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Loss/Gain Framing, Dose, and Reactance: A Message Experiment

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Whether a loss or gain frame has a persuasive advantage in communicating health risks is a matter of ongoing debate. Findings reported in the literature are mixed, suggesting that framing effects are likely complex and may be influenced by a combination of factors. This study examined reactance as a mediator and dose as a moderator of loss/gain framing effects. Adults ($N = 1{,}039$) read framed messages about the health consequences of physical (in)activity in varying message doses (i.e., number of framed statements). Compared to loss frames, gain frames generated more threat to freedom and reactance. Dosage exerted significant influence at the extremes; the one-dose messages invoked less intentions to exercise compared to the four-dose messages. Planned contrasts revealed significant frame × dose interactions. Notably, the one-dose gain-framed messages triggered significantly more freedom threat and less intentions to engage in physical activity—a situation that changed when the information was loss-framed or when the dosage was increased.

KEY WORDS: Dose; health risk; loss and gain framing; message framing; reactance

1. INTRODUCTION

Effectively communicating to the public about behavioral health risks is challenging (Atkin & Wallack, 1990; Backer, Rogers, & Sopory, 1992; Cho & Salmon, 2007; Liberman & Chaiken, 1992). Yet loss/gain framing has been indicated as one highly viable strategy for enhancing message effectiveness (Jones, Sinclair, & Courneya, 2003; Meyerowitz & Chaiken, 1987; Nan et al., 2016; Rothman & Salovey, 1997). For instance, a health recommendation can be framed in terms of the advantages of performing a healthy behavior (*gain frame*) or the disadvantages of not performing it (*loss frame*).

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Loss/gain framing effects are frequently examined through the lens of prospect theory (Jones et al., 2003; Meyerowitz & Chaiken, 1987; Rothman & Salovey, 1997), which holds that people are generally more motivated to avoid losses than to pursue gains—a phenomenon labeled "loss aversion" (Kahneman & Tversky, 1984). Therefore, loss frames have been expected to outperform gain frames at motivating people to adopt healthy behaviors. Yet several decades of research offer minimal support for this assumption (see Nan, Daily, & Qin, 2018; O'Keefe & Jensen, 2007, 2009). In meta-analyses of health-related loss/gain framing studies, the summed effect size difference between gain- and loss-framed messages on persuasive outcomes (e.g., attitude change, intention, behavior) was negligible (O'Keefe & Jensen, 2006, 2007, 2009). This calls into question whether loss aversion is really an ideal framework for investigating framing effects, at least in the context of communicating about health risks—or if the answer to when and why

a particular frame persuades is driven by other factors.

Recently, scholars have suggested that framing effects might be better understood by examining the impact of additional (and often overlooked) features of framed messages (Van 't Riet et al., 2016), as well as how framing might influence multiple psychological processes (Gal & Rucker, 2018; Nan et al., 2018; Van 't Riet et al., 2016).

One psychological process that framing scholars have turned attention toward is psychological reactance (Nan et al., 2018). Psychological reactance theory holds that certain types of communication are more likely to provoke individuals to feel their freedom is being threatened (Brehm & Brehm, 1981). Perceived freedom threat, in turn, triggers *reactance*, a resistant cognitive and/or affective motivational state that often results in failed persuasion (Brehm & Brehm, 1981; Dillard & Shen, 2005). It is possible that variations in framing effectiveness occur because a particular frame (gain or loss) is more likely to heighten perceived freedom threat. Accordingly, a line of research has started to investigate the relationship between framing effects and reactance (see Nan et al., 2018).

Another possible explanation for inconsistency in framing effects is variation in message design. Following their meta-analysis, O'Keefe and Jensen (2006) noted a need for more research exploring moderators of loss/gain framing effects, including message characteristics such as dosage. Dose refers to the quantity or proportion of the message and can be characterized in a number of ways, including message length, number of words/bullet points, or consumed space. Dose of the framed statements could moderate the impact of message framing either directly (e.g., by making the message manipulation more salient) or indirectly (e.g., by triggering a nonconscious psychological response). The latter is of particular interest in this study, as message dose has the potential to influence reactance. On the surface, one might expect a dose–response relationship where increased dose magnifies perceived threat to freedom. However, low dosage could also come across as weak rationale for a risk recommendation—a situation that might lead to greater reactance at smaller doses. Both patterns are plausible at this point.

This study engages loss/gain framing research by investigating reactance and dose as possible explanatory mechanisms. Examining both mechanisms simultaneously also provides a platform for advancing understanding of the relationship between reactance and dose.

2. LITERATURE REVIEW

2.1. Loss/Gain Framing Research

In message framing, message designers select language to change the lens, perspective, or context through which audiences view an issue. Kahneman and Tversky (1984) observed that people are especially sensitive to one type of framing—loss/gain framing—and will perceive risks differently depending on whether an outcome is framed as a gain or a loss, even if it is comparable or logically equivalent (e.g., a gain or loss of the same magnitude). In turn, message framing can influence a person's attitudes, intentions, and behaviors with regard to the risk or recommended behavior (McNeil, Pauker, Sox, & Tversky, 1982; Rothman, Bartels, Wlaschin, & Salovey, 2006). Loss/gain framing has compelling application in communicating about health risks (Rothman & Salovey, 1997). A message designer can choose to frame an appeal in terms of the advantage of performing a behavior like exercise (e.g., "maintaining a healthy heart") or the disadvantages of not performing it (e.g., "increasing one's risk of heart disease") (O'Keefe & Jensen, 2007).

