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ARTICLE

Doing What Makes You Happy: Health Message Framing for Younger and Older Adults

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ABSTRACT

Background: Health-related messages, framed in terms of gains or losses, can impact decision-making differently across the adult life span. The focus of this study was on the emotional responses evoked by such framing and their relationship to perceived effectiveness, as mechanisms that may underpin how health messages impact health decisions.
Methods: A web-based study using Amazon's Mechanical Turk platform was conducted with a sample of 132 younger adults and 106 older adults. Participants were asked to read exercise-related messages framed in terms of gains or losses, and to rate each message for affect and effectiveness.
Results: Relative to younger adults, older adults showed less negative reactions to loss-framed messages and to messages that described undesirable outcomes. Importantly, younger and older adults differentially used affective cues to gauge effectiveness of framed messages: for gain-framed messages (which tended to evoke positive affect), older adults found messages that made them feel good to be more effective; but for loss-framed messages (which tend to evoke negative affect), younger adults found messages that made them feel bad to be more effective.
Conclusions: These results suggest that in processing health messages, older adults may be more motivated by positive affect, while younger adults may be more motivated by negative affect.

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Doing What Makes You Happy:

Health Message Framing for Younger and Older Adults

Public health advocates often use persuasive messages in an attempt to promote healthy behaviors or change unhealthy behaviors. In fact, the way in which such messages are constructed can, in some cases, have a strong effect on the intention for behavior change (Rothman & Salovey, 1997). There is also emerging evidence that messages can evoke differential emotional responses depending on how they are constructed (Mikels et al., 2016). Given that aging tends to bring a shift toward positivity in emotional experience, which can affect cognitive processing (Carstensen, Mikels, & Mather, 2006), message framing, then, might be expected to produce differential effects on decision-making via emotional responses as a function of age. Indeed, there is evidence that message framing has different effects on the health behaviors of older versus

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younger adults (Notthoff & Carstensen, 2014). Furthermore, explicit emotional information in health-care choice options can impact information search and memory for health decisions differentially for younger and older adults (Löckenhoff & Carstensen, 2007). However, little is known about how more subtle differences in the expression of health messages that evoke emotional responses contribute to motivating behavioral change, nor how age differences in affective responses are linked to perceived effectiveness of the messages. For practical reasons, a better understanding of such relationships is needed to tailor health messages for different age groups to motivate behavior change. Theoretically, an understanding of the dynamic among the linguistic expression of information and its emotional and cognitive effects with aging is important to a broad range of problems (Stine-Morrow & Radvansky, 2017).

The central idea of studies on message framing is that a specific situation can be described in ways to make either the potential gains or losses of the situation more salient. Although the objective aspects of the situation are equivalent, framing can have a strong influence on the perception of those messages and decision-making preferences (Tversky & Kahneman, 1981). In the health domain, messages can be framed in terms of the benefits (gains) of adopting a particular healthy behavior or the costs (losses) of not adopting the behavior, as well as the desirability of the outcomes (Rothman & Salovey, 1997). As demonstrated in Table 1, gain-framed messages emphasize how engagement in a healthy behavior (i.e., "*frequent exercising*") can lead to the attainment of a desirable outcome (i.e., "*good respiratory functions*") or the avoidance of an undesirable outcome (i.e., "*bad respiratory functions*"); loss-framed messages, on the other hand, focus on how not engaging in a healthy behavior (i.e., "*infrequent exercising*") can reduce the likelihood of desirable outcomes or lead to undesirable outcomes. Because the potential for gain promotes risk-aversion, while a potential loss promotes risk-seeking (Tversky & Kahneman, 1981), Rothman and Salovey (1997) argued that the effectiveness of gain- and loss-framed messages for behavior change may depend on the type of health behavior that is targeted. Generally, for behaviors that aim to prevent the onset or development of health problems, such as exercise (which entails minimal risk), gain-framed messages are found to be more effective than loss-framed messages in engendering those behaviors (Gallagher & Updegraff, 2012).

