relationship between exposure rates and unfavorable outcomes yields insight about message frequency, particularly related to negative outcomes that can occur due to repeated message exposure. This study extends previous research on message repetition that found increases in effects as the number of message repetitions increased (Shi & Smith, 2016). Specifically, this study increased the amount of message exposure from three to four exposures and examines the potential mediating effects of message fatigue and how repetitions may impact psychological reactance.

This dissertation has three goals. First, it investigates the effectiveness of current public health messaging trends by exposing women to repeated health messages. Second, this work aims to advance theory and the empirical examination of the emerging concept of message fatigue. The third goal is to better understand the impacts of using novel approaches and technologies for public health messaging. To accomplish these goals, this dissertation first reviews the literature on message repetition. Second, possible unintended outcomes of message repetition, including message fatigue, psychological reactance, and boomerang effects, are

discussed. Then, HPV and breast cancer, the two content areas of the message conditions, are reviewed. The study's methods are then described, leading to the results of this research. Finally, the implications of these findings are discussed, along with future directions for research.

MESSAGE REPETITION

The impact of message exposure crosses numerous disciplines, with a large amount of literature found in the field of advertising. Berlyne's (1970; 1971) two-factor model explains the inverted U-shaped curve as a visual of the effects that repetition has on individuals, explaining that repetition falls on a U-shaped curve, with messaging at first occurring in the wear-in stage of effects. During the wear-in stage, repetition is effective, having positive effects on individuals. As repetition continues, however, the effects of repetition eventually hit a plateau, where such positive effects begin to halt (Berlyne, 1970). After the plateau, message repetition begins to enter the wear-out phase, in which such messaging no longer has positive effects on the individual. Even more, during the wear-out phase, repetition of messages may have negative effects on the individual receiving the messages (Berlyne, 1970), such as boredom, irritation, and tedium (Sawyer, 1981).

Cacioppo and Petty (1979) proposed that the effects of message repetition may differ depending on the type of information presented in the repeated messaging as they believed prior work focused primarily on information that appeared to be meaningless or barely meaningful to participants. Cacioppo and Petty believed the effects found in such research may not be due to the repetition but rather the type of information. Using two different experiments, results of both experiments found that repetition resulted in increased agreement with messages at first, with subsequent messaging resulting in decreased agreement (Cacioppo and Petty, 1979).

Building upon these findings, Cacioppo & Petty (1989) sought to extend work on message repetition and persuasion by investigating moderate message repetition and whether it can affect persuasion by increasing the opportunities for participants to evaluate the message's arguments. Using a two (argument quality: weak vs. strong) by two (number of repetitions: 1 vs

3) factorial design, results showed that arguments from the strong version of the messages were recalled more than those from the weak version of the arguments. Additionally, results show that moderate repetition of messages (defined as three in this study) leads to individuals' ability to remember the message, expand on the argument of the message, and to access attitudes toward the recommended actions or behaviors from the repeated message (Cacioppo & Petty, 1989). Both studies from Cacioppo and Petty (1979, 1989) support the notion that repetition is able to increase or decrease one's feelings or beliefs towards an attitude or object depending on the ways in which receivers relate to the message's arguments.

More recent investigation of message repetition found an indirect negative effect due to increases in message repetition, with results showing that as the repetition of messages continued to increase, participants believed the message was an attempt to persuade them (Koch & Zerback, 2013). Results also revealed that message repetition can increase experiences of psychological reactance, such that as repetitions increase and individuals view the repetitions as attempts to persuade, reactance occurs. This reactance was found to impede on trust of the message among participants, resulting in a large decrease in perceived credibility (Koch & Zerback, 2013).

Another area where there has been some research on the effects of message repetition is in the political sphere. When investigating the impact that campaign message repetition can have on credibility, it was found that negativity moderates the relationship between political campaign message repetition and credibility such that audience member's negative political message repetition resulted in increased negative attitudes towards the political messages (Ernst, Kuhne, & Wirth, 2017). Results also found that increased negative political campaign messaging resulted in decreased judgments of the message's credibility from participants.

In the field of health communication, Shi & Smith (2016) sought to investigate the impacts of fear appeal repetition on perceptions of threat, efficacy, and personal behavioral intention. Using public health messages focused on the prevention of melanoma, results revealed that perceived susceptibility and perceived response efficacy both significantly increased as repetition continued. As repetitions occurred in the study, thoughts relating to the stimuli message decreased, and receivers of these messages began relying on heuristics related to the message. These findings were based on a study in which people were exposed to three message repetitions, with the authors suggesting that further investigation with additional repetitions would yield more insight. The current study builds upon these findings by using a fourth message repetition.

As previously stated, studies of the effects of message repetitions and persuasion stem beyond the field of communication. In the advertising literature, it has been found that when individuals have low purchasing intentions or counter arguments against commercials' claims, commercial message repetition results in more positive brand attitudes and purchasing intentions. However, these increases in attitudes and intentions diminish or level off when there are high purchasing intentions or numerous counter arguments (Batra & Rae 1986). For example, as individuals continue to hear repetitive messages about contracting HPV and getting vaccinated, individuals may be more likely to adhere to recommendations; however, if repetitions continue to increase or numerous counter arguments are present, the initial effects boost the likelihood to adhere to the message may decrease or level off (Batra & Rae, 1986; Belch, 1982).

POSSIBLE UNINTENDED OUTCOMES OF MESSAGE REPETITION

The effects of message repetition on persuasive outcomes show that repetition can impact persuasion in various ways. Message fatigue, psychological reactance, and boomerang effects are several unintended response outcomes related to message exposure. Message fatigue, of primary interest in this dissertation, will be discussed first.

Message Fatigue

Communication scholars have examined the impact of repeated exposure to public health messages and the deleterious effects that can ensue from repetitive exposure and potential overexposure, including message fatigue. Conceptualized by So and colleagues (2017) as "an aversive motivation state of being exhausted and bored by overexposure to similar, redundant messages over an extended period of time." (p. 20). Message fatigue is believed to be an outcome of repetitive messaging (primarily in the public health messaging domain) that is comprised of four dimensions: perceived over-exposure, perceived redundancy, exhaustion, and tedium (So et al., 2017).

Perceived over-exposure refers to the belief that an individual has been exposed to a message or type of message beyond the desired amount. For example, when women are inundated with messages about breast cancer more often than they anticipated or desired, they may feel as if they are over-exposed to breast cancer information. *Perceived redundancy* refers to the belief that the individual feels that exposure to such messages is repetitive and concurrent. An example of this may be during breast cancer awareness month (October) when people are constantly exposed to repeated messaging about breast cancer. *Exhaustion* is the phenomena of being tired, exemplified by the potential for individuals to be exhausted after hearing the content of messages. Finally, *tedium* is the feeling of no joy or enthusiasm after being exposed to a

message. People may experience tedium when they are not interested in the topic of messages as they may not have a stake in the content (So, Kim, & Cohen, 2017). For example, a sexually inactive woman might be completely disinterested in HPV messages because she does not engage in the sexual activity that transmits HPV.

Message fatigue is a relatively newer concept in the realm of communication science. In an investigation into perceived tobacco-related message fatigue, it was found that current tobacco users reported more fatigue as compared to non-users even when given the same number of anti-tobacco messages (So & Popova, 2018). These results indicate that intended results of anti-tobacco messaging such as the Truth campaign, the nation-wide campaign aimed at smokers to reduce their tobacco use, may not be as effective as intended as the target audience can become fatigued by repeated public health messages.

Although a newer concept, an influx of work on message fatigue was conducted as a response to the COVID-19 pandemic, with much of the work finding audiences experience more message fatigue as repetition of messaging around the pandemic continued (Ball & Wozniak, 2022; Guan, Li, Scoles, & Zhu, 2022; Shen et al., 2022). Additionally, earlier research has proposed that tedium, one of the aforementioned dimensions of message fatigue, increases as repetition increases (Ananda & Sternthal, 1990). Thus, hypothesis one is proposed:

H1: Individuals will exhibit more message fatigue as the number of public health message repetitions they are exposed to increases.

Psychological Reactance

Psychological reactance theory was developed to better understand the ways in which individuals either enact or discard persuasive messages (Brehm, 1966; Brehm & Brehm, 1981). PRT posits that psychological reactance manifests after an individual feels or perceives that their

own free will has been impeded upon or when an individual feels social pressures to enact or accept a belief or behavior (Brehm, 1966). Reactance is an unfavorable or undesirable motivational stimulation that occurs when people perceive their free will is being hindered. PRT is based on four different components: freedom, threat to freedom, psychological reactance, and restoration of reactance (Brehm & Brehm, 1981).

Freedom refers to an individual's ability to act, think, or feel freely on their own accord (Brehm & Brehm, 1981; Burgoon et al., 2002). Individual freedoms are seen as subjective views that individuals develop over their lives, which are present in both unconditional and provisional contexts (Wicklund, 1974; Brehm, 1966). Unconditional contexts are ones in which the freedom is ever present. For example, an individual may feel an unconditional freedom to make their own preventive health decisions. Whereas a provisional context of freedom may be that in specific circumstances, an individual's choice may be restricted due to the environment. For example, if a young woman seeks to get vaccinated against HPV, the outcome may be provisional based on insurance coverage or parental approval. A freedom must be present to assess a situation from a PRT lens because without a freedom present, a threat to freedom does not exist (Brehm, 1966; Brehm & Brehm, 1981).

A *threat to freedom* is determined by one's perception that their ability to act, think, or feel freely is being threatened or impeded upon. Brehm (1966) posits that any communication that attempts to persuade somebody can be perceived as a threat to freedom. However, threats to freedom fall within a wide range, from minimal and minute to extremely severe. A minimal threat to freedom, for example, might be being told to conduct breast self-exams to assess for any irregularities, whereas an extremely severe threat might be someone being forced to receive an immunization against HPV. Regardless of the scale of threat, it is believed that any threat to

freedom can elicit motivation within individuals to restore their freedom (Brehm, 1966). This motivation to restore individual freedom is reactance.

As noted previously, reactance is an internal, motivational arousal that occurs in individuals who feel as if their freedom has or is being diminished (Brehm, 1966; Brehm & Brehm, 1981). However, the amount of reactance that an individual may experience can vary dependent upon how important the individual perceives the threatened freedom to be. Threats to freedom that are perceived as minimal may elicit very little reactance (e.g., someone whom you don't know telling you not to get a mammogram); however, threats to freedom that are perceived as large and a severe threat to the freedom of an individual may elicit a large amount of reaction in the individual (e.g., for example, a child's parents making them receive a vaccination against HPV) (Dillard & Shen, 2005; Miller, et al., 2007; Worchel & Brehm, 1970). These threats to freedom, or reactance, elicit a need to regain the freedom. This is referred to as restoration of reactance.

Restoration of reactance occurs when an individual is motivated to perform an action or think in a way that allows them to feel as if their freedom has been restored (Brehm, 1966). Restoration of reactance can be achieved in a variety of ways. For the most part, these ways fall within two umbrella categories of restoration, direct and indirect. Direct restoration is achieved by performing the freedom that an individual believes has been diminished or by an agent acting directly in accordance with the freedom an individual has perceived is diminished (Brehm, 1966; Worchel & Brehm, 1970; Quick & Stephenson, 2008). For example, if an individual is exposed to a message about refraining from using a make-up product due to chemicals in it being linked to breast cancer risk, one might purchase the product and use it as a form of direct restoration. Indirect restoration occurs in a variety of ways including increasing the liking of the behavior or

belief that has been impeded upon, denying that the threat exists, exercising a different freedom that the individual does perceive themselves to have control over, being around individuals who partake in the freedom, or by derogating the source of the threat (Quick & Stephenson, 2008). For example, if the Centers for Disease Control and Prevention (CDC) creates messages requesting that individuals not partake in sexual relations without a condom to prevent HPV, someone may try to engage in indirect restoration by explaining that HPV is not a risk, or by exclaiming that the CDC is not a credible source of information.

Since its introduction as a construct, psychological reactance has received significant attention with research on psychological reactance spanning across multiple disciplines such as political messaging (van der Linden, 2019; Ma, Dixon, & Hmielowski, 2019), stigma (Brown et al., 2015), and cigarette labeling (LaVoie, et al., 2015; Erceh-Hurn & Steed, 2011) to name a few. Regardless of context, research focused on messaging and psychological reactance appears to make a connection such that increases in message exposure can increase the potential for psychological reactance. For example, individuals who struggle with mental health were found to experience more reactance when exposed to repeated messages about mental health (Lienemann & Siegel, 2016). These findings suggest that psychological reactance can increase as message repetition does, even if the message content is relevant to the receiver.

Other research has found similar results. When investigating the impact of message exposure and psychological reactance in political messaging, results found that repeated exposure to a political message resulted in a negative evaluation of the message and individuals experiencing increased psychological reactance (Miller, 1976). Further, as advertisements on social media are repeated, it has been found that some users see repetitive advertisements as a

freedom threat to use the website, which resulted in an increase of psychological reactance (Youn & Kim, 2019). Thus, hypothesis 2 is proposed:

> H2: There will be a positive relationship between message repetition and psychological reactance, such that as message repetition increase so will feelings of psychological reactance.