Examining framing effects via prospect theory (Kahneman & Tversky, 1979, 1984) and the concept of loss aversion has led health communication scholars to assume that when a condition is presented in terms of a loss, people will be more motivated to take action. However, loss frames have not been substantially more effective than gain frames at generating favorable health attitudinal and behavioral outcomes (Gallagher & Updegraff, 2012; Kühberger, 1998; O'Keefe & Jensen, 2006, 2007, 2009).

Following a 1998 meta-analysis of framing effects, Kühberger (1998) concluded there were too many different features involved to arrive at "*the* framing effect" (p. 42, emphasis added). He recommended that researchers attempt to identify what types of framing are effective, when, and why. Subsequent meta-analyses by O'Keefe and Jensen (2006, 2007, 2009) suggested a continued need for more sophisticated framing research design. They proposed that lack of significant summary effects across studies likely indicated a need for new methodological approaches, including testing of mediation and moderation effects. Answering this call, second-generation

framing research has begun to explore mediators (e.g., message processes) and moderators (e.g., message features) to illuminate specific conditions under which loss or gain frames are more likely to persuade (Cassotti et al., 2012; Covey, 2014; Jensen et al., 2018; Latimer, Salovey, & Rothman, 2007; Malaviya & Brendl, 2014; Pabst, Brand, & Wolf, 2013; Rothman & Updegraff, 2011; Vezich, Katzman, Ames, Falk, & Lieberman, 2017).

As one explanation for variation in framing effects, researchers proposed a distinction between two categories of health behavior: disease prevention and disease detection (Rothman et al., 2006). This was again grounded in prospect theory, which holds that loss aversion motivates individuals to act when the stakes are high, but not when the stakes are low (Kahneman & Tversky, 1979). Transferred to health message framing, it was suggested that detection scenarios (wherein a person might currently have an undetected health condition) will feel high risk, while preventive scenarios (where an individual might stave off future disease) will feel low risk (Salovey, Schneider, & Apanovitch, 2002). Thus, individuals would be more motivated by disease detection messages that are loss-framed and prevention messages that are gain-framed. However, this distinction also has not received much empirical support (O'Keefe & Jensen, 2007, 2009). Scholars have recently noted that prospect theory originally connected framing effects to level of "riskiness" in terms of amount of uncertainty of an outcome, not severity of a possible outcome (Harrington & Kerr, 2017; Van 't Riet et al., 2016). Thus, prospect theory and disease prevention/detection distinctions may not be the most suitable frameworks for understanding loss/gain framing effects.

2.2. Alternate Explanations for Varied Framing Effects: Reactance and Dose

2.2.1. State Reactance and Threat to Freedom

Knowing how to advise about health risks without provoking psychological reactance is of premium interest to message designers (Cho & Salmon, 2007; Dillard & Shen, 2005). Psychological reactance theory posits that messages with a clear intent to persuade are likely to trigger perceived freedom threat (Brehm & Brehm, 1981), and so are messages that threaten to eliminate behavioral freedoms (Brehm & Brehm, 1981). Advocacy messages, including health risk warnings, often fall into both of these categories (Dillard & Shen, 2005; Quick & Stephenson, 2008).

When people perceive a threat to their freedom to think, feel, or act a certain way, they are likely to feel motivated to reinforce this freedom (Brehm, 1966; Brehm & Brehm, 1981). Reactance is expected to follow and is characterized by a negative affective response (e.g., anger), a negative cognitive response (e.g., counterarguing), or both (Dillard & Shen, 2005; Quick & Stephenson, 2007). This, in turn, is expected to produce less positive attitudes toward the advocated behavior and lower intentions to comply with the recommendation (Dillard & Shen, 2005).

Researchers have continued to investigate why some types of persuasive health messages are perceived as more freedom threatening than others (Quick, Shen, & Dillard, 2013). Because individuals value their ability to choose among options (Brehm & Brehm, 1981), presenting someone with either a gain *or* a loss frame—as opposed to both possibilities—could cause a person to feel that his or her actions or outcomes are being unfairly constrained. Despite the apparent potential for either frame to trigger reactance, scholars have typically hypothesized that loss frames will produce higher perceived freedom threat and reactance because of the threat of taking something *away* (Lee & Cameron, 2017; Quick & Bates, 2010; Quick, Kam, Morgan, Montero Liberona, & Smith, 2015; Reinhart, Marshall, Feeley, & Tutzauer, 2007; Shen, 2015).

Yet empirical evidence has been inconclusive. Gain frames were associated with lower freedom threat and reactance than loss frames in some cases (Reinhart et al., 2007; Shen, 2015), while in other cases, the findings were mixed (Lee & Cameron, 2017; Quick & Bates, 2010; Quick et al., 2015). Reinhart et al. (2007) compared loss and gain frames in the context of organ donation advocacy and found that reactance—captured as expressions that an individual does not like being told how to feel about an issue—was higher in the loss frame condition. Similarly, Shen (2015) found loss-framed skin cancer risk messages to correspond with greater perceived freedom threat. However, Quick et al. (2015) found the opposite: in their organ donation study, gain frames were associated with greater threat to freedom. Findings were mixed in a framing study (Lee & Cameron, 2017) about diet and exercise for weight management, where loss-framed messages led to increased negative cognitions, but did not significantly influence perceived freedom threat, counterarguing, anger, attitudes, or intentions. Message frame also

failed to predict freedom threat and anger in college students warned about the risk of excessive alcohol consumption (Quick & Bates, 2010). Taken together, these findings suggest a possible connection between framing and reactance, yet the direction and precise nature of the connection is still uncertain.