Effects of emotional content and message framing on behavior change have been found to vary with age. Löckenhoff and Carstensen (2007) found that in a health decision-making task, older adults were more likely than younger adults to search for and recall a larger proportion of positive than negative information. In addition, compared to younger adults, when given health pamphlets to read, older adults rated positively framed pamphlets as more informative and showed better memory of them than negatively framed pamphlets (Shamaskin, Mikels, & Reed, 2010). A substantial base of research has shown that compared to younger adults, older adults are more likely to attend to

Table 1. Conditions of message framing.

Condition		Message
Frame	Outcome	
Gain	Attain desirable	Frequent exercising can lead to good respiratory functions.
	Avoid undesirable	Frequent exercising can prevent bad respiratory functions.
Loss	Avoid desirable	Infrequent exercising can hinder good respiratory functions.
	Attain undesirable	Infrequent exercising can lead to bad respiratory functions.

and recall positive relative to negative stimuli, a phenomenon referred to as the positivity effect (Carstensen & Mikels, 2005; Reed, Chan, & Mikels, 2014). This positivity effect is thought to be related to a developmental shift in motivation that leads to differential processing of emotional information. According to socioemotional selectivity theory (SST; Carstensen, Isaacowitz, & Charles, 1999), priorities for social-emotional and information-seeking goals are set in a temporal context, such that these goals change as a function of perceived time left in life. This theory suggests that as people get older and perceive the time left to be less than the time traversed, present-oriented and emotionally meaningful goals become more important. As a result, SST suggests that aging is associated with tendencies to avoid negative information, and to seek positive information to achieve emotional well-being (Carstensen & Mikels, 2005). Indeed, researchers have started to examine age differences in processing emotional information as the mechanism underlying the age differences in response to framed health-related messages.

There is evidence that gain- and loss-framed messages engender differential emotional responses. Mikels et al. (2016) asked younger and older participants to read a series of health-promoting messages framed in terms of gains and losses and then to rate their affective response to each message. Relative to loss-framed messages, gain-framed health messages evoked more positive affect (which among younger adults was related to increased zygomaticus activity, subtle changes in muscle activity around the mouth that is a physiological measure of positive affect). Importantly, this effect on affect ratings differed by age, such that older adults responded less negatively to loss-framed messages relative to younger adults, but both age groups had similar affective responses to gain-framed messages. Mikels et al. (2016) suggested that the age differences in emotional reactions to framed messages may lead to the age differences in how messages are processed, which may, in turn, influence the perceived effectiveness of messages. However, an empirical linkage between affective response and effectiveness or even perceived effectiveness in framed messages has not been established. It is also worthwhile to note that the effects of outcome frames (attainment/avoidance of desirable/undesirable outcomes) in health messages have not been well studied in previous research. Most studies investigated the gain- and loss-framing effects collapsing across the outcome conditions; thus, it is not clear whether the phrasing of behavioral outcomes would impact the effects of aging and message framing.

In the current study, we aimed to examine age differences in affective reactions and perceived effectiveness of framed exercise-promoting messages. Based on previous literature on message framing and the age-related positivity effect, we expected to replicate the findings of subjective affective reactions from Mikels et al. (2016) such that older adults would rate loss-framed messages as less negative than younger adults would. In terms of perceived effectiveness, we also expected to find the age-related positivity effect such that relative to younger adults, older adults would perceive gain-framed messages as more effective in promoting exercise than loss-framed messages. More essentially, we wanted to investigate the relationship between affective reactions and perceived effectiveness among framed messages, and how it can vary as a function of age. Given that older adults' tendency to attend to positive or gain-framed information can be due to their shifted motivation in processing emotional information (Carstensen et al., 1999), we expected an age difference in how people use emotional responses to gauge effectiveness of gain-

versus loss-framed messages. In addition to effects of gain- and loss-framing, we were also interested in further exploring the more subtle effects of outcome framing in messages.