Boomerang Effects

Hovland and colleagues (1953) originally coined the boomerang effect as a phenomenon that occurs when individuals do the opposite of what is recommended in communication messages. Since the initial conception of the boomerang effect, there has been limited research investigating the causes of boomerang effects. However, boomerang effects have been associated and compared to other deleterious outcomes such as psychological reactance (Haynes, 2015). Although boomerang effects are similar to psychological reactance, they are also distinct; boomerang effects pertain to specific actions (Hovland et al., 1953), while psychological reactance deals with the feelings associated with a loss of freedom (Brehm, 1966). For example, if someone is exposed to a public health message to refrain from tobacco use because it increases cancer risk, individuals may experience psychological reactance by feeling like their decision of whether to use tobacco is being made for them or impeded upon; whereas a potential boomerang effect may be that the individual decided to use tobacco.

Other research has shown the negative effects of boomerang effects, primarily conducted in health communication contexts. For example, in a study of high school students exposed to anti-tobacco messaging, Grandpre and colleagues (2003) found that tenth grade students who were shown messages that explicitly stated not to use tobacco products were more likely to report trying a cigarette sooner than students who did not receive such a message. An

older investigation of the impact of message exposure and boomerang effects found that repeated exposure to messages about anti-drug use can actually decrease negative attitudes towards drug-use, indicating a boomerang effect (Feingold & Knapp, 1977). Overall, there is limited research on message exposure in terms of potential boomerang effects. Thus, hypothesis three is proposed:

> H3: There will be a positive relationship between message repetition and boomerang effects such that as message repetitions increase, so will the likelihood of boomerang effects.

Message Fatigue as a Mediator between Message Repetition and Negative Outcomes

As discussed, there is an apparent link between message repetition and negative outcomes, such as the boomerang effect or psychological reactance. The mechanisms by which this relationship occurs, though, appear to be unclear in the literature. One possible mechanism that may link these two constructs is that of message fatigue, especially as prior research has shown that deleterious outcomes, such as psychological reactance, are linked to message fatigue (Kim & So, 2018). However, the primary focus of work relating these constructs has focused on message fatigue as an outcome of reactance rather than as playing a mediating role (Kim & So, 2018). The literature shows a direct link between message exposure and message fatigue (So, Kim, & Cohen, 2017; So, & Popova, 2018). It appears that message fatigue might be an important mediating variable in the relationship between repetition and negative outcomes as it directly accounts for the tiredness, overexposure, redundancy, and tedium people might from high levels of repetition. It is possible that the correlations between repetition and psychological reactance, and repetition and boomerang effects, will be higher if message fatigue is considered. To investigate the role of message fatigue as a mediator, the following hypotheses are proposed:

H4: Message fatigue will mediate the relationship between message repetition and psychological reactance.

H5: Message fatigue will mediate the relationship between message repetition and the boomerang effect.

The health message conditions for the proposed study, breast cancer and HPV prevention messages, have received significant attention in the media as relevant women's health issues. An overview of the two message contexts is provided next.

WOMEN'S HEALTH MESSAGE DOMAINS

The proposed hypotheses are tested by using an experimental design containing two different message conditions. Both message conditions contained messages pertaining to women's health issues. Women's health is an important focus as women are usually the decision makers when it comes to health care, with estimates showing about 80% of all health care decisions for families being made by women (Matoff-Stepp, Applebaum, Pooler, & Kavanagh, 2014). The first health message condition in this work is on breast cancer risk. Breast cancer risk is a pertinent issue to women's health and disproportionately affects women compared to men (American Cancer Society, 2023). The second health message condition focuses on HPV risk. HPV risk is relevant to women's health as HPV is linked to genital warts and cervical cancer, two other important women's health issues (CDC, 2023). Additionally, women account for more of the cases of cancer due to HPV than men (CDC, 2023). These message conditions domains are explained further below.

Breast Cancer

Breast cancer is a prevalent health issue in the United States (U.S.) as it is the leading cause of cancer-related death among American women (American Cancer Society, 2023). Approximately one in eight American women will develop breast cancer in their lifetimes, with an estimated 43,700 expected deaths due to breast cancer in 2023 alone (American Cancer Society, 2023). Although prior work shows that women are generally aware of breast cancer and the importance of breast cancer screening (National Cancer Institute, 2006), information pertaining to breast cancer risk reduction strategies is necessary to help women protect themselves against breast cancer or to help women detect breast cancer early to better ensure remission of breast cancer status.

In addition to breast cancer screenings to ensure early detection, emerging science shows there are many environmental variables that can influence one's risk of developing breast cancer. At the forefront of investigating the role of environmental factors' influence on breast cancer risk was the Breast Cancer and the Environment Research Program (BCERP). BCERP, a longstanding NIH funded collaborative research program, investigated environmental influences of breast cancer risk from 2003-2020. One focus of the BCERP was on communicating findings from emerging science about breast cancer risk reduction to women, particularly those who are mothers with daughters. For example, BCERP has materials for mothers and caregivers that pertain to educating their dependents on chemical exposures to toxic chemicals such as phthalates and bisphenol A (BPA), as well as the importance of living a healthy life (What You Can Do, n.d.).

Pinkwashing

Breast cancer has received extensive attention in the media (AbiGhannam, Chilek, & Koh, 2018; Harvey & Strahilevitz, 2009). Different events such as Breast Cancer Awareness Month and breast cancer focused marathon races have kept breast cancer at the forefront of American culture. This has resulted in a phenomenon referred to as "pinkwashing," defined as "the activities of companies and groups that position themselves as leaders in the struggle to eradicate breast cancer while engaging in practices that may be contributing to rising rates of the disease" (Malkan, 2007, p.75). Numerous companies and businesses promote breast cancer awareness through campaigns, messaging, advertisements and products. This has led to mixed results (Elliott, 2007); specifically, while there is evidence of heightened breast cancer awareness (Glynn et al., 2011), there is also criticism of entities for capitalizing on breast cancer awareness for financial gain (Carter, 2015).

In addition to pinkwashing, research has demonstrated that breast cancer awareness sees much more attention than other types of cancer. When compared to other types of cancer, breast cancer awareness elicits more online activity (Glynn et al, 2011) and breast cancer receives more funding opportunities than other types of cancer as compared to its relative burden (Carter & Nguyen, 2012). For example, among 21 different types of cancer, only three types of cancer funding were found to deviate extremely in the positive, which suggests overfunding; and among them, breast cancer was deemed to be the cancer most overfunded (Carter & Nguyen, 2012). Such findings help cement breast cancer as a good context for the current research project given the high level of exposure to breast cancer messages compared to other types of cancer. Another health issue that has received attention in the last 15 years is the human papilloma virus (HPV), a widespread health issue for Americans.

HPV

According to the CDC, about 80 million people in the U.S. are living with HPV and an estimated 14 million contract the virus annually (CDC, 2018). It is the most widespread sexually transmitted infection in the United States. HPV can cause numerous types of cancer, including cancers of the cervix, vagina, vulva, penis, anus, and oropharynx (CDC, 2018). The best ways to protect oneself from potential HPV infection is to get the HPV vaccine and use protection during sexual intercourse (CDC, 2018).

Research related to HPV in the field of communication highlights the importance that communication can have in protecting oneself against HPV infection. One source that has been found to positively influence HPV vaccination is communication with parents, specifically with mothers (Roberts et al., 2010; Romo, Cruz, & Neilands, 2011; Gross, Laz, Rahman, & Berenson, 2015; Head & Harsin, 2016). In addition to parents, health care providers may also be an

interpersonal communicative source that can impact HPV vaccination decisions (Romo, Cruz, & Neilands, 2011; Head & Harsin, 2016; Krawczyk et al., 2012). More so, individuals who perceive themselves as more vulnerable to HPV are also more likely to get vaccinated (Roberts et al., 2010).

One of the most heard rebuttals against vaccination revolves around risk compensation, or the thought that vaccination may cause individuals to engage in more sexual behaviors because of their vaccination status. A review of the literature on HPV vaccine hesitancy found that a vast majority of the research in this area does not support the theory of risk compensation after HPV vaccination (Zimet, et al., 2013). Research on HPV vaccination, specifically in women, highlights the need for more communication in this area. Given the salience of HPV among Americans, specifically women, HPV presents itself as an excellent message condition in this study. Similar to breast cancer, HPV is a serious health issue that can impact women's health. However, unlike breast cancer messaging, messaging around HPV is often aimed at both sexes. Additionally, HPV prevention receives less attention in the media, allowing any results to be compared among two conditions that are somewhat different in salience, visibility, and audience.

In summary, this research seeks to better understand the relationships between message fatigue, psychological reactance, and the boomerang effect. More specifically, this research investigates the potential mediating role that message fatigue plays between message exposure and unintended outcomes of psychological reactance and boomerang effects by using novel experimental methods. These methods are discussed next.

METHODS

This online experiment recruited a community sample pool and were randomly assigned to one of two message conditions. Participants took a pre-survey after enrolling in participation to assess baseline levels. Then, for four subsequent days, participants were sent a repetitive public health message with a corresponding survey.

Recruitment

Participants were recruited for this study using the Michigan State University (MSU) College of Communication Arts and Sciences (CAS) Community SONA pool. Inclusion criteria for this study required that participants be women, who are 18 years old or older, and have access to a cell phone capable of receiving (SMS) text messages.

Participants

A total of 636 participants enrolled in the present study across five waves of data collection. The longitudinal nature of this study, as well as some participants providing incorrect telephone numbers or having some difficulty receiving the text messages led to high levels of attrition, with a total of 179 participants across the two conditions participating in at least four of the five data collection points. Of these, 84 participants were in the first condition, and 95 participants were in the second condition. Participants ranged in age from 18 to 69, with many participants falling between ages 18-25 years old (n=106). Most women identified as Caucasian/White (n=131), with others identifying as Asian/Pacific Islander (n=21), African American/Black (n=8), Multiracial (n=8), Hispanic (n=6) and a few providing no race or selecting other (n=5). Additional demographic information can be found in Table 1.

Table 1.

Descriptive statistics for Participants.

	Frequency	Percent
Age		
18-25 years old	106	59.2%
26-33 years old	28	15.6%
34-41 years old	25	14.0%
42-49 years old	11	6.1%
50-57 years old	3	1.7%
58-64 years old	4	2.2%
65-69 years old	2	1.1%
Race		
Caucasian/White	131	73.2%
Asian/Pacific Islander	21	11.7%
African American/Black	8	4.5%
Multiracial	8	4.5%
Hispanic	6	3.3%
Prefer not to say/Other	5	2.8%
Marital Status		
In a relationship	70	39.1%
Single	66	36.9%
Married	37	20.7%
Separated	3	1.7%
Prefer not to say	2	1.0%
Widowed	1	0.6%
Education		
Bachelors Degree	76	42.5%
Some college	53	29.6%
Masters Degree	32	17.9%
Doctoral/Professional Degree	8	4.5%
High School/GED	5	2.8%
Associates Degree	3	1.7%
Prefer not to say	2	1.1%
Income Level		
Less than $20,000	107	22.2%
$20,000 - $34,999	91	18.9%
$35,000 - $49,999	81	16.8%
Over $100,000	71	14.7%

Table 1 (cont'd)		
$50,000 - $74,999	69	14.3%
$75,000 - $99,999	47	9.8%
Prefer not to say	16	3.3%

Procedure

After providing informed consent, participants were randomly assigned to either the HPV message condition or the breast cancer message condition and completed a baseline survey. Following this, for four subsequent days, participants were texted a public health message accompanied by a daily survey. The public health messages used in this research were created by adapting messages provided on the CDC website and the BCERP (see Appendix for messages). Participation was completed after the fourth message and survey, and participants who completed the study received an Amazon gift card as remuneration for their participation. Overall, participants took five surveys; one pre-survey (T1) and one survey that is taken after each of the four message exposures (T2, T3, T4, T5).

Measures

In addition to various demographic items, scales adapted from previous research were used for this research. Example items are listed below, with full instrument measures as well as their scoring anchors provided in Table 2 (See Appendix C).

Message Fatigue. The message fatigue scale was developed to determine the levels of message fatigue individuals experience due to the repetitive exposure to public health messaging (So, Kim, & Cohen, 2017). This scale is a 17-item scale that measures the four different dimensions of message fatigue: perceived over-exposure, perceived redundancy, exhaustion, and tedium. Items are measured on a 7-point Likert-type scale with values ranging from 1 (Strongly Disagree) to 7 (Strongly Agree). Items were adapted to fit the topic of breast cancer. Sample

items include, “I have lost track of the amount of time I have heard that breast cancer/HPV is a serious problem” and “Messages about breast cancer/HPV make me want to sigh.”

Psychological reactance. Psychological reactance was assessed with two different methods. The first way approach follows Dillard and Shen (2005)’s recommendation that psychological reactance is comprised of two dimensions; anger and negative cognitions. Anger was assessed using a four-item anger scale that has been adapted from a well-validated scale in the literature comprised of anger, annoyance, aggravation and irritation (Dillard & Peck, 2000; Dillard & Shen, 2005; Dillard et al., 1996). Sample items include, “I was angry with the amount of information about breast cancer/HPV I received,” and “I was annoyed with the messages about breast cancer/HPV risk.”