2.2.2. Message Dose

One possible, yet underexplored, reason for inconsistent loss/gain framing effects is variation in message dose, which can be conceptualized, for instance, as the number of statements in a message or the proportion of different types of content. Recent research tested six different ratios of threatening (fear-provoking) content to efficacy-enhancing content in the context of HPV prevention (Carcioppolo et al., 2013). Certain proportions (e.g., a 1:1 ratio) were found to have greater impact on audience intentions to vaccinate. In framing, dose of the framing manipulation—whether an individual is exposed to a single or multiple framed statements, for example, or what proportion of the total message contains framed content—could conceivably also lead to variations in persuasive effects.

O'Keefe and Jensen (2011) found dose to be underexamined in framing research and encouraged further investigation. Reactance theory posits that a greater number of freedom threats will lead to a higher magnitude of reactance (Brehm, 1966). In this case, a higher dose of loss-framed statements could lead to greater reactance and thus less favorable attitudes and intentions. It is also possible that higher doses bypass reactance—that is, at certain doses, the benefits of the advocated behavior become more salient and overcome audience impulses to experience freedom threat, get angry, or counterargue against the message. As a third possibility, higher doses could lead to message fatigue, which has been connected in prior work to both reactance and failed persuasion (Kim & So, 2018). Given the limited amount of prior research on dose, it is difficult to predict exactly how dose might influence the effect of framing on reactance or persuasive outcomes.

2.2.3. The Present Experiment

To examine relationships among frame, dose, and reactance in risk communication, we designed a message experiment within the context of physical activity. Stimulus messages used either gain frames, highlighting the protective health benefits of regular physical activity, or loss frames, highlighting the health risks associated with insufficient physical activity. Message dose was manipulated in terms of the number of loss-/gain-framed bullet points.

Lack of physical activity is a major behavioral risk factor in numerous chronic diseases and health ailments (U.S. Department of Health and Human Services [USDHHS], 2014).Yet physical activity behaviors can be difficult to change (Lau, Quadrel, & Hartman, 1990). This is a potentially sensitive risk communication domain, wherein reactance and dose might have a marked influence on the relationship between framing effects and outcomes. Indeed, a meta-analysis by O'Keefe and Jensen (2011) did find a significant framing effect in the specific context of physical activity, where gain frames exhibited a persuasive advantage.

Based on prior work, we expect that, compared to loss-framed messages, gain-framed messages will elicit more positive attitudes and intentions to engage in physical activity (H1a–H1b). The relationship between loss/gain framing and reactance is less clear, but the weight of existing evidence suggests that gain-framed messages are less likely to invoke threat to freedom (H2). The intertwined model of psychological reactance theory (Dillard & Shen, 2005) posits a sequential chain wherein less threat to freedom leads to less reactance (intertwined anger and negative thoughts) and greater persuasion (attitudes and intentions) (H3). At the moment, it is unclear how dose will function. Given that, we posit three research questions exploring whether dose is directly related to persuasive outcomes (RQ1) or if it moderates the impact of message framing on intentions (RQ2) or perceived freedom threat (RQ3).

3. METHODS

3.1. Design and Procedure

A sample of U.S. adults was recruited by Qualtrics Panels to participate in an online study. Participants were removed if they violated the speed threshold for time to complete the survey or if they incorrectly answered one of the attention check questions, resulting in a final sample of 1,039. Participants' mean age was approximately 43 (mean age = 42.80, $SD = 16.81$, range: 18–86) and the sample was 50.3% female. A majority of participants were identified as white (79.7%). One-fifth (20.6%) had a bachelor's degree or higher.

Participants completed a pretest, were randomly assigned to an experimental condition, and then completed a posttest. For the experiment, participants were randomly assigned to one of the message conditions in a 2 (frame: loss or gain) × 4 (dose: 1, 2, 3, or 4 message pairs) design.

Dose also incorporated a nested factor—message content—so that message dose could be examined independent of message content. One of the challenges of studying the effects of message dose is that it is difficult to create stimuli where the quantity of information increases without qualitatively changing the content. For example, Jensen et al. (2018) manipulated message dose by adding new statements to create two- and three-dose conditions. Thus, in their study, the two- and three-dose conditions had both more content and new content.

To engage this problem, this study developed materials where message dose and message content were not confounded. First, materials were created to promote the health impacts of physical activity. The intervention was a digital image that contained illustrations of people engaging in various physical activities, with text overlaid that advocated physical activity in a gain or loss frame, in one of four doses. In line with Jensen et al. (2018), dose was operationalized as two bullet pointed statements. Thus, the single-dose condition had two bullet pointed statements in it. The rationale to operationalize dose as two bullet pointed statements is that a single bullet pointed statement looks atypical. Information about the health consequences of physical activity and the ideal amount of activity was drawn from Healthy People 2020 (USDHHS, 2014) and Mayo Clinic (n.d.). Although the term "exercise" was used in the message headline, an addendum explained that the message was about a broad range of types of physical activity.