Method

Participants

Younger (n = 132, aged 19–39 years old) and older (n= 106, aged 60–86 years old) adults participated in the study via Amazon's Mechanical Turk system.[1] Validity checks were implemented to verify participant's self-reported age and their responses to the message rating task. As a result, data from three additional younger participants and one additional older participant were eliminated because they failed to pass the validity checks. All participants were native speakers of English, residing in the United States. As shown in Table 2, there were no age differences in gender composition, $\chi^2(1) = 0.01$, education level $t(237) = 0.67$, or self-reported physical activity level[2] (Washburn, Smith, Jette, & Janney, 1993), $t(237) = 1.36$.

Materials

Forty-eight exercise-related messages were developed, and four versions of each message were constructed according to Rothman and Salovey's (1997) framework (cf. Table 1). Gain-framed messages were expressed either in terms of the attainment of desirable health outcomes (GF-D) or the avoidance of undesirable outcomes (GF-U) associated with engagement in exercise. Loss-framed messages were expressed either in terms of the loss of desirable outcomes (LF-D) or the likelihood of undesirable outcomes (LF-U) from the lack of exercise.

Each participant read a version of each of the 48 messages, with 12 from each of the four framing conditions (GF-D, GF-U, LF-D, LF-U). Materials were counterbalanced across framing conditions to create four stimulus lists so that no participant was presented

Table 2. Participant characteristics of young and older adults.

Characteristic		Young	Older
Age	M (SE)	29.4 (0.4)	65.9 (0.4)
Gender	% Male	54.5	54.7
Education	M (SE)	15.1 (0.2)	15.3 (0.2)
	min-max	10.5–20.0	12.0–20.0
Activity	M (SE)	53.6 (3.7)	46.1 (4.1)
	min-max	0.0–205.8	2.2–196.0

Activity was measured by Physical Activity Scale for the Elderly (Washburn et al., 1993) question 3–5.

[1]The recruitment had two stages: The study was first posted without targeting a specific age range, in which 135 younger adults aged from 18 to 39 years old and 17 older adults aged older than 60 years old were recruited. There were also 50 middle-aged adults aged from 40 to 59 years old that were recruited, but because this study aimed to compare just younger and older adults, the responses collected from those middle-aged participants were not included for data analysis. To recruit additional older participants, the study was posted again on Mechanical Turk, targeting participants older than 60 years old, which resulted in recruiting an additional 90 older adults who did not participate in the study in the first stage recruitment.

[2]The physical activity level was not related to any of the rating measures (i.e., affect and effectiveness rating scores), and so was not incorporated into later analyses.

the same message in more than one condition, and across the experiment, each message appeared approximately equally often in each condition. Messages were presented in a single random order for all four stimulus lists. Each stimulus list was divided into two blocks, one for affect ratings and the other for effectiveness ratings, and the order of the two ratings was counterbalanced across participants, so that half the participants rated affect and then effectiveness, and the other half rated effectiveness and then affect. Thus, eight presentation conditions were created. Participants were randomly assigned to one of these eight presentation conditions, so every participant viewed all four message conditions and provided both effectiveness and affect ratings. A 4 (stimulus list) × 2 (rating order) analysis of variance (ANOVA) indicated that neither the stimulus list nor the order of blocks had an effect on the ratings, ps > .10, so we report analyses collapsed across stimulus lists and block orders.

Procedure

This study was presented online on Mechanical Turk using Qualtrics survey software. The University of Illinois at Urbana-Champaign Institutional Review Board approved this study protocol. The average time to complete the study was approximately 10 min. After consenting to participate, participants were randomly assigned to one of the eight versions of the questionnaire. For both blocks, participants were asked to read each exercise-related message and to provide a rating on a 6-point Likert scale. For the affect rating block, participants were asked to indicate "*How does each statement make you feel?*" with a rating scale from very negative (−3) to very positive (+3), and for the effectiveness rating block, participants indicated "*How effective is each statement for making you want to exercise?*" with a rating scale from very ineffective (−3) to very effective (+3), with no option for a neutral midpoint for either scale. After the two rating blocks, participants were asked to answer questions about their demographic background and physical activity during leisure time.