Negative cognitions were reported using thought-listing techniques (Petty & Cacioppo, 1986). Participants were asked to list all the thoughts they generated when receiving the messages about breast cancer or HPV via text. Following the thought listing, each participant rated their thoughts as either positive, negative, or neutral. Only the negative thoughts were used in this analysis based on the measurements in other work (Dillard & Shen, 2005).

The second method used for measuring psychological reactance was a modified version of the Hong & Faedda (1996) Psychological Reactance Scale. This 11-item scale measures items on a 7-point Likert-type scale with scores ranging from 1 (Very Strongly Disagree) to 7 (Very Strongly Agree). Sample items include, “I become frustrated when I am unable to make free and independent decisions,” and “I resist the attempts of others to influence me.”

For all analyses, the Hong & Faedda (1996) Psychological Reactance Scale was used for psychological reactance measurement. A review of the data revealed that the thought listing technique outlined in the Dillard and Shen (2005) method of measuring psychological reactance

revealed that very few participants completed thought listing, rendering analysis difficult with this method. Both measurements were employed to ensure measurement of reactance.

Boomerang effect. Boomerang effects are difficult to operationalize in surveys, given that boomerang effects are in reference to actual behavioral actions. There appears to be no universal scale to measure a boomerang effect; thus, this study used items based on behavioral intention as a proxy for boomerang effects. Sample items from this measurement include "I plan to act on the recommendations of the messages" and "I will avoid following the message's recommendation." Negative items were reverse coded, and all items were measured on a 7-point Likert-type scale with scores ranging from 1 (Strongly Disagree) to 7 (Strongly Agree).

Table 2.

Scale items and Anchors for Measurements.

Construct		Item Text	Scale Anchors
Message Fatigue			
	1	I have lost track of the amount of times I have heard that breast cancer/HPV is a serious problem.	(1=strongly disagree, 7=strongly agree)
	2	At this point, I've heard about problems related to breast cancer/HPV more than I ever needed to.	(1=strongly disagree, 7=strongly agree)
	3	I have heard enough about how important it is to be cognizant of breast cancer/HPV risks.	(1=strongly disagree, 7=strongly agree)
	4	There are simply too many health messages about breast cancer/HPV nowadays	(1=strongly disagree, 7=strongly agree)
	5	The importance of knowing one's breast cancer/HPV status is overtaught.	(1=strongly disagree, 7=strongly agree)
	6	Breast cancer/HPV-related messages rarely provide new information.	(1=strongly disagree, 7=strongly agree)
	7	After hearing them for years, messages about breast cancer/HPV seem repetitive.	(1=strongly disagree, 7=strongly agree)
	8	Messages about breast cancer/HPV are all beginning to sound the same to me.	(1=strongly disagree, 7=strongly agree)
	9	I can predict what a message about breast cancer/HPV is going to say.	(1=strongly disagree, 7=strongly agree)
	10	I am burned out from hearing that breast cancer/HPV is a serious problem.	(1=strongly disagree, 7=strongly agree)

Table 2 (cont'd)

11	I am sick of hearing about the risks of breast cancer/HPV.	(1=strongly disagree, 7=strongly agree)
12	I am tired of hearing about the importance of knowing one's risk of developing breast cancer/HPV.	(1=strongly disagree, 7=strongly agree)
13	Breast cancer/HPV-related messages make me want to sigh.	(1=strongly disagree, 7=strongly agree)
14	Health messages about breast cancer/HPV are boring.	(1=strongly disagree, 7=strongly agree)
15	Breast cancer messages make me want to yawn.	(1=strongly disagree, 7=strongly agree)
16	I find messages about breast cancer to be dull and monotonous.	(1=strongly disagree, 7=strongly agree)
17	Breast cancer-related messages are tedious.	(1=strongly disagree, 7=strongly agree)

Psychological Reactance – Anger Scale

1	I was angry with the amount of information about breast cancer I received.	(1=strongly disagree, 7=strongly agree)
2	I was annoyed with the messages about breast cancer.	(1=strongly disagree, 7=strongly agree)
3	I became aggravated when receiving information about breast cancer.	(1=strongly disagree, 7=strongly agree)
4	When I received messages about breast cancer, it irritated me.	(1=strongly disagree, 7=strongly agree)

Psychological Reactance – Thought Listing

Prompt	For the next two minutes, list all the thoughts you experienced when receiving messages pertaining to breast cancer.	
1	How many positive thoughts did you have?	Count
2	How many negative thoughts did you have?	Count
3	How many neutral thoughts did you have?	Count

Psychological Reactance – Hong Scale

1	I become frustrated when I am unable to make free and independent decisions.	(1=strongly disagree, 7=strongly agree)
2	I become angry when my freedom of choice is restricted.	(1=strongly disagree, 7=strongly agree)

Table 2 (cont'd)

3	It irritates me when someone points out things which are obvious to me.	(1=strongly disagree, 7=strongly agree)
4	Regulations trigger a sense of resistance in me.	(1=strongly disagree, 7=strongly agree)
5	I find contradicting others stimulating.	(1=strongly disagree, 7=strongly agree)
6	When something is prohibited, I usually think "that's exactly what I am going to do."	(1=strongly disagree, 7=strongly agree)
7	I resist the attempts of others to influence me.	(1=strongly disagree, 7=strongly agree)
8	It makes me angry when another person is held up as a model for me to follow.	(1=strongly disagree, 7=strongly agree)
9	When someone forces me to do something, I feel like doing the opposite.	(1=strongly disagree, 7=strongly agree)
10	I consider advice from others to be an intrusion.	(1=strongly disagree, 7=strongly agree)
11	Advice and recommendations induce me to do just the opposite.	(1=strongly disagree, 7=strongly agree)

Boomerang Effect Scale - Intention

1	I plan to do what the messages recommended.	(1=strongly disagree, 7=strongly agree)
2	I intend to act on the recommendations of the messages I received.	(1=strongly disagree, 7=strongly agree)
3	I will avoid following message recommendations.	(1=strongly disagree, 7=strongly agree)
4	The recommendations from the messages were useful.	(1=strongly disagree, 7=strongly agree)
5	I intend on acting to better my health as a result of the messages.	(1=strongly disagree, 7=strongly agree)
6	I plan to do whatever I want, regardless of message recommendations.	(1=strongly disagree, 7=strongly agree)

Boomerang Effect Measures – Behavioral Intention

1	I have done what the messages recommended.	(1=strongly disagree, 7=strongly agree)
2	I have acted on the recommendations of the messages I received.	(1=strongly disagree, 7=strongly agree)
3	I have avoided following message recommendations.	(1=strongly disagree, 7=strongly agree)

Table 2 (cont'd)

4	The recommendations from the messages are useful.	(1=strongly disagree, 7=strongly agree)
5	I have already acted to better my health as a result of the messages.	(1=strongly disagree, 7=strongly agree)
6	I have done whatever I want, regardless of message recommendations.	(1=strongly disagree, 7=strongly agree)

RESULTS

Prior to data analysis the data set was reviewed and cleaned. T-tests were conducted to assess for any differences between the two message conditions, with results showing no significant differences between the two conditions (See Table 3). Following, all data were combined, items that required reverse coding were fixed in the data set. After, all data points from all participants were reviewed. Participants who did not complete at least four of the five data collection points were excluded from this analysis. Missing data was handled using full information maximum likelihood (Enders, 2010).

Table 4 shows means, standard deviations, confidence intervals, inter-variable correlations, and reliability coefficients for all study variables. Table 5 contains the results for both the first- and second- order factor analysis for message fatigue. While the likelihood ratio test comparing the chi-square fit indices showed the first-order model fit the data better, all other fit indices were approximately the same. To ensure latent growth curve model parsimony and to cohere with other message fatigue research, the second-order model was retained for analyses. Figure 6 shows the means of all study variables across each time point.

Table 3.

T-tests comparing study variables across message conditions across time points.

	Group 1 M (SD) [95% CI]	Group 2 M (SD) [95% CI]	Equality of Variance F	P	Equal t(df)	P	Unequal t(df)	P	Cohen's d [95% CI]
1. Message Fatigue (Baseline)	3.16 (1.04) [3.03, 3.31]	3.29 (0.92) [3.17, 3.42]	1.91	0.17	-1.34 (414)	0.18	-1.34 (407.14)	0.18	-0.13 [-0.32, 0.06]
2. Psychological Reactance (Baseline)	3.82 (0.82) [3.73, 3.94]	3.81 (0.85) [3.71, 3.93]	0.06	0.90	0.13 (416)	0.90	0.13 (415.17)	0.90	0.01 [-0.18, 0.20]
3. Message Fatigue (T1)	3.12 (.96) [2.92, 3.33]	2.97 (1.03) [2.78, 3.16]	0.65	0.65	1.06 (192)	0.29	1.06 (189.39)	0.29	0.15 [-0.13, 0.44]
4. Psychological Reactance (T1)	3.56 (0.91) [3.37, 3.75]	3.59 (0.88) [3.46, 3.77]	0.15	0.70	-0.16 (198)	0.87	-0.16 (187.05)	0.87	-0.02 [-0.30, 0.26]
5. Intention (T1)	5.14 (0.75) [5.00, 5.29]	5.22 (0.92) [5.05, 5.40]	2.02	0.16	-0.67 (194)	0.50	-0.69 (194.00)	0.49	-0.10 [-0.39, 0.19]
6. Message Fatigue (T2)	3.18 (1.03) [2.99, 3.38]	3.01 (1.03) [2.81, 3.20]	0.16	0.69	1.23 (217)	0.22	1.23 (215.36)	0.22	0.17 [-0.10, 0.43]
7. Psychological Reactance (T2)	3.49 (0.82) [3.33, 3.66]	3.45 (0.90) [3.29, 3.65]	0.05	0.83	0.31 (214)	0.76	0.31 (213.19)	0.76	0.04 [-0.22, 0.31]
8. Intention (T2)	5.08 (0.75) [4.93, 5.23]	5.22 (0.88) [5.07, 5.41]	2.36	0.13	-1.22 (215)	0.22	-1.22 (192.24)	0.22	-0.17 [-0.43, 0.10]
9. Message Fatigue (T3)	3.31 (1.17) [3.10, 3.53]	3.12 (1.18) [2.90, 3.34]	0.00	0.99	1.30 (216)	0.19	1.30 (215.90)	0.19	0.18 [-0.09, 0.44]
10. Psychological Reactance (T3)	3.48 (0.99) [3.30, 3.68]	3.47 (0.92) [3.30, 3.64]	0.08	0.78	0.13 (216)	0.90	0.13 (213.76)	0.90	0.17 [-0.25, 0.28]
11. Intention (T3)	4.97 (.95) [4.78, 5.15]	5.13 (0.93) [4.96, 5.29]	0.04	0.85	-1.25 (209)	0.21	-1.25 (208.41)	0.21	-0.17 [-0.44, 0.10]
12. Message Fatigue (T4)	3.30 (1.06) [3.09, 3.50]	3.29 (1.30) [3.03, 3.57]	2.75	0.10	0.05 (191)	0.96	0.05 (181.46)	0.96	0.01 [-0.27, 0.29]

Table 3 (cont'd)

13. Psychological Reactance (T4)	3.44 (1.01) [3.24, 3.66]	3.47 (0.98) [3.28, 3.67]	0.05	0.82	-0.15 (191)	0.88	-0.15 (190.85)	0.88	-0.02 [-0.30, 0.26]
14. Intention (T4)	4.90 (0.75) [4.73, 5.08]	5.09 (0.90) [4.92, 5.23]	0.32	0.57	-1.51 (193)	0.13	-1.51 (192.24)	0.13	-0.22 [-0.50, 0.07]

Table 4.

Interitem correlation coefficients with means, standard deviations, and 95% confidence intervals with alpha reliability coefficients for all study variables across time points.