To create all combinations, and avoid confounds, four message pairs were created (A, B, C, and D). Participants assigned to the single-dose condition received one of these message pairs, whereas those in the two-dose condition received one of six possible combinations (AB, AC, AD, BC, BD, and CD) and those in the three-dose condition received one of four combinations (ABC, ABD, ACD, and BCD). The four-dose condition contained all four message pairs (ABCD). Thus, there were 15 possible combinations (A, B, C, D, AB, AC, AD, BC, BD, CD, ABC, ABD, ACD, BCD, and ABCD) per frame, or 30 conditions total (see Supporting Information).

3.2. Measures

Prior exercise behavior. Prior behavior was assessed with a single item: "During the past year, how many months did you engage in regular (daily or almost daily) physical activity for all four weeks of the month?" Participants responded using a 13-point scale; 0 *months* through 12 *months* ($M = 5.78$, $SD = 4.57$).

Perceived freedom threat. Freedom threat was measured with four items (Dillard & Shen, 2005) on a Likert-type scale (1 = *strongly disagree*, 5 = *strongly agree*) asking the extent to which respondents agreed with statements such as "The message tried to make a decision for me" and "The message tried to pressure me." The scale achieved acceptable reliability ($M = 1.87$, $SD = 0.97$, $\alpha = 0.91$).

Reactance. Reactance was captured as a combination of anger and counterarguing, in line with the intertwined model (Dillard & Shen, 2005; Rains, 2013). Four items (Dillard & Shen, 2005) were used to measure anger arousal on a Likert-type scale (1 = *none of this feeling*, 7 = *a great deal of this feeling*; $M = 1.51$, $SD = 0.94$, $\alpha = 0.96$). Participants reported the extent to which the message made them feel irritated, aggravated, annoyed, and angry. We measured the cognitive component of reactance with a three-item, seven-point counterarguing scale (Silvia, 2006). Items included: "While reading the message, were you thinking of points that went against the information presented?" ($M = 2.09$, $SD = 1.52$, $\alpha = 0.90$).

To test the intertwined model, anger and counterarguing were also transformed into a factor score ($M = 0.00$, $SD = 0.97$). Standardizing these scores and combining them into a single reactance variable is typical in reactance research (e.g., Quick & Stephenson, 2007).

Attitudes and intentions. Attitudes and intentions are useful indicators of whether a person is likely to continue or adopt an advocated behavior (Kim & Hunter, 1993a, 1993b). Accordingly, attitude toward getting at least 75–150 minutes of physical activity each week (the Healthy People recommendation) was measured with seven items on seven-point semantic differential scales ($M = 5.69$, $SD = 1.48$, $\alpha = 0.94$; bad/good, useless/useful, dumb/smart, unhealthy/healthy, unnecessary/necessary, worthless/worthwhile, difficult/easy). Intentions to engage in regular physical activity were measured using three items on a five-point scale (1 = *strongly disagree* to 5 = *strongly agree*): "The information I just

read made me seriously think about being physically active more often," "I want to regularly participate in physical activity in the next 4 weeks," and "I intend to regularly participate in physical activity in the next 4 weeks" ($M = 3.88$, $SD = 1.01$, $\alpha = 0.84$).

3.3. Data Analysis and Manipulation Checks

To inform analyses, bivariate correlations were examined between all study variables. Next, research questions and hypotheses were tested using three-way ANOVAs. Frame and dose were treated as fixed factors and message as a nested factor within dose. Nesting message within dose allows researchers to examine the impact of dose alone, but there are other analytical challenges to address. Dosage has been understudied in communication research, yet has been at the center of other fields for decades, including toxicology, chemistry, and medicine. Accordingly, those fields have developed analytical norms for detecting dose response, some of which appear useful for message effects research. For example, Stewart and Ruberg (2000) argued that planned contrasts are essential to detect dose response. Relevant to this study, they note that common approaches include conducting contrasts that compare (1) "the highest dose versus placebo" (or the lowest dose) and (2) "a single contrast of the responses at various doses" (p. 914). In line with this recommendation, we planned contrasts to compare the highest dose (four doses) to the lowest dose (one dose), and we examined the difference between loss/gain framing at each level of dose (one, two, three, and four doses). Finally, serial mediation analysis was used to assess the theoretical pathway postulated by the intertwined reactance model (message → freedom threat → reactance → attitude → intentions). The loss/gain frame variable was dummy coded (loss = 0, gain = 1).

In the pretest, participants completed an item assessing physical activity over the prior 12 months. Prior physical activity did not vary by frame, $F(1, 1019) = 0.10$, $p = 0.75$, dose, $F(3, 1019) = 0.95$, $p = 0.42$, or frame × dose, $F(3, 1019) = 1.49$, $p = 0.22$. Thus, prior physical activity was not controlled for in subsequent analyses as it successfully randomized across conditions.