Results

Unless otherwise specified, data were analyzed with a 2 × 2 × 2 mixed model ANOVA. Age (young vs. old) was the between-subjects variable, and message Frame (gain vs. loss) and Outcome (desirable vs. undesirable) were within-subject variables.

Affect Ratings

We found main effects of Frame, $F(1, 236) = 243.54$, $p < .001$, $\eta_p^2 = .51$, and Outcome, $F(1, 236) = 34.35$, $p < .001$, $\eta_p^2 = .13$: GF messages were rated as more positive than LF messages ($M_{GF} = 1.27$, $SE = 0.06$; $M_{LF} = -0.35$, $SE = 0.08$), and messages with desirable outcomes were rated as more positive than those with undesirable outcomes ($M_{DES} = 0.55$, $SE = 0.05$; $M_{UND} = 0.36$, $SE = 0.06$). As shown in the left panel of Figure 1, these two factors interacted, $F(1, 236) = 9.74$, $p = .002$, $\eta_p^2 = .04$, such that GF messages with desirable outcomes were rated differentially more positive than those with undesirable outcomes, $t(237) = 6.02$, $p < .001$, $d = 0.39$, relative to LF messages, $t(237) = 2.08$, $p = .04$, $d = 0.13$.

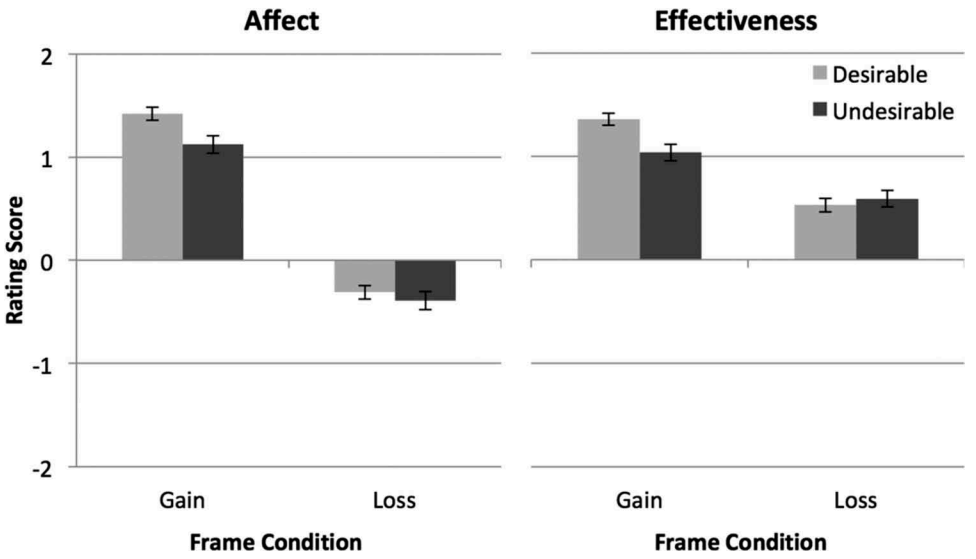

Figure 1. Mean ratings for affect (left) and effectiveness (right) as a function of message framing and outcome desirability.