	M (SD) [95% CI]	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**
1. Psychological Reactance (T1)	3.63 (.83) [3.49, 3.79]	*(a=.86)*											
2. Psychological Reactance (T2)	3.43 (.91) [3.278, 3.60]	**.85***	*(a=.87)*										
3. Psychological Reactance (T3)	3.40 (.96) [3.22, 3.57]	**.84***	**.87***	*(a=.89)*									
4. Psychological Reactance (T4)	3.48 (1.04) [3.30, 3.68]	**.84***	**.88***	**.89***	*(a=.89)*								
5. Message Fatigue (T1)	3.07 (1.01) [2.89, 3.27]	**.30***	**.36***	**.33***	**.34***	*(a=.93)*							
6. Message Fatigue (T2)	3.15 (1.05) [2.96, 3.35]	**.34***	**.35***	**.35***	**.38***	**.88***	*(a=.95)*						
7. Message Fatigue (T3)	3.29 (1.19) [3.07, 3.52]	**.32***	**.38****	**.41***	**.44***	**.80***	**.86***	*(a=.96)*					
8. Message Fatigue (T4)	3.34 (1.19) [3.12, 3.56]	**.32***	**.36***	**.34***	**.39***	**.57***	**.678***	**.79***	*(a=.96)*				
9. Intention (T1)	5.17 (.80) [5.01, 5.31]	**-.24***	**-.20***	**-.29***	**-.30***	**-.33***	**-.38***	**-.37***	**-.27***	*(a=.81)*			
10. Intention (T2)	5.15 (.82) [4.98, 5.30]	**-.32***	**-.25***	**-.33***	**-.30***	**-.37***	**-.37***	**-.39***	**-.32***	**.73***	*(a=.79)*		
11. Intention (T3)	5.03 (.91) [4.86, 5.20]	**-.30***	**-.26***	**-.33***	**-.34***	**-.41***	**-.41***	**-.45***	**-.38***	**.69***	**.79***	*(a=.84)*	
12. Intention (T4)	4.97 (.86) [4.80, 5.13]	**-.22***	**-.25***	**-.28***	**-.30***	**-.35***	**-.38***	**-.50***	**-.43***	**.63***	**.75***	**.82***	*(a=.80)*

* = p <.05

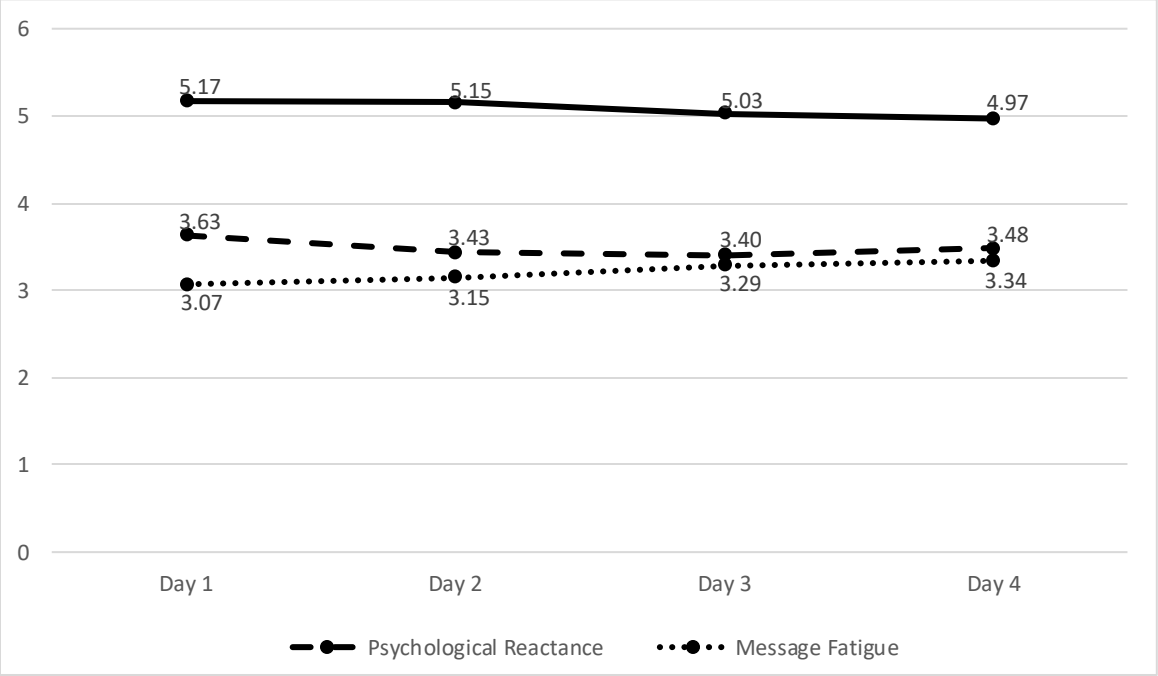
Table 5.

First and second order CFA results for message fatigue.

Model	x^2	*df*	x^2_{diff}	*CFI*	*NFI*	*RMSEA [90% CI]*	*SRMR*
Time 1							
First Order	359.91	113	-	0.91	0.86	0.10 [0.09, 0.12]	0.06
Second Order	376.43	115	16.52*	0.91	0.87	0.11 [0.10, 0.12]	0.07
Time 2							
First Order	280.87	113	-	0.95	0.92	0.08 [0.07, 0.09]	0.05
Second Order	322.25	115	41.38*	0.94	0.91	0.09 [0.08, 0.10]	0.06
Time 3							
First Order	324.07	113	-	0.94	0.92	0.09 [0.08, 0.10]	0.05
Second Order	381.16	115	57.09*	0.93	0.90	0.10 [0.09, 0.11]	0.06
Time 4							
First Order	336.29	113	-	0.94	0.91	0.10 [0.09, 0.11]	0.05
Second Order	372.01	115	35.72*	0.93	0.90	0.11 [0.10, 0.12]	0.06

Figure 1.

Study variable means across time points.



Hypotheses were tested by fitting latent growth curve models to each study variable (McArdle & Epstein, 1987; Meredith & Tisak, 1990) using the "growth()" function in the R package "lavaan." A latent growth curve model maps the trajectory or rate of change of a variable over time, estimating the intercept—the starting value of the given variable—and its slope or rate of change. The estimate of the slope can be used to infer whether change occurs in the variable over time and in which direction (i.e., increasing or decreasing over time). This analysis also allows for the fitting of bivariate growth curve models, in which two variables are modeling as changing with one another, providing estimates for the extent to which either variable's slope and intercept estimates are interrelated. Latent models for each set of analyses were set with intercept loadings fixed to "1" and slope loadings fixed to "0" for the first message exposure, "1" for the second exposure, "2" for the third exposure, and "3" for the fourth and final message exposure (Preacher et al., 2008). Model fit for growth curve models is assessed with indices similar to structural equation modeling and confirmatory factor analysis (e.g., χ^2, CFI, TLI, RMSEA, SRMR), though it is a best practice to judge fit against alternative model specifications (see Curran, Obeidat, & Losardo, 2010). Variances and covariances were estimated with robust standard errors by successively testing 1) an intercept-only or "no growth" model (see Figure 1 for general path model), 2) a linear growth model (see Figure 2 for general path model), and 3) a linear growth model in which residuals were fixed or homoscedastic (Grimm, Ram, & Estabrook, 2017). Missing data were accommodated using full information maximum likelihood (Enders, 2010).

Figure 2.

Path model of the "no growth" or "intercept-only" model used for each variable.

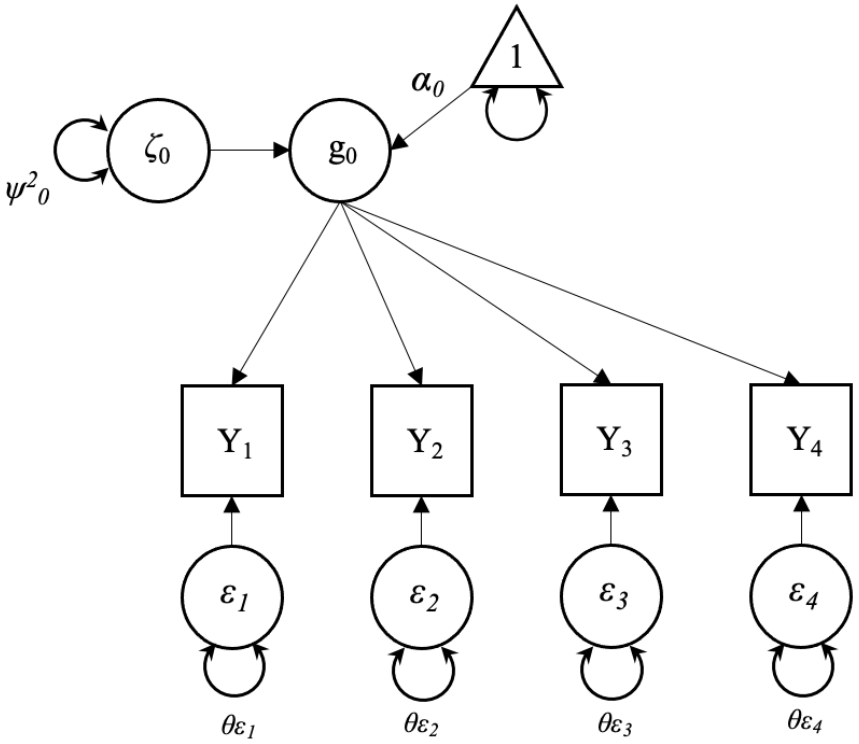
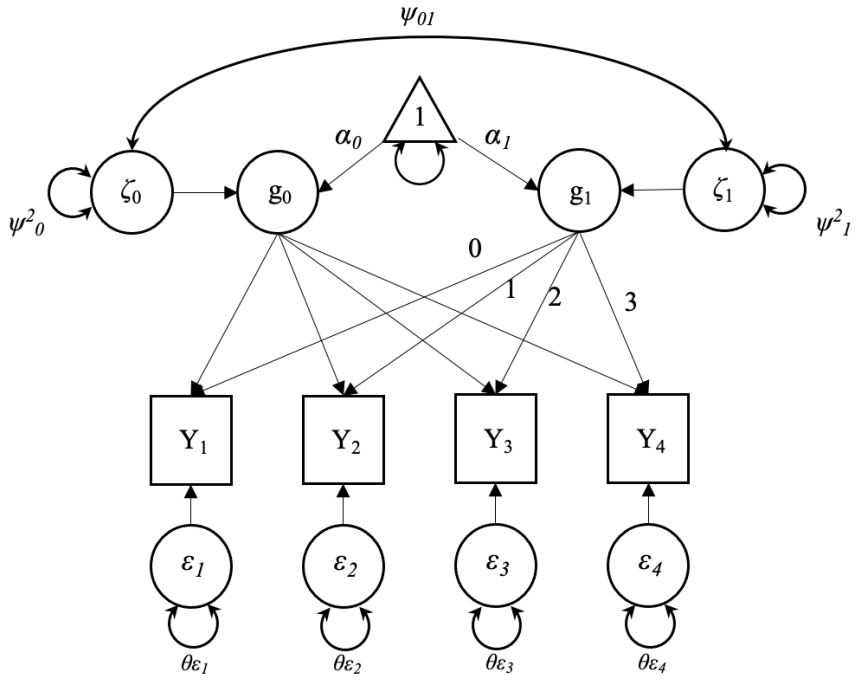


Figure 3.

Path model of a general linear growth model used for each variable.



Hypothesis One

Hypothesis one predicted that individuals who experience less message repetition will have less message fatigue than those who experience more message repetition. In other words, message fatigue and message repetition should be positively related. This was tested by fitting a latent growth curve model to participant ratings of message fatigue across the four message exposures. Shown in Table 6, first, the "no growth" model was estimated and showed poor fit with the data$\Delta\chi^2(3) = 28.09$, $p < .05$ (8) = 80.21, $p < .05$, RMSEA = .18 [.15, .21], *CFI* = .77, *TLI* = .83, *SRMR* = .07. The linear model showed improved though still not ideal fit with the data, $\chi^2(5) = 19.91$, $p < .05$, *RMSEA* = .10 [.06, .56], *CFI* = .95, *TLI* = .94 = .07, and fit the data significantly better than the no growth model according to the likelihood ratio test, $\Delta\chi^2$ (3) = 52.45, p <.05. Constraining residuals to be homoscedastic resulted in a statistically significant

poorer fit with the data, $\Delta\chi^2$ (3) = 17.86, p <.05, so the heteroscedastic model was retained. Parameter estimates suggest an average "starting point" or time 1 score of 2.98 (*SE* = .06), p < .05, and a rate of change of .11 (*SE* = .02), p <.05. Furthermore, there was not a statistically significant association between the intercept/starting score and the rate of change, meaning that the rate at which an individual changed over time was not a function of how high or low they scored on message fatigue at the first message exposure. Overall, the direction and statistical significance of the rate of change estimate suggests that message fatigue increased over time, across subsequent message exposures. Therefore, hypothesis one was supported.

Change in reported message fatigue was further explored by fitting a quadratic growth curve model (see Figure 3 for general path model), which assesses whether the data show a "U-shaped curve," meaning scores move in one direction over time and then at some point move in the other (Curran et al., 2010), to assess if this model better fit the data. This model did not show improved or worsened fit compared to the linear model, $\Delta\chi^2$ (1) = .04, p = .84, and the curvature parameter, which would suggest whether and in which direction a "U-shaped curve" was exhibited, was not statistically significant, -.003 (.02), p = .84. Therefore, there did not appear to be a quadratic growth pattern in these data. To explore this one step further in an attempt to fit a model more accurately representing the data, a latent curve model was fit with the data (see Figure 4 for general path model), in which only the first and final slope loadings are fixed while the remaining values are estimated and can be interpreted in Table 6 as the percent deviation from what would be expected in the linear model (McArdle & Epstein, 1987). This model also fit the data approximately as well as the linear model, $\chi^2(3) = 24.30$, $p < .05$, *RMSEA* = .16 [.09, .24]. *CFI* = .93, *TLI* = .87, *SRMR* = .09, and approximately as well as the linear model according to the likelihood ratio test, $\Delta\chi^2(2) = 3.61$, p = .16. This model was ultimately retained given that

more variance was explained in the intercept and slope parameters and given the pattern of results observed in estimating time-specific slopes. As can be seen in Table 6, the slope parameter at Time 2 was estimated at 1.03 (*SE* = .23), $p < .05$, meaning there was approximately a 3% steeper slope than would be expected under linearity, and a Time 3 estimate of 2.88 (*SE* = .49), $p < .05$, meaning there was approximately an 88% steeper slope than expected under linearity. In all, hypothesis one was supported but analyses showed a more complex pattern than expected.