As a manipulation check following exposure to the stimuli, participants completed the following message perception items measured on a 1 (*strongly disagree*) to 5 (*strongly agree*) scale: "The message I just read described the costs of not getting enough exercise" and "The message I just read had many bullet points listing the impact of exercise." For the first item, there was a significant main effect for frame, $F(1, 1011) = 89.33$, $p < 0.001$. Compared to those in the gain-framed condition ($M = 3.42$, $SE = 0.06$), participants in the loss-framed condition ($M = 4.16$, $SE = 0.06$) were more likely to agree that the message described the costs of not getting enough exercise. For the second item, there was a significant main effect for dose, $F(3, 1016) = 33.12$, $p < 0.001$. Participants were more likely to agree there were lots of examples as dose increased: dose 1 ($M = 3.60$, $SE = 0.06$), dose 2 ($M = 3.73$, $SE = 0.06$), dose 3 ($M = 4.17$, $SE = 0.06$), dose 4 ($M = 4.34$, $SE = 0.06$). This suggests the message manipulations were perceived as intended by the participants.

4. RESULTS

4.1. Bivariate Correlations

Bivariate correlations are reported between all study variables in Table I. Dose was positively correlated with intention ($r = 0.07$, $p = 0.02$). It should be noted that this is a very small correlation. Attitudes and intentions were positively correlated, and negatively correlated with freedom threat, anger, counterarguing, and reactance.

4.2. ANOVAs (H1a, H1b, H2, RQ1, RQ2, RQ3)

Frame. H1a, H1b, and H2 posited that gain-framed messages would generate more positive attitudes and intentions and less freedom threat. Significant main effects for frame were observed for freedom threat, $F(1, 1020) = 3.94$, $p = 0.047$, $\eta^2 = 0.004$, anger, $F(1, 1020) = 3.88$, $p = 0.049$, $\eta^2 = 0.004$, and reactance, $F(1, 1020) = 4.24$, $p = 0.040$, $\eta^2 = 0.004$. Compared to loss-framed messages, gain-framed messages invoked significantly more freedom threat, anger, and reactance (for means, standard errors, and effect sizes, see Table II). Frame was not related to attitude, $F(1, 1020) = 0.02$, $p = 0.90$, $\eta^2 < 0.001$, intention, $F(1, 1020) = 0.19$, $p = 0.660$, $\eta^2 < 0.001$, or counterarguing, $F(1, 1020) = 2.54$, $p = 0.112$, $\eta^2 = 0.002$. Thus, H1a, H1b, and H2 are rejected.

Dose. RQ1 queried whether dose was related to persuasive outcomes. In this study, dose was operationalized as two bullet points with four levels (one to four doses or two to eight bullet points). We also compared the extremes (one vs. four doses) as they represent the sharpest contrast of the message

Table I. Bivariate Correlation Matrix

	1	2	3	4	5	6	7	8
(1) Frame	–							
(2) Dose	0.02	–						
(3) Attitude	0.01	0.04	–					
(4) Intention	−0.01	0.07**	0.35**	–				
(5) Freedom threat	0.04	−0.02	−0.20**	−0.21**	–			
(6) Anger	0.05	−0.03	−0.21**	−0.21**	0.53**	–		
(7) Counterarguing	0.04	−0.01	−0.21**	−0.21**	0.68**	0.58**	–	
(8) Reactance	0.05*	−0.03	−0.24**	−0.23**	0.64**	0.96**	0.79**	–

Note: $N = 1{,}039$. Bivariate correlations between study variables. Loss/gain frame variable was dummy coded (loss = 0, gain = 1).
*$p < 0.10$; **$p < 0.05$.

Table II. Main Effects for Frame

	Loss	Gain	Cohen's *d*
Attitude	5.66 (0.07)	5.64 (0.07)	0.01
Intention	3.88 (0.05)	3.85 (0.05)	0.03
Freedom threat	1.79 (0.05)[a]	1.93 (0.05)[b]	0.12
Anger	1.44 (0.05)[a]	1.57 (0.05)[b]	0.12
Counterarguing	1.98 (0.07)	2.14 (0.07)	0.10
Reactance	−0.08 (0.05)[a]	0.06 (0.05)[b]	0.13
N	514	525	

Note: Means and standard errors (in parentheses). Means in the same row that do not share a common superscript letter are significantly different at $p < 0.05$. For example, compared to loss-framed messages, gain-framed messages invoked significantly more freedom threat.

construct. As noted in Section 3.3, this aligns with the common dose–response testing approach of comparing the highest dose to the lowest dose or placebo (Stewart & Ruberg, 2000). Accordingly, we examined both the four-level variable and conducted a planned contrast comparing the one-dose and four-dose conditions.

As a four-level variable, there were no significant main effects for dose (see Table III). That is, dose was not significantly related to attitude, $F(1, 1020) = 1.15$, $p = 0.33$, $\eta^2 = 0.003$, intention, $F(1, 1020) = 1.29$, $p = 0.28$, $\eta^2 = 0.004$, freedom threat, $F(1, 1020) = 1.89$, $p = 0.13$, $\eta^2 = 0.005$, anger, $F(1, 1020) = 1.27$, $p = 0.28$, $\eta^2 = 0.004$, counterarguing, $F(1, 1020) = 1.05$, $p = 0.37$, $\eta^2 = 0.003$, or reactance, $F(1, 1020) = 1.37$, $p = 0.25$, $\eta^2 = 0.004$.

However, the planned contrast comparing one dose to four doses revealed a significant difference for intention, $F(1, 501) = 4.30$, $p = 0.04$, $\eta^2 = 0.008$. Compared to the one-dose condition, the four-dose condition invoked increased intention ($p = 0.04$, Cohen's $d = 0.19$; see Table III).