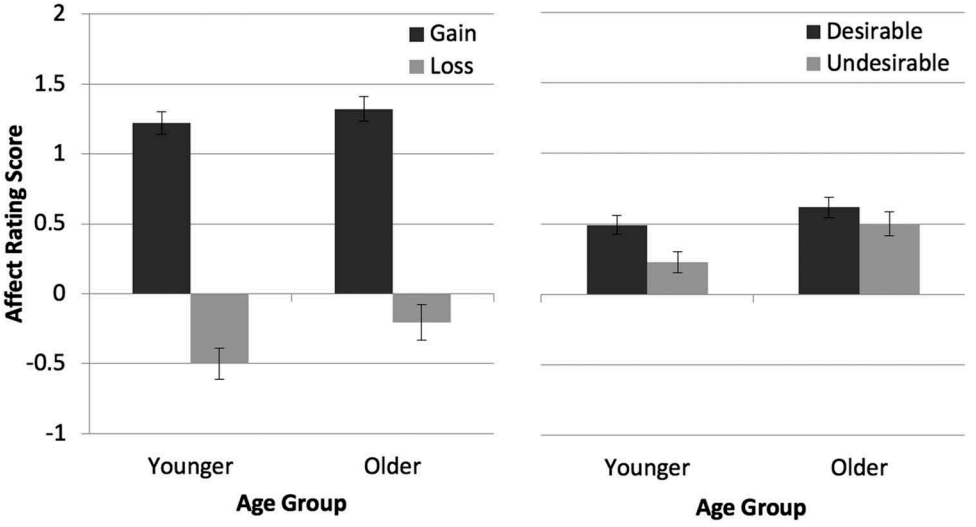

Figure 2. Mean rating for affect as a function of frame (left) and outcome desirability (right) for younger and older adults.

A significant main effect of age, $F(1, 236) = 3.85$, $p = .05$, $\eta_p^2 = .02$, confirmed that older adults' ratings were more positive than those of younger adults ($M_Y = 0.36$, $SE = 0.07$; $M_O = 0.56$, $SE = 0.08$). As demonstrated in the left panel of Figure 2, consistent with our predictions, older adults showed less negative reactions to LF messages than younger adults ($M_Y = -0.50$, $SE = 0.11$; $M_O = -0.20$, $SE = 0.13$), $t(236) = 1.78$, $p = .035$ (one-tailed), $d = 0.23$. There was no age difference for GF messages ($M_Y = 1.22$, $SE = 0.08$; $M_O = 1.32$, $SE = 0.09$), $t(236) < 1$. The interaction between Age and Frame was not significant, $F(1, 236) = 1.00$.

As shown in the right panel of Figure 2, the interaction between Age and Outcome was significant, $F(1, 236) = 5.46$, $p = .02$, $\eta_p^2 = .02$. Young and old did not differ in affective response to messages describing desirable outcomes ($M_Y = 0.49$, $SE = 0.06$; $M_O = 0.62$, $SE = 0.08$), $t(236) = 1.25$, $p = .21$, $d = 0.16$. However, for undesirable outcomes, older adults responded more positively than younger adults ($M_Y = 0.22$, $SE = 0.08$; $M_O = 0.50$, $SE = 0.09$), $t(236) = 2.42$, $p = .02$, $d = 0.32$. The three-way interaction was not significant, $F(1, 236) < 1$., so this pattern did not vary across the type of frame. Thus, younger and older adults experienced the same qualitative pattern of affective responses as a function of framing, but there were subtle age differences in the magnitude of this effect. Generally, older adults had more positive reactions, an effect that was primarily due to a diminished negative reactivity to loss frames and to undesirable outcomes.

Effectiveness Ratings

The main effects of Frame, $F(1, 236) = 91.97$, $p < .001$, $\eta_p^2 = .28$, and Outcome, $F(1, 236) = 13.07$, $p < .001$, $\eta_p^2 = .05$, were significant, such that GF messages were perceived to be more effective than LF messages ($M_{GF} = 1.20$, $SE = 0.06$; $M_{LF} = 0.56$, $SE = 0.08$), and messages with desirable outcomes were rated as more effective than those with undesirable outcomes ($M_{DES} = 0.95$, $SE = 0.06$; $M_{UND} = 0.81$, $SE = 0.07$). As shown in the right panel of Figure 1, the interaction between Frame and Outcome was significant, $F(1, 236) = 30.51$, $p < .001$, $\eta_p^2 = .11$. GF messages were rated as more effective when outcomes were desirable relative to when they were undesirable, $t(237) = 6.88$, $p < .001$, $d = 0.45$, whereas the desirability of outcome did not impact the perceived effectiveness of LF messages, $t(237) = 1.13$, $p = .26$, $d = 0.07$. Thus, the main effect of Outcome on effectiveness ratings was probably due to the differential reactions to outcome desirability among GF messages rather than in LF messages.

There was no main effect of Age on effectiveness ratings, $F(1, 236) = 2.20$, $p > .1$, nor did the effects of Frame