Table 6.

Model comparisons assuming no growth, linear growth, quadratic growth, and growth using a latent curve of message fatigue across time points.

Parameter	No Growth Estimate (SE)	Linear Growth Estimate (SE)	Latent Model Estimate (SE)
Mean intercept (α_1)	**3.10*** (.06)	**2.98*** (.06)	**2.99*** (.06)
Mean slope (α_2)	-	**.11*** (.02)	**.08*** (.03)
Intercept variance (ψ^2_0)	**.88*** (.08)	**.90*** (.09)	**.86*** (.09)
Slope variance (ψ^2_1)	-	**.07*** (.02)	**.05*** (.02)
Curvature Parameter	-	-	-
Intercept/slope covariance (ψ_{01})	-	-.04 (.03), p = .20	-.01 (.03), p = .84
Variance			
Time 1	**.21*** (.04)	.06 (.09), p = .28	.08 (.06), p =.17
Time 2	**.10*** (.02)	**.14*** (.03)	**.13*** (.02)
Time 3	**.29*** (.05)	**.17*** (.04)	.07 (.09), p = .42
Time 4	**.66*** (.12)	**.35*** (.10)	**.48*** (.15)
Percent Change in Outcome (Latent Basis Model)			
Time 1	-	-	0
Time 2	-	-	**1.03*** (.30)
Time 3	-	-	**2.88*** (.80)
Time 4	-	-	3
Model Fit			
χ^2 (*df*)	**80.21*** (8)	**19.91*** (5)	**24.30*** (3)

Table 6 (cont'd)

RMSEA [90% CI]	.18 [.15, 21]	.10 [.06, .15]	.16 [.09, .24]
CFI	.77	.95	.93
TLI	.83	.94	.87
SRMR	.11	.07	.09
χ^2 (*df*) Change	-	**52.45*** (3) (vs. No Growth)	3.61 (2), *p* = .16 (vs. Linear)

* = p < .05; *Note*: $\Delta\chi 2$ (3) = 17.86, p < .05 between linear growth models assuming heteroscedastic versus homoscedastic residuals

Figure 4.

Path model of a general quadratic growth model.

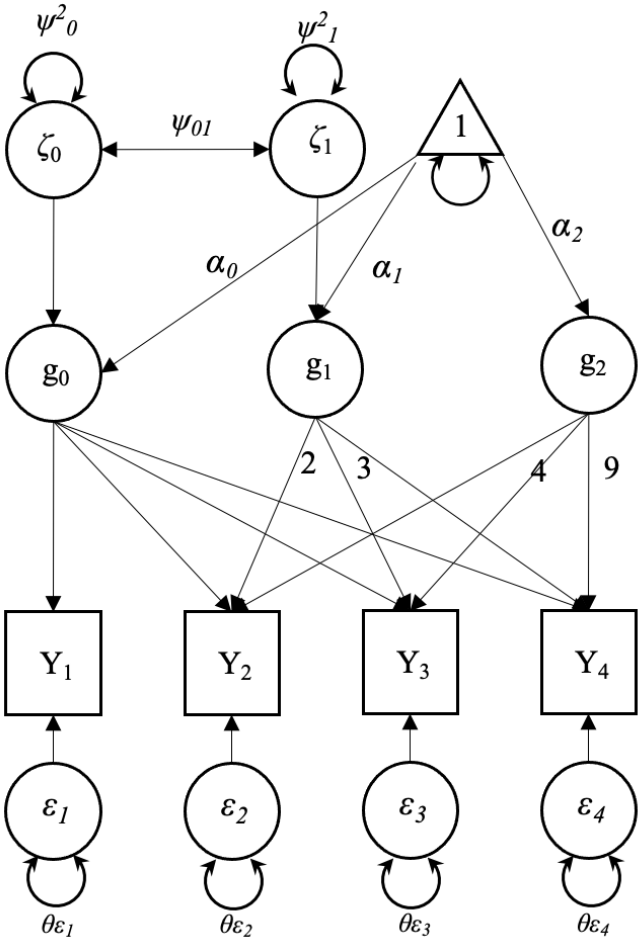
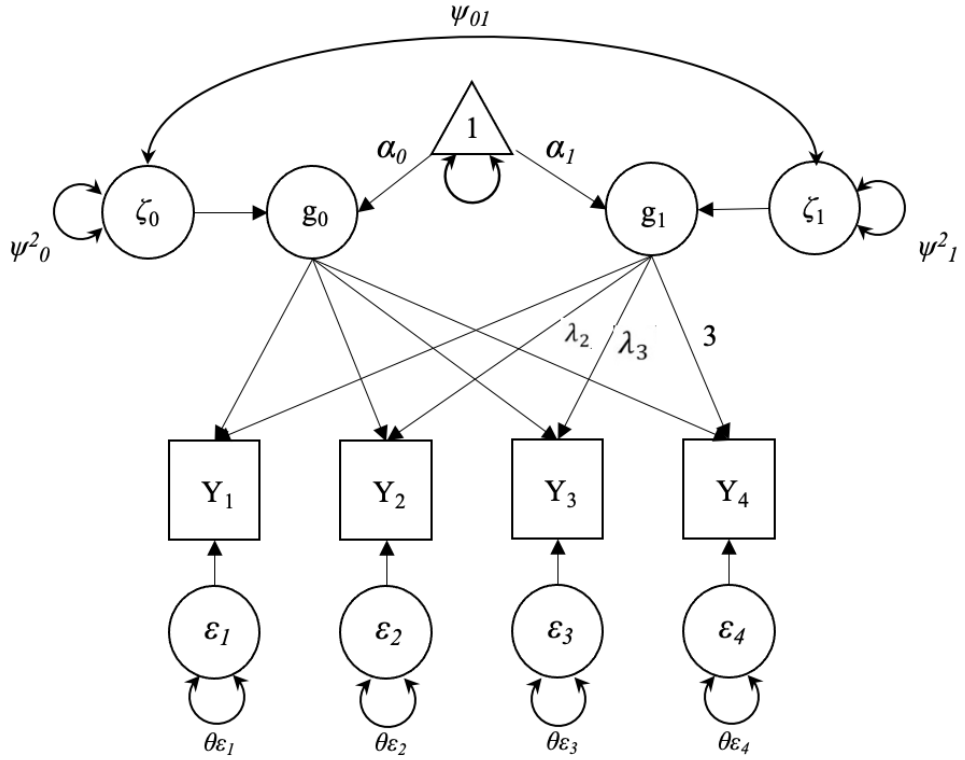


Figure 5.

Path model of a general latent growth model used for each variable.



Hypothesis Two

Hypothesis two predicted that there will be a positive relationship between message repetition and psychological reactance, such that as message repetition increases so will feelings of psychological reactance. In other words, psychological reactance should increase over time across subsequent message exposures. This was again tested by fitting a latent growth curve model to participant ratings of psychological reactance across the four message exposures. Shown in Table 7, the no growth model showed poor fit with the data, $\chi^2(8) = 38.92$, $p < .05$, *RMSEA* = .12 [.09, .15], *CFI* = .93, *TLI* = .94, *SRMR* = .10, while the linear growth curve model showed adequate though still not ideal fit with the data, $\chi^2(5) = 15.49$, $p < .05$, *RMSEA* = .09

[.04, .14], *CFI* = .99, *TLI* = .99, *SRMR* = .03, and performed significantly better than the no growth model, $\Delta\chi^2(3) = 20.46$, $p < .05$. Assuming homoscedastic residuals did not change the data fit, $\Delta\chi^2(3) = 2.47$, $p = .48$, but overall fit indices should good fit with the data, $\chi^2(8) = 14.74$, $p = .07$, *RMSEA* = .06 [.01, .10], *CFI* = .99, *TLI* = .99, *SRMR* = .03, so the homoscedastic residual model was retained. Parameter estimates suggest an average "starting point" or time 1 score of 3.55 (*SE* = .05), and a rate of change of -.04 (*SE* = .01), $p < .05$. The sign and statistical significance of the rate of change estimate suggests that psychological reactance decreased over time, across subsequent message exposures, which was the opposite of what was predicted. This analysis did not support hypothesis two.

While the linear model with homoscedastic residuals fit the data well, there was still room to improve model fit. As such, change was further explored by fitting a quadratic growth curve model. This model showed excellent fit with the data, $\chi^2(7) = 7.85$, $p = .35$, *RMSEA* = .02 [.00, .07], *CFI* = 1.00, *TFI* = 1.00, *SRMR* = .02, and showed significantly improved fit with the data compared to the linear growth model according to the likelihood ratio test, $\Delta\chi^2(1) = 10.17$, $p < .05$. The curvature parameter was estimated as .04 (*SE* = .02), $p < .05$. The sign and statistical significance of this coefficient implied that the data follow a convex shape, meaning that psychological reactance scores at first decrease, and then at some time point increase once again. Inspection of the mean scores across time points in Table 4 suggest that participant reports of psychological reactance decreased over time through the third message exposure but increased following the fourth and final message exposure. Therefore, hypothesis two was partially supported; with support only between the final two message exposures, but results showed a more complex pattern than predicted. Given the overall change parameter (slope) estimate being negative and statistically significant, hypotheses two was overall not supported. However,

analyses again showed a more complicated relationship between message repetition and psychological reactance.

Table 7.

Model comparisons assuming no growth, linear growth, and quadratic growth of psychological reactance across time points.

	No Growth	**Linear Growth**	**Linear Growth**	**Quadratic Growth**
	Estimate (SE)	**Estimate (SE)**	**Estimate (SE)**	**Estimate (SE)**
Mean intercept (α_1)	**3.49*** (.05)	**3.54*** (.05)	**3.55*** (.05)	**3.58*** (.05)
Mean slope (α_2)	-	**-.03*** (.01)	**-.04*** (.01)	**-.17*** (.05)
Intercept variance (ψ^2_0)	**.74*** (.07)	**.59*** (.01)	**.61*** (.06)	**.62*** (.06)
Slope variance (ψ^2_1)	-	.01 (.01), p = .45	**.01*** (.01)	.01 (.01), p = .07
Curvature Parameter (g_2)	-	-	-	**.04*** (.02)
Intercept/slope covariance (ψ_{01})	-	**.05*** (.01)	**.04*** (.01)	**.04*** (.01)
Variance	-	-	**.12*** (.01) (Time 1-4)	**.11*** (.01) (Time 1-4)
Time 1 (ε_1)	**.19*** (.03)	**.16*** (.03)	-	-
Time 2 (ε_2)	**.10*** (.03)	**.11*** (.02)	-	-
Time 3 (ε_3)	**.12*** (.02)	**.11*** (.02)	-	-
Time 4 (ε_4)	**.13*** (.03)	**.11*** (.02)	-	-
Model Fit				
χ^2 (df)	**38.92*** (8)	**15.49*** (5)	14.74 (8), p = .07	7.85 (7), p = .35
RMSEA [90% CI]	.12 [.09, .15]	.09 [.04, .14]	.06 [.01, .10]	.02 [.00, .07]
CFI	.93	.99	.99	1.00
TLI	.94	.99	.99	1.00
SRMR	.10	.03	.03	.02
$\Delta\chi^2$ (df)	-	**20.46*** (3)	**25.36*** (3) (vs No Growth)	**10.17*** (1) (vs Linear)

* = p <.05; *Note:* $\Delta\chi^2$ (3) = 2.47, p = .48 between linear growth models assuming heteroscedastic versus homoscedastic residuals.

Hypothesis Three

Hypothesis three predicted there will be a positive relationship between message repetition and boomerang effects, such that as message repetition increases, so will the likelihood of boomerang effects. In other words, reported intention scores should decrease over time as message exposures increase. This was assessed by fitting a latent growth curve model to participant ratings of intention across the four message exposures. Shown in Table 8, the no growth model showed poor fit with the data well, $\chi^2(8) = 35.93$, $p < .05$, *RMSEA* = .11 [.08, .15], *CFI* = .93, *TLI* = .95, *SRMR* = .09, while the linear growth curve model showed excellent fit with the data, $\chi^2(5) = 5.33$, $p = .38$, *RMSEA* = .02 [.00, .08], *SRMR* = .04, and fit the data significantly better than a model assuming no change over time according to the likelihood ratio test, $\Delta\chi^2(3) = 28.09$, $p < .05$. Assuming homoscedastic residuals resulted in poorer fit with the data, $\Delta\chi^2(3) = 8.39$, $p < .05$, so the heteroscedastic residual model was retained. Parameter estimates suggest an average "starting point" or time 1 score of 5.22 (*SE* = .05), and a rate of change of -.07 (*SE* = .02), $p < .05$. The sign and statistical significance of the rate of change estimate suggests that intention decreased over time, across subsequent message exposures. Therefore, hypothesis three was supported.

Table 8.

Linear growth curve model of intention across time points.