Frame × dose. RQ2 and RQ3 queried whether dose moderated the impact of framing on intentions and freedom threat. A marginally significant frame × dose interaction was found for freedom threat, $F(3, 1020) = 2.50$, $p = 0.059$, $\eta^2 = 0.007$. For freedom threat, the one-dose gain-framed message invoked significantly more threat than the three-dose ($p = 0.04$, Cohen's $d = 0.26$) or four-dose ($p = 0.03$, Cohen's $d = 0.28$) gain-framed messages.

The frame × dose interaction was not significant for intention, $F(1, 1020) = 1.29$, $p = 0.28$, $\eta^2 = 0.004$. However, a planned contrast (one vs. four doses) revealed significant differences between dose conditions for the gain-framed message, $F(1, 501) = 6.21$, $p = 0.01$, $\eta^2 = 0.012$. For intention, the one-dose gain-framed message invoked significantly less intention to engage in physical activity compared to the four-dose gain-framed message ($p = 0.01$, Cohen's $d = 0.32$). See Table IV for means and standard deviations.

Stewart and Ruberg (2000) argued for planned contrasts examining the impact of experimental variables at each level of dose. Thus, planned contrasts were conducted comparing loss/gain framing at each level of dose. With intention as the outcome, loss and gain frames were not statistically different at two doses, $F(1, 501) = 0.26$, $p = 0.610$, $\eta^2 < 0.001$, three doses, $F(1, 501) = 0.06$, $p = 0.801$, $\eta^2 < 0.001$, or four doses, $F(1, 501) = 0.03$, $p = 0.869$, $\eta^2 < 0.001$. There was a marginally significant difference between loss and gain frames at the one-dose level, $F(1, 501) = 3.78$, $p = 0.052$, $\eta^2 = 0.007$. The one-dose gain-framed message invoked less intention compared to the one-dose loss-framed message ($p = 0.052$, Cohen's $d = 0.24$).

In summary, the analysis highlighted two contrasts with significant differences. Intentions were

Table III. Main Effects for Dose

	Dose			
	1	2	3	4
Attitude	5.68 (0.09)	5.56 (0.09)	5.73 (0.09)	5.79 (0.09)
Intention	3.78 (0.06)[a]	3.85 (0.06)[ab]	3.92 (0.06)[ab]	3.97 (0.06)[b]
Freedom threat	1.97 (0.06)	1.78 (0.06)	1.87 (0.06)	1.86 (0.06)
Anger	1.60 (0.06)	1.44 (0.06)	1.50 (0.06)	1.50 (0.06)
Counterarguing	2.20 (0.10)	1.97 (0.09)	2.07 (0.09)	2.11 (0.10)
Reactance	0.09 (0.06)	−0.08 (0.06)	−0.01 (0.06)	−0.01 (0.06)
N	255	263	268	253

Note: Means and standard errors (in parentheses). Means in the same row that do not share a common superscript letter are significantly different at $p < 0.05$.

Table IV. Interaction Effects for Frame × Dose

	Loss				Gain			
	1	2	3	4	1	2	3	4
Attitude	5.75 (0.13)	5.60 (0.13)	5.66 (0.13)	5.66 (0.13)	5.60 (0.13)	5.53 (0.13)	5.80 (0.13)	5.91 (0.13)
Intention	3.91 (0.09)[a]	3.82 (0.09)[ab]	3.91 (0.09)[a]	3.96 (0.09)[a]	3.66 (0.09)[b]	3.88 (0.09)[ab]	3.94 (0.09)[a]	3.98 (0.09)[a]
Freedom threat	1.86 (0.08)[a]	1.66 (0.09)[b]	1.90 (0.09)[ac]	1.92 (0.09)[ac]	2.08 (0.09)[c]	1.90 (0.08)[ac]	1.84 (0.08)[a]	1.81 (0.09)[a]
Anger	1.50 (0.08)	1.34 (0.08)	1.53 (0.08)	1.48 (0.08)	1.70 (0.09)	1.54 (0.08)	1.48 (0.08)	1.51 (0.08)
Counterarguing	2.14 (0.13)	1.79 (0.14)	2.10 (0.13)	2.03 (0.13)	2.26 (0.14)	2.14 (0.13)	2.03 (0.13)	2.19 (0.14)
Reactance	0.00 (0.08)[ab]	–0.20 (0.09)[a]	0.02 (0.09)[ab]	–0.03 (0.09)[ab]	0.19 (0.08)[b]	0.05 (0.08)[b]	–0.04 (0.08)[ab]	0.02 (0.09)[ab]
N	133	127	127	127	122	136	141	126

Note: Means and standard errors (in parentheses). Means in the same row that do not share a common superscript letter are significantly different at $p \leq 0.05$.

different between the lowest and highest dosages (one vs. four), but only for the gain-framed condition. Intentions were also different between loss and gain frames, but only for the lowest dose. This supports contrasting (1) the one-dose gain-framed message with the four-dose gain-framed message (contrast one vs. four) and (2) the one-dose gain-framed message and the one-dose loss-framed message (contrast one vs. one).