Parameter	No Growth Estimate (SE)	Linear Growth Estimate (SE)
Mean intercept (α_1)	**5.12*** (.05)	**5.22*** (.05)
Mean slope (α_2)	-	**-.07*** (.02)
Intercept variance (ψ^2_0)	**.56*** (.07)	**.58*** (.08)
Slope variance (ψ^2_1)	-	**.03*** (.01)
Intercept/slope covariance (ψ_{01})	-	-.03 (.02), $p = .13$
Variance	-	-
Time 1 (ε_1)	**.28*** (.05)	**.19*** (.05)

Table 8 (cont'd)

Time 2 (ε_2)	**.15*** (.03)	**.15*** (.03)
Time 3 (ε_3)	**.19*** (.03)	**.19*** (.03)
Time 4 (ε_4)	**.21*** (.03)	**.09*** (.04)
Model Fit		
χ^2 (*df*)	**35.93*** (8)	5.33 (5), p = .38
RMSEA [90% CI]	.11 [.08, .15]	.02 [.00, .08]
CFI	.93	1.00
TLI	.95	1.00
SRMR	.09	.04
$\Delta\chi^2$ (*df*)	-	**28.09*** (3) (vs. No Growth)

* = $p < .05$; *Note:* $\Delta\chi^2$ (3) = 8.39, $p < .05$ between linear growth models assuming heteroscedastic versus homoscedastic residuals

Hypothesis Four

Hypothesis four predicted that message fatigue will mediate the relationship between message repetition and psychological reactance. Given the nature of these data, a formal mediation test was not conducted as message repetition cannot be isolated from each variable. Instead, a bivariate growth curve model (see Figure 5 for general path model) was fit in which change in message fatigue over time—which is here inherently tied to repeated exposure to study messages—was modeled as covarying with change in psychological reactance—which is also inherently tied to repeated exposure to messages in this study—over time (Curran et al., 2010).

Table 9 shows the results of this model test. As can be seen, the bivariate model fit the data well, $\chi^2(21) = 30.16$, $p = .09$ *RMSEA* = .04 [.00, .07], *CFI* = .99, *TLI* = .99, SRMR = .06, and fit approximately as well as the final quadratic growth model for psychological reactance on its own, $\Delta\chi^2(14) = 23.08$, $p = .06$. The rate of change for message fatigue and the rate of change for psychological reactance were estimated to have a small though statistically significant

covariance, .01 (*SE* = .004), $p < .05$, meaning that the change in one over time was associated with over-time change in the other. There was also a statistically significant association between the starting value of psychological reactance with both its own change over time, .04 (*SE* = .01), $p < .05$, and with the starting value of message fatigue, .24 (*SE* = .06), $p < .05$. Given the signs of these coefficients, it can be inferred that baseline psychological reactance scores were positively associated with baseline message fatigue scores—the more message fatigue experienced, the more reactance experienced—and with the rate at which reported psychological reactance changed over time—the higher one's baseline fatigue, the faster one's psychological reactance changed over time. There were no associations between the intercept value of message fatigue and its own rate of change of that of psychological reactance. Taken together, these data support hypothesis four.

Figure 6.

Path model of the bivariate growth model used for either analysis.

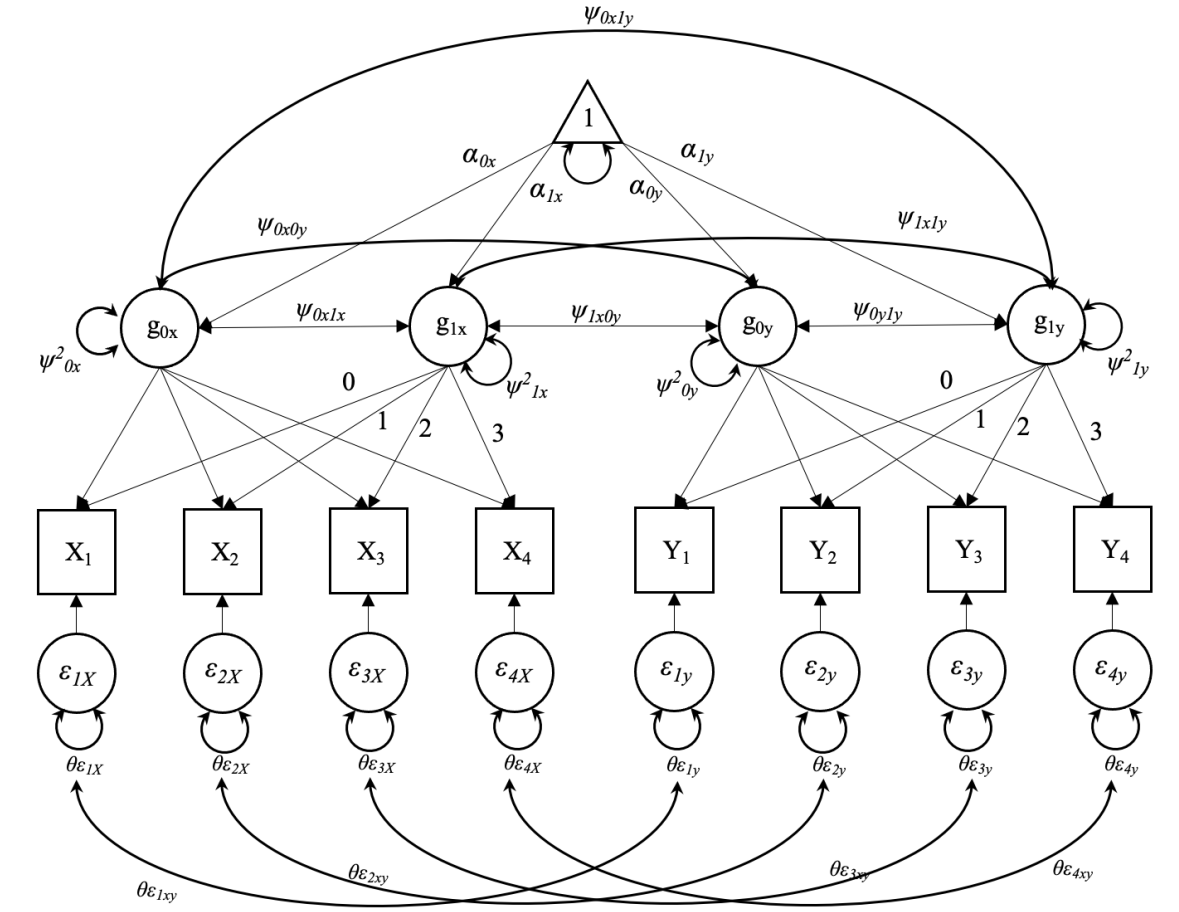


Table 9.

Bivariate growth curve of message fatigue covarying with psychological reactance.

Parameter	Message Fatigue Estimate (SE)	Psychological Reactance Estimate (SE)
Mean intercept (α_1)	**2.99*** (.06)	**3.59*** (.05)
Mean slope (α_2)	**.07*** (.02)	**-.17*** (.05)
Intercept variance (ψ^2_0)	**.85*** (.09)	**.62*** (.06)
Slope variance (ψ^2_1)	**.04*** (.02)	.01 (.01), p = .08
Curvature Parameter (g_2)	**.04*** (.01)	
Covariances		

Table 9 (cont'd)

Reactance Intercept with Reactance Slope (ψ_{0x1x})	**.04*** (.01)	
Fatigue Intercept with Fatigue Slope (ψ_{0y1y})	.001 (.03), p = .98	
Reactance Intercept with Fatigue Intercept (ψ_{0x0y})	**.24*** (.06)	
Reactance Intercept with Fatigue Slope (ψ_{0x1y})	.03 (.02), p = .09	
Fatigue Intercept with Reactance Slope (ψ_{1x0y})	.03 (.01), p = .06	
Reactance Slope with Fatigue Slope (ψ_{1x1y})	**.01*** (.004)	
Percent Change in Outcome (Latent Basis Model)		
Time 1	1	-
Time 2 (λ_2)	**1.03*** (.28)	-
Time 3 (λ_3)	**3.13*** (.85)	-
Time 4	3	-
Variances	-	**.11*** (.01)
Time 1 (ε_1)	.06 (.06), p = .29	-
Time 2 (ε_2)	**.14*** (.03)	-
Time 3 (ε_3)	**.16*** (.03)	-
Time 4 (ε_4)	**.51*** (.14)	-
Model Fit		
χ^2 (*df*)	30.16 (21), p = .09	
RMSEA [90% CI]	.04 [.00, .07]	
CFI	.99	
TLI	.99	
SRMR	.06	
$\Delta\chi2$ (*df*)	23.08 (14), p = .06 (vs. Reactance Quadratic)	

* = p < .05; Note: Reactance was fit with homoscedastic residuals and fatigue was fitted with residuals free to vary given the results shown in Tables 3-5; The bivariate model allowing

slope parameters to be freely estimated for message fatigue (Model B; versus being fixed in Model A) showed improved fix according to the likelihood ratio test, $\chi2$ (2) = 6.24, p < .05.

Hypothesis Five

Finally, hypothesis five predicted that message fatigue will mediate the relationship between message repetition and the boomerang effect. Again, these data did not lend themselves to a typical mediation test, so instead, a bivariate growth curve model was fit in which change in

message fatigue over time was modeled as covarying with change in intention—which is also inherently tied to repeated exposure to messages in this study—over time. Table 10 shows the results of this model test. As can be seen, the bivariate model fit the data well, $\chi^2(19) = 23.98$, $p = .20$, *RMSEA* = .03 [.00, .06], *CFI* = 1.00, *TLI* = 1.00, SRMR = .06, and fit approximately as well as the linear growth model for intention on its own, $\Delta\chi^2(14) = 18.67$, $p = .18$. The rate of change for message fatigue and the rate of change for intention were estimated to have a small though statistically significant covariance, -.02 (*SE* = .01), $p < .05$, meaning that the change in one over time was negatively associated with over-time change in the other. There was also a statistically significant association between the starting value of intention with the starting value of message fatigue, -.25 (*SE* = .06), $p < .05$. Given the signs of these coefficients, it can be inferred that baseline intention scores were negatively associated with baseline message fatigue scores—the more message fatigue experienced, the less intention or more boomerang effects reported. There were no other statistically significant associations between intercept and slope values. Taken together, these data support hypothesis five.

Table 10.

Bivariate growth curve of message fatigue covarying with intention.

Parameter	Message Fatigue Estimate (SE)	Intention Estimate (SE)
Mean intercept (α_1)	**2.99*** (.06)	**5.22*** (.05)
Mean slope (α_2)	**.09*** (.03)	**-.07*** (.02)
Intercept variance (ψ^2_0)	**.87*** (.09)	**.58*** (.08)
Slope variance (ψ^2_1)	**.05*** (.02)	**.03*** (.01)
Covariances		
Intention Intercept with Intention Slope (ψ_{0x1x})	-.03 (.02), $p = .11$	
Fatigue Intercept with Fatigue Slope (ψ_{0y1y})	-.01 (.03), $p = .78$	
Intention Intercept with Fatigue Intercept (ψ_{0x0y})	**-.25*** (.06)	
Intention Intercept with Fatigue Slope (ψ_{0x1y})	-.02 (.02), $p = .16$	
Fatigue Intercept with Intention Slope (ψ_{1x0y})	-.02 (.02), $p = .31$	
Intention Slope with Fatigue Slope (ψ_{1x1y})	**-.02*** (.01)	

Table 10 (cont'd)

Percent Change in Outcome (Latent Basis Model)		
Time 1	1	-
Time 2 (λ_2)	**1.00*** (.29)	-
Time 3 (λ_3)	**2.77*** (.56)	-
Time 4	3	-
Variances		
Time 1 (ε_1)	.08 (.05), p = .14	**.18*** (.05)
Time 2 (ε_2)	**.13*** (.02)	**.15*** (.03)
Time 3 (ε_3)	.09 (.06), p = .16	**.19*** (.03)
Time 4 (ε_4)	**.47*** (.13)	**.08*** (.04)
Model Fit		
χ^2 (*df*)	23.98 (19), p = .20	
RMSEA [90% CI]	.03 [.00, .06]	
CFI	1.00	
TLI	1.00	
SRMR	.06	
$\Delta\chi2$ (*df*)	18.67 (14), p = .18 (vs. Intention Linear)	

* = p < .05; Note: Reactance was fit with homoscedastic residuals and fatigue was fitted with residuals free to vary given the results shown in Tables 3-5; The bivariate model allowing slope parameters to be freely estimated for message fatigue (Model B; versus being fixed in Model A) showed improved fix according to the likelihood ratio test, $\chi2$ (2) = 4.17, p = .12.

DISCUSSION

As science continues to emerge about the various factors that can influence one's health, there is a simultaneous emergence in health messaging to provide people with the information to make decisions to best protect their health. However, much of the prior work in this realm has been limited to cross-sectional research, or experimental designs with immediate or near-immediate post-test measurement at best (Bokemper et al., 2022; Matt, 2022; Trelohan, 2022; Flicińska-Turkiewicz et al., 2022; Kim et al., 2022). Much of the early work on repetitive messaging has been conducted outside the realm of health messaging, with work in advertising showing that there may be a curve in which repetition does result in positive outcomes, but eventually hits a plateau with future repetition resulting in diminished or negative effects (Berlyne, 1970;1971; Sawyer, 1981). Related research also shows support for the notion that message repetition can affect one's feelings or beliefs towards the message content (Sidhu et al., 2022; Jia et al., 2022; Stanton et al., 2022).

In the domain of health communication, message exposure has been found to be associated with perceived susceptibility and response efficacy (Biggsby et al., 2022; Rainear & Christensen, 2022; Basirat et al., 2022; Neil et al., 2022). However, as repetition continues there is evidence that thoughts relating to the message stimuli decreased, whereas heuristic thoughts increased (Shi & Smith, 2016; Garcia-Marques & Mackie, 2001). Message fatigue, one emerging topic related is believed to be an outcome of repetitive messaging due to perceived over-exposure, perceived redundancy, exhaustion, and/or tedium. Recent work investigating message fatigue provides limited support that message fatigue can results in unfavorable outcomes to the message content (So & Alam, 2019; So et al., 2016; So, 2021; Dillard et al., 2018).

This dissertation seeks to advance communication science work by using a novel approach to further investigate the impacts of repetitive public health messages and the potential negative effects that can occur in receivers of such messages. Public health messages have been and continue to be created to help promote awareness, information retention, and behavioral change (Nan et al., 2022; Vafeiadis & Shen, 2022) and as technology continues to advance, public health messages will continue to be disseminated in novel ways. This research used a unique dissemination method for public health messaging by texting participants their public health message. Participants were randomly assigned to one of two different message conditions (a breast cancer message condition or an HPV message condition) to determine the relationship between message repetition, message fatigue, psychological reactance, and boomerang effects over time as message repetition continues. Prior to analyses, results revealed no differences between the two message conditions, allowing for them to be collapsed for analyses. This bolsters the robustness of these findings, avoiding the single-message error and possibility that findings could be based solely on the message content (Jacobs, O'Keefe, & Jacobs, 1988; Jackson & Jacobs, 1983).

There is an apparent link between message repetition and negative outcomes. Psychological reactance theory posits that psychological reactance is a result of an individual's perception that their freedom has been impeded upon, or that the individual feels as if social pressures are influencing them to enact a specified behavior or accept a specified belief (Brehm, 1966; S. Brehm & J. Brehm, 1981; Dillard & Shen, 2005). Psychological reactance is seen as a negative motivational stimulation experienced when an individual believes that their free will is being impeded upon (Brehm, 1966; Dillard & Shen, 2005). Much of the work in psychological reactance has found a connection between message exposure and increased psychological

reactance (Campo & Cameron, 2006; Shorey-Fennell & Magnan, 2019; Dillard et al., 2021). From these studies, it appears that people who believe or act contrary to the message content experience more psychological reactance as messaging increases (Clayton, 2022; Kim & So, 2018; So, 2021; Reynods-Tylus, 2019), creating cause for concern on how to reach audiences that would benefit most from attitudinal or behavioral change.

Another potential negative outcome of repetition is boomerang effects, which occurs when individuals do the opposite of what a message is promoting (Hoyland et al., 1953). There have been associations between boomerang effects and psychological reactance, however, these phenomena are two distinct different entities. Where psychological reactance investigates feelings associated with a loss or perceived loss of freedom (Brehm, 1966), boomerang effects refer to specific actions (Hoyland et al., 1953). While there is some support of the notion that messaging strategies and content can result in lowered likelihood of engaging in promoted behaviors (Belch, 1982), the literature as a whole is inconclusive (Yang et al., 2021; Keller-Hamilton et al., 2023).

This dissertation investigates the impact of message repetition as it relates to message fatigue, psychological reactance, and boomerang effects by using a novel dissemination method and a time series approach. More specifically, this dissertation examines how repetitive public health messages can influence one's experience of message fatigue, psychological reactance, and boomerang effects. Additionally, it examines the ways that message fatigue interacts with psychological reactance and boomerang effects. This section starts with an overview of the study's findings. It goes on to discuss implications for communication science and public health messaging. Following this, study limitations are discussed before ending with a conclusion.

Implications of Hypothesis Testing

The results of this study showed that repetitive public health messaging is related to message fatigue and psychological reactance, but not always as expected. While latent growth curve modeling shows a positive relationship between message repetition and message fatigue, supporting hypothesis 1, additional investigation using latent growth curve modeling in which only the first and final slope loadings are fixed showed that this relationship is more complex than expected. After the first message, the slope parameter was 3% steeper than it would be assumed under linearity; however, this changed drastically after the second message, with the slope parameter being 88% steeper than assumed under linearity. These findings are not consistent with past work, as previous research has shown that the third repetition is when negative effects begin to manifest (Shi & Smith, 2016). These findings expand on the limited work surrounding message fatigue and imply that message fatigue can begin to manifest in individuals before other negative outcomes, such as reactance and boomerang effects. These results demonstrate that message fatigue may serve as precursor to additional forthcoming negative outcomes and may serve as a warning sign for future unintended outcomes if repetition continues.

Hypothesis 2 states that message repetition and psychological reactance are positive related, such that as repetition increases, as will reactance. This was not supported using latent growth curve modeling, with results showing the opposite, reactance scores decreased as repetitions increased. But quadratic growth curve modeling showed an interesting convex shape, such that reactance scores decrease after the first three message repetitions, and then begin to increase after the fourth message repetition. This supports prior work, such as Berlyne's (1970; 1971) two factor model, which states that message repetition can fall on a U-shaped curve and

that repetitions fall within different stages. During the wear-in stage, the first few repetitions are effective and have a positive effect until they hit a plateau. As messages continue to repeat, the wear-out phase begins, and message repetitions can have negative effects on the individual. One rationale for this is that women may not feel like their free will is impeded upon until they have begun to feel fatigued by messages, which would explain the findings that fatigue increased after the second repetition, but psychological reactance did not increase until the fourth and final repetition. This supports past work that has investigated the effects of message repetition but recommended additional work with additional repetitions (Shi & Smith 2016). Further, given the rate of change in these findings, more work with additional repetitions is needed to more fully understand the effects of repetition.

Hypothesis 3 states that message repetition and boomerang effects are positively related, such that as repetitions increase so will boomerang effects. Given that we were unable to surveil participants for actions, we used intent to do the action as a proxy measure for boomerang effects. Results show a negative relationship between message repetition and intention, such that each repetition resulted in less likelihood of engaging in the promoted behavior. While there is limited work into boomerang effects, especially as they change over time, the results of such investigation are inconclusive, with both no effect of message repetition on behavioral intention being found (Keller-Hamilton et al., 2023; Betts et al., 2019), as well as message repetition resulting in decreased intention, signifying boomerang effects (Kim & So, 2018; Belch, 1982). Further, these data show that boomerang effects may be present after the first exposure, with intention scores decreasing with each message. It could be that static messages may not elicit behavioral change as well as visual, interactive, and dynamic messages as these types of messages have been found to elicit more emotional and cognitive responses (Li & Sundar, 2022;

Namin et al., 2020; King & Lizard, 2020). However, this is beyond the scope of the present work and sets the scene for potential future investigations into these phenomena.

Hypothesis 4 states that message fatigue will mediate the relationship between message repetition and psychological reactance. Bivariate growth curve modeling showed that change in message fatigue scores were related to psychological reactance scores over time, as well as baseline message fatigue scores being associated with change in time scores of psychological reactance, supporting this hypothesis. These data show that message fatigue had a sharp incline after the second message repetition, whereas reactance did not increase until the fourth and final message. While reactance has been linked to message repetition, no other work has looked at the potential mediating effects of message fatigue on reactance, instead, prior investigation into psychological reactance has mainly focused on reactance being the main force behind adhering to a recommended message or not (Martinez Gonzales; Kim & So, 2018). Our findings suggest that psychological reactance may not be the primary force behind message fatigue, but instead that message fatigue may lead to psychological reactance, revealing that messaging dissemination methods should be wary of eliciting message fatigue, especially as public health messaging continues to become more salient. If a campaign's messaging strategies elicit message fatigue, action would be best taken to alleviate this fatigue, or additional outcomes such as reactance may manifest in audience members, further making it difficult to enact behavioral or attitudinal change. For example, in breast cancer messaging, pinkwashing is a phenomenon seen recently in media to promote breast cancer awareness and prevention. The influx of messaging relating to breast cancer may cause the receivers of this messaging may begin to feel fatigued as they continue to receive this messaging. If organizations begin to see that their audience members are beginning to feel fatigued, they should take action to help reduce the fatigue. Such

actions may include changing the message or changing the dissemination methods for the message. The present results suggest if steps are not taken, receivers of this breast cancer messaging may go on to experience additional effects, such as psychological reactance.

Hypothesis 5 states that message fatigue will mediate the relationship between message repetition and potential boomerang effects. Bivariate growth curve modeling shows that the change in message fatigue and intention were negatively related, both at baseline and as repetitions continued, supporting hypothesis 5. This shows that as women reported more message fatigue, their intention to enact the behavior decreased. Communication theory focused on behavioral outcomes tend to exclude the impact that repetition can play, focusing instead on various other internal and external factors (Becker, 1974; Ajzen, 1991). And the limited work around message fatigue has been focused by assessing message fatigue as an outcome. These data suggest that the field of communication may benefit from incorporating message fatigue in theoretical models, in addition to common theoretical constructs such as attitude and norms as predictors of reactance rather than the opposite relationship.

Theoretical Implications

Taken together, this dissertation adds to research on communication theory. First, this work sought to extend the understanding of message fatigue by advancing understanding of the effects of message fatigue and the point at which message fatigue can begin to manifest as repetition of public health messages increases. Second, the present study pursued a better understanding of psychological reactance and boomerang effects, which are related, yet a conceptually distinct phenomenon. Third, this work sought to extend upon previous work by using a novel time series approach and messaging approach to better understand how people experience these phenomena over time.

Message Fatigue

This dissertation adds to the understanding of message fatigue as a construct and how it fares over time with subsequent messaging. The current data analyses reveal that message fatigue is positively related to frequency of message exposure, reflecting prior work (So & Popova, 2018; Kim & So, 2018). It also extends this work by tracking how message fatigue changes over time from subsequent messages. This novel approach lends additional support to the predictive power of message fatigue in adverse outcomes (Chaffee & Berger, 1987) by assessing the mediating effects of message fatigue on adverse outcomes of persuasive messaging. Importantly, the data show that message fatigue increases sharply after the second exposure to the message, highlighting that message fatigue may be a warning of other unfavorable feelings if repetition continues. This is important for health communication practice as public health messaging continues to be more salient than ever before. When considering behavioral change models, health communication practice may benefit from incorporating message fatigue into regularly used models of behavioral change, such as the health belief model (Becker, 1974) and theory of planned behavior (Ajzen, 1991), to better understand the role that repetition can play in adherence to message recommendations as message fatigue is not currently a factor in theoretical models. For example, the health belief model was created by public health professionals and is still often used in public health practice today. The health belief model posits that six factors influence one's likelihood of engaging in a promoted health behavior, including perceived severity, perceived susceptibility, perceived benefits, perceived barriers, cues to action, and self-efficacy (Becker, 1974). Messaging using the health belief model as a framework may highlight factors such as self-efficacy and benefits in efforts to increase the likelihood of enacting a behavior. However, this model does not account for the amount of messaging or receiver's

feelings towards the message. By including message fatigue in this model, practitioners can not only tailor their messages to their audience but can also monitor experiences of message fatigue and make necessary adjustments to messaging and messaging practices as needed to reduce fatigue and prevent potential further effects, highlighting the importance of process evaluation in research (Atkin & Freimuth, 2013).

Additionally, the mediating role of message fatigue shows that it has the ability to impact other theoretical constructs, suggesting that such models may want to investigate how message fatigue can impact these well-established factors that lead to behavioral or attitudinal change. In contrast to prior work that has examined the mediating role of reactance in the relationship between message exposure and fatigue (Kim & So, 2018), our findings add to this understanding by highlighting the role fatigue may play between exposure and psychological reactance. Incorporation of message fatigue into more establish theoretical models will continue to unveil the impacts that message fatigue can have on audiences. It's also possible that in contexts where messages feel familiar and audiences like the messages, fatigue may be less of a problem. Further research should investigate positive reactions to public health messages further. Last, the operationalization of message fatigue has been focused primarily through the use of the message fatigue scale (So et al., 2017). The present study extends further support of this instrument for measuring message fatigue.

Psychological Reactance

The present findings add to the understanding of psychological reactance, as well as operationalization of it. Scholars in communication science have operationalized psychological reactance in various ways. This study employed two different ways of operationalizing psychological reactance; using a modified version of Hong & Faedda's (1996) Psychological

Reactance Scale and Dillard & Shen's (2005) operationalization consisting of an anger scale and negative cognitions. Negative cognitions were measured using thought listing techniques, with only negative cognitions being considered. These data show that, at least in the current study, that operationalization of psychological reactance through an anger scale and thought listing was difficult to enact. Participants rarely engaged in the thought listing survey item, and for those who did, it rarely was done throughout the entirety of the study. Thought listing techniques appear to take more effort than a standard scale, with participants having to not only process the message, but also process their thoughts, list their thoughts, and characterize whether they were positive, negative, or neutral. While empirical evidence shows the success of this operationalization, this dissertation is unable to achieve such success, perhaps due to the repeated measures application that may have necessitated it. Thus, communication science should continue to revisit the operationalization of psychological reactance, or at the very least more focused work on comparisons of reactance are needed.