4.3. Serial Mediation

Reactance was tested as an intertwined process (H3) in line with past research (Dillard & Shen, 2005; Rains, 2013) using the path analysis modeling tool PROCESS in SPSS (Hayes, 2013). H3 postulated that loss frames would initially trigger increased freedom threat—a pattern that did not emerge—which translates to rejection, but planned contrast testing, guided by Stewart and Ruberg (2000), did suggest two other contrasts (contrast one vs. four and contrast one vs. one) that could be investigated within the context of the intertwined model. To test the intertwined model, two contrast variables were created based on the results of prior analyses. First, a contrast variable was created that compared a one-dose gain-framed message to a four-dose gain-framed message (contrast one vs. four). The one-dose gain frame message invoked considerable freedom threat, a situation that seemed to dissolve as dosage increased. Second, a contrast was created that compared the one-dose gain-framed message to the one-dose loss-framed message (contrast one vs. one). Serial mediation analysis tested the following model: contrast variable → freedom threat → reactance → attitude → intentions.

4.3.1. One-Dose Gain Versus Four-Dose Gain

The indirect path was supported, coefficient = 0.01, boot $SE = 0.01$, boot 95% CI: 0.0004–0.0510 (see Fig. 1). The single-dose gain frame message invoked greater freedom threat, coefficient = –0.27, $SE = 0.13$, $p = 0.04$, which, in turn, was related

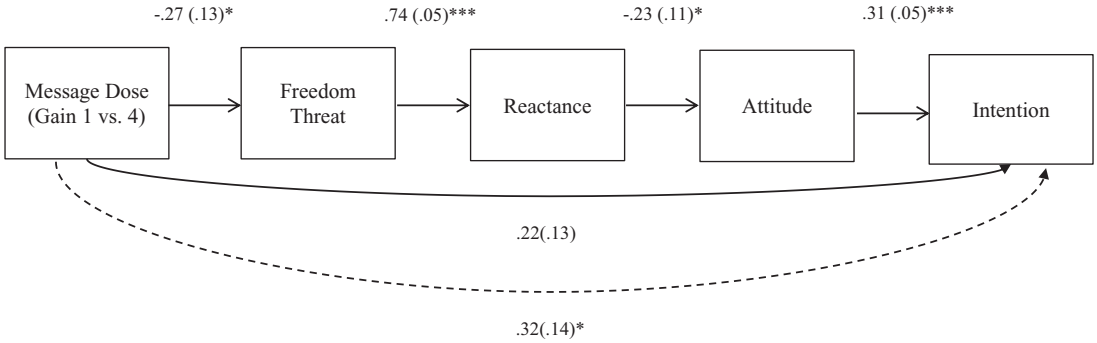

Fig. 1. Serial mediation—indirect effect at one- versus four-dose gain frame, with one dose producing significantly higher freedom threat. *Note*: Process Model 6 with 5,000 bootstraps. The serial mediation model was significant, coefficient = 0.01, boot $SE = 0.01$, boot 95% CI: 0.0004–0.0510. $^{*}p < 0.05$; $^{***}p < 0.001$.

to increased reactance, coefficient = 0.74, $SE = 0.05$, $p < 0.001$. Reactance was negatively related to attitude, coefficient = –0.23, $SE = 0.11$, $p = 0.04$, and attitude was positively related to intention, coefficient = 0.31, $SE = 0.05$, $p < 0.001$.

4.3.2. One-Dose Gain Versus One-Dose Loss

The indirect path was not supported, coefficient = 0.01, boot $SE = 0.01$, boot 95% CI: –0.0004 to 0.0452. The model was not supported because the single-dose loss/gain frame messages did not evoke differing levels of freedom threat, coefficient = –0.22, $SE = 0.14$, $p = 0.11$.

5. DISCUSSION

A goal of second-generation loss/gain framing research is to unpack the variation in framing effects by examining possible mediators and moderators (Cassotti et al., 2012; Covey, 2014; Jensen et al., 2018; Latimer et al., 2007; Malaviya & Brendl, 2014; Pabst et al., 2013; Rothman & Updegraff, 2011; Vezich et al., 2017). To this end, this study tested reactance as a mediator and dose as a moderator of loss/gain framing effects in the context of physical activity and health risks. Results suggest that reactance and dose each play a role in framing effects, but in unexpected and somewhat unclear ways. Gain frames invoked more freedom threat, anger, and reactance than loss frames. There was no main effect of frame on attitudes or intentions. An interaction effect emerged, however: at the single dose, gain-framed messages generated lower attitudes and intentions to engage in physical activity than loss-framed messages. Single-dose gain frames also provoked greater freedom threat compared to loss frames and to higher-dose gain frames.

Overall findings from this experiment suggest the long-standing assumption that losses have a greater psychological impact than gains may not translate perfectly to persuasive health risk messages. The original framework for examining framing effects was in probabilistic decision-making contexts where gains and losses were presented with varying degrees of uncertainty (Kahneman & Tversky, 1984), usually in the context of monetary choices (see Gal & Rucker, 2018). Attempts to apply the experimental conditions and assumptions of prospect theory in a persuasive health risk environment—where outcome probabilities are usually unspecified (Harrington & Kerr, 2017), and where individuals are highly sensitive to freedom threats (Dillard & Shen, 2005)—have not been fully successful (Nan et al., 2018; O'Keefe & Jensen, 2006).