A great deal of work in the realm of psychological reactance has focused on psychological reactance being a predictor of behavioral intention (Miller, Lane, Deatrick, Young, & Potts, 2007; Worchel & Brehm, 1970; LaVoie, Quick, Riles, & Lambert, 2015; Erceh-Hurn & Steed, 2011). However, the present study conceptualized psychological reactance as an outcome and found that message fatigue mediates the relationship between message repetition and psychological reactance. These data show a convex pattern that resembles the two-factor model, supporting propositions from the two-factor model (Berlyn, 1970;1971). However, the present data is limited to the number of repetitions to four. There remains uncertainty of how the two-factor model holds with common trends in today's practices, given that audiences are often exposed to repetitive health messages over longer periods of time than four days. If these trends

were to continue, valuable insight would be provided, as well as insight into the experience of psychological reactance. Additional theorizing around how psychological reactance may be in alignment with the two-factor model is needed to better understand such dynamics, which would also reveal at which points plateaus occur.

Theoretically, the data show a clear need for additional investigation into the role that message fatigue can play regarding psychological reactance theory. Psychological reactance theory posits that people experience reactance when they believe their free will has been impeded upon (Brehm, 1966), and while there has been minimal investigation into the relationship between fatigue and reactance, it has focused on the belief that psychological reactance can impact one's experience of message fatigue (Martinez Gonzales et al., 2021; Kim & So, 2018). The current study adds to the explanatory power of psychological reactance theory by using an innovative and longitudinal approach to better understand some of the phenomena that can impact psychological reactance, results suggest that message fatigue is a precursor to psychological reactance, with fatigue sharply increasing before an increase in experiences of psychological reactance. This allows for a better understanding of not only the underlying mechanisms that can influence psychological reactance, but also when psychological reactance starts to occur. Theoretical models benefit from such findings by being able to take this timing into account, allowing for such models to be tested in additional contexts.

Boomerang Effects

Health communication research on boomerang effects has been limited, with work often assessing cross-sectional data on an exposure and boomerang effects (Grandpre et al., 2003; Feingold & Knapp 1977). The present work extends to further investigate how boomerang effects may not only be impacted by exposure, but how repeated exposure to messages can

impact potential boomerang effects. These data show that reports of intention to perform the specified health behavior decline over time, supporting the notion that repetitive messaging may result in unintended boomerang effects. These data further support the distinction between psychological reactance and boomerang effects, with reports of psychological reactance having a convex shape, and intention declining with each subsequent message.

Practical Implications

Given the innovative approach used in the present study, the results have several implications for health communication practice. The implications these findings have on message exposure, delivery of health messages, and adverse outcomes are discussed below.

Message Exposure

As technology continues to advance, and we continue to understand more about the factors that can influence human health than ever before, health messaging also continues to be created to provide health recommendations that aim to protect health. This has led to health messaging being somewhat inescapable in today's society, with people often being inundated with various messages pertaining to various health risks. Particularly, there is an influx of messaging on various topics, with current practices being to spread such messages as massively as possible in attempts to inform audiences. Some of the most prolific health campaigns have employed these tactics, such as the CDC's Truth Initiative and the drug abuse resistance education program (D.A.R.E.), and while it is true that individuals must be exposed to messages to potentially impact behavioral or knowledge change, the present data suggest that current practices of inundating audiences with messages may not be the most effective approach. Not only may these methods not be effective at enacting behavioral change, but they could also lead to adverse outcomes, or adopting behaviors and ideas that are contrary to message content.

Expressed in terms of the present study, exposure to repetitive messages can cause individuals to experience higher levels of message fatigue, indicating that audience members can begin to feel exhausted or over-exposed after only two repetitions of the same message. Even more, if repetitions continue, these data demonstrate that after the third repetition, receivers of the message begin experiencing more psychological reactance with each exposure. Thus, planning and placement of messages so they do not activate message fatigue are necessary.

It's important to note that although we found increases in fatigue and reactance as repetitions continued, these changes were small and did not go above the mid-point of the scales. These results suggest that these changes may happen very slightly with further repetition. Although we expanded on prior work (Shi & Smith, 2016), it could be that more repetitions could elicit larger negative responses, or that repetitions result in small increases in message fatigue and reactance. While it is well known that repetition is needed in order for information retention and processing (Silk et al., 2012), these results show that repetitions can result in increases in negative outcomes. Practitioners should be wary of inundating audiences with repetitive messages and potentially should incorporate different messages or dissemination routes to help alleviate these increases as message repetition continues.

The extant work in psychological reactance, along with these results, show that reactance can result in many unintended outcomes, including disregarding of messages, seeking out information contrary to the message content, or even message avoidance (Dillard & Shen, 2005; Quick, 2012; Thrasher et al., 2016; Diaz & Cova, 2022). Overall, practitioners that are seeking to create effective health communication messaging should use an approach to messages that exposes audience members to messages at a lower frequency, possibly over an extended period. Additionally, practitioners can benefit from these results by assessing the rate at which fatigue

and psychological reactance increase. As people are exposed to public health messaging, message fatigue can serve as a warning sign to psychological reactance. If audience members begin to show signs of fatigue, practitioners should investigate the rate at which they are exposing people to messaging and adjust to avoid such reactance or possibly adjust message features, so they are refreshing and energizing for the audience.

Message Features

This work used public health messages based on language from the CDC that promote proactive health behaviors. Each condition uses a single static message, and the results show that this may not yield intended results. However, this isn't necessarily different compared to today's health messaging practices. While health communication campaigns may have multiple messages, they frequently use the same messages to inundate people, with many, such as the CDC's Truth Initiative campaign using the same message for a period of time before replacing it with a new message with similar content. Other message features, such as tailoring, using narratives, and message framing have been found to impact one's feelings towards health messages and behavioral adoption based on messages (Bekalu et al., 2018; Murphy et al., 2015; Noar et al., 2016; Altendorf et al., 2020). These findings help to understand how static messaging may result in unintended outcomes; however, future consideration of message features may be important in improving health communications for maximum benefit. Message features can also be adopted to help refresh and perhaps reduce perceived over-exposure, redundancy, exhaustion and/or tedium.

Message Delivery

This dissertation uses a somewhat novel approach to public health messaging by sending the message through an (SMS) text message. Given technological advances, both current and

future, it is likely that innovative delivery methods such as texting will only increase in popularity. This is especially true as younger generations continue to turn from traditional forms of media, such as newspapers and cable television, for newer approaches. At face value, the present approach is an effective route to exposing people to messages, given that 97 percent of Americans own a cell phone (Pew Research Center, 2021). Text messages are delivered to a cell phone and offer a more captive audience, with people having to interact with the message, even if to avoid it by having to open and delete it. While health communication will have to adopt to the changing trends in media consumption, these results show that using these avenues for message dissemination may lead to fatigue and psychological reactance after only a few repetitions of the same message.

Future Directions

The present work strove to understand how message repetitions can impact message fatigue, psychological reactance, and boomerang effects and offers a basis for future research into this area. First, continued work is needed in additional contexts to better understand whether message topic has implication for changes. While differences in the present data were not found between the two conditions, the message topics are limited, and the samples are comprised of only women. Further investigation would benefit from not only varying content areas, but also using samples that are comprised of other genders to assess for potential differences.

Another step for future work in this domain is by using other methods of dissemination. While email has been around several decades, there is very limited work on the impacts of health message delivery through email (see Turner et al., 2013; Franklin et al., 2006). As technology continues to advance, more novel approach of delivery can continue to be assessed, such as potential interactive messages through smart home products, such as Amazon's Alexa and other

smart home products. Smart home products often have speaker capabilities, that would allow products to deliver health messages. Such smart products could provide an interesting method for message delivery. Additionally, given the present work only focused on a novel approach of using (SMS) text messaging, future work should compare traditional message dissemination methods with more novel approaches to assess if these novel approaches are more effective at messaging, or if due to the personal nature of technology, these methods seem more intrusive and can create unintended consequences at a fast rate.

Although this work expands upon previous work in the number of message repetitions, future work with additional repetitions would provide valuable insight. Given the convex shape that reactance was found to emulate in participants, future research would allow insight about repetitions past three to see if reactance continues to increase, or if it continues to waver in a wave shape. Similarly, this expanded work would allow insight into if message fatigue and boomerang effects hit an eventual plateau. Likewise, further investigation would benefit from assessing whether the message source impacts message fatigue, psychological reactance, and boomerang effects. Message source has been found to impact perceptions and adherence of the message (Boynton et al., 2021; Kirkpatrick & Lee, 2021), and with low governmental trust that seemingly continues to decline (United Nations, 2021), considering source would yield valuable insight for various entities creating health messaging.

These dissertation results offer additional investigation to be conducted to advance communication theory. As discussed, message tailoring is an effective tool for persuasive messaging (Noar et al., 2016; Altendorf et al., 2020). With advances on the internal, user statistics are easily accessible, and work tailoring messages based on personal characteristics would advance theoretical understandings of message exposure and effectiveness of persuasive

outcomes. Similarly, future work should further delve into the mediating role that message fatigue plays in unintended outcomes.

One further area for future research is examining the roles of message repetition in psychological reactance theory, specifically the role of reactance restoration (Quick & Stephenson, 2007). When individuals feel as if their free will has been impeded upon, they may think or perform behaviors in ways that make them feel as if they are gaining their freedom back (Brehm, 1966). While it can be argued that boomerang effects may be a form of direct restoration, as both include individuals acting in ways contrary to the message (Brehm, 1966; Hoyland et al., 1953), investigation into indirect restoration tactics of reactance, such as degradation of the source, belief change, or denying for example, would yield valuable insights in how people attempt to restore their freedom, especially given the amount of inaccurate information that is easily accessible in today's technological world.

Limitations

This dissertation has limitations that impact the results of this work. First, the methods employed for this research do not allow for traditional mediation analysis. Given the within-subjects design of the study, mediation is not possible as message repetition cannot be isolated for other variables. Without having different conditions with varying levels of repetition, the results of this study limit the explanatory power of the mediating effects of message fatigue on psychological reactance and boomerang effects. However, using bivariate growth curve modeling allows for insight into how message fatigue covaries over time with reactance and boomerang effects, all of which are inherently tied to repeated exposure in this study.

Another limitation of the present study is that it used intention as a proxy measure for boomerang effects, and intention is not always representative of actual behaviors. Given that

boomerang effects concern actual behaviors (Hoyland et al., 1953), analysis into boomerang effects would be best understood by employing observation data collection methods that shed light on actual behavior. One other limitation with measurements is that of message fatigue. First- and second-order factor analyses for message fatigue revealed that the first order model fit the data better according to likelihood ratio test comparing chi-square fit indices, however all other measures of fit were nearly the same. Further investigation would be beneficial in assessing the second-order factor model of message fatigue.

Further, this dissertation required participants to have a cell phone that was enabled to receive (SMS) text messages, limiting the explanatory power of these findings. By requiring a cell phone for participants to receive messages, individuals that may be unable to afford a cell phone, or those that rely on government-assisted cell phones that can have limited text messaging capabilities are unable to participate in the present study. While this limitation is not able to be addressed in the parameters of the study, it is possible that results from this under-represented group may be vastly different given that those with limited income and possibly who rely on government assistance are disproportionately affected by health issues and have shorter life spans (Finegood et al., 2021).

Two final limitations are related to the sample and its size. First, the study used a convenience sample, preventing the generalization of these findings. Participants were recruited through the Michigan State University College of Communications Arts and Sciences SONA pool, limiting the sample to be comprised of a very minimal number of women who are aware of, and registered, for the SONA pool. And finally, it was difficult to retain participants. Power analyses with an effect size of 0.30, significance level of 0.05, and power of 0.80 revealed a sample of 278 participants were needed (139 per condition). Although these results add to the

field of communication science, they are limited to the power and a full powered sample may yield additional insight.

CONCLUSION

The public is highly saturated with health messaging. While message exposure is necessary to influence knowledge retention or behavioral change, it remains uncertain how to deliver these messages without creating unintended outcomes. Communication science provides useful contexts and frameworks to continue investigating the impacts of public health repetition. Further, communication theories and constructs such as message fatigue, psychological reactance, and boomerang effects as examined in this dissertation, help to better understand some of the nuance around the impacts of repetitive health messaging. It appears that in practice and theory, message fatigue can serve as a warning sign of future unintended outcomes. More research is needed to further understand outcomes associated with message repetition, and communication science theory provides a useful framework to not only do so, but also understand if message features can play a role. In doing so, health messaging can be conducted to best impact knowledge retention or behavioral change, with limited unintended outcomes.

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APPENDIX

Message Conditions

Breast Cancer Condition Message

Did you know that steps you take now can reduce your breast cancer risk in the future? When you can, try to use fragrance free products, and other products that don't have "phthalates" (THAL-ates) on the label. Using food and drink containers made of glass or ones that are plastic and "BPA free" can also reduce breast cancer risk. You can learn more at https://bcerp.org. Your survey link will follow in a separate message.

HPV Condition Message

Did you know that steps you take now can reduce your risk of contracting Human-papilloma virus (HPV) in the future? When you can, getting vaccinated against HPV is the safest way to protect yourself against HPV. Also, using protection during sexual intercourse can reduce your risk. You can learn more at www.cdc.gov/hpv. Your survey link will follow in a separate message.