Recently, scholars have proposed that, in light of minimal empirical support for loss aversion as a general principle, framing researchers should consider context-based effects of loss/gain framing and should shift focus toward understanding how frames may differently affect psychological processes (Gal & Rucker, 2018). Our findings lend support for psychological reactance theory as a possible message processing framework for understanding some of the variation in loss/gain framing effects (see Fig. 1), perhaps especially in the context of communicating about health risks. Results were counter to hypothesized relationships, however, indicating that further research is needed to understand this connection.

One of the challenges to studying communication is that it is common to become focused on a specific message feature or contrast and then design

experiments with the goal of studying that feature or contrast (e.g., loss vs. gain frames). However, it is easy to unintentionally manipulate other features, or to not be mindful of other features, in the process of creating stimuli. Data from this study suggest loss and gain frames may be prone to triggering freedom threats in nuanced ways. Notably, the single-dose gain frame message triggered significant freedom threat in this study; a situation that changed when the information was loss-framed or when the dosage was increased. This finding is unexpected, but also deeply thought provoking. Message dose and message content were not confounded in this experiment; therefore, it was the dose itself that triggered freedom threat, anger, and lower intentions. Why certain frames would trigger freedom threat at certain message doses is unclear.

One possible explanation is that the single-dose gain frame violated audiences' expectations. Frequently, messages about the benefits of exercise provide a list of several advantages. Thus, individuals may have expected to read more than a very short two-point message—an expectation that people might not tend to have toward messages about the disadvantages of not exercising. Furthermore, low doses may come across as weak rationale for a risk recommendation—a situation that might be perceived differently depending on frame. We consider findings from this study tentative. Ultimately, more work explicating which features of framed messages (e.g., dose) induce freedom threat, and why, is needed.

Another complication when studying dose in communication research is that scholars have yet to agree on a standard unit of analysis. This study conceptualized dose within a single message, and found the biggest differences between the extremes (one vs. four doses). This suggests that future research might begin by exploring those two extremes, and perhaps venturing outward (one vs. eight doses, one vs. 12 doses). Yet other avenues warrant additional research, as it is equally plausible that dose is best operationalized as multiple exposures to a single message, exposure to multiple distinct messages, or even exposure to a message across different channels.

On a related note, in a message experiment of this complexity, there is always the possibility of more stories to uncover depending on the analytical goals of the researcher. For example, a reader might notice that the two most different cells in the design are the one-dose gain-framed message and the two-dose loss-framed message; those two cells generated significantly different levels of freedom threat and reactance. Section 4 does not explore a contrast between these two cells—as we had no *a priori* rationale to do so—but future research may support it if one-dose gain-framed messages continue to falter in this manner or two-dose loss-framed messages continue to perform well. Alternately, the data in hand may be viewed differently as our understanding of the relationship between dose and message features evolves to account for why a particular level of dose may be optimal in different message situations. To support this future work, we have provided the means and standard errors for each variable and cell.

6. LIMITATIONS

This experiment had several limitations. For one, we manipulated messages about the impact of physical activity on health, and it is unclear whether the findings can be generalized to other risk communication domains. Second, we recruited participants through a paid online panel service. On one hand, this afforded a diverse sample of adults from around the United States, allowing us to move beyond the college student sample commonly used in framing and reactance studies. However, because participants self-select to participate, they do not form a stratified, nationally (or internationally) representative sample.

The difficulty in designing study stimuli with equivalent gain- and loss-framed messages should also be acknowledged. Telling someone they will lower health risks with exercise or telling them they will increase health risks by *not* exercising—while creating a clean flip—are not equivalent statements. The latter may appear to be saying that someone cannot get similar health benefits from activities other than exercise. There are many other activities that influence a person's health status and risk levels. This dichotomization could influence the degree to which message recipients experience message resistance, an important consideration when framing health risk information in both research and practice.

7. CONCLUSION

Loss/gain framing research has shifted toward identifying factors that explain the wide variation in framing effects, such as mediators (e.g., message processes) and moderators (e.g., message features). This study contributed to this line of inquiry by testing reactance as a mediator and message dose as a moderator. Of note, one-dose gain-framed messages

triggered more freedom threat than the one-dose loss frame or higher doses of gain-framed points. In light of this finding, combined with the fact that dose was un-confounded from message content in this experiment, it would be worthwhile to continue to explore the relationship between frame and dose in future studies. Findings also suggest reactance is a message processing framework that deserves further study in the context of framed messages about health risks.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Fig. S1. One-dose gain frame (1A).
Fig. S2. One-dose gain frame (1B).
Fig. S3. One-dose gain frame (1C).
Fig. S4. One-dose gain frame (1D).
Fig. S5. Two-dose gain frame (2AB).
Fig. S6. Two-dose gain frame (2AC).
Fig. S7. Two-dose gain frame (2AD).
Fig. S8. Two-dose gain frame (2BC).
Fig. S9. Two-dose gain frame (2BD).
Fig. S10. Two-dose gain frame (2CD).
Fig. S11. Three-dose gain frame (3ABC).
Fig. S12. Three-dose gain frame (3ABD).
Fig. S13. Three-dose gain frame (3ACD).
Fig. S14. Three-dose gain frame (3BCD).
Fig. S15. Four-dose gain frame (4ABCD).
Fig. S16. One-dose loss frame (1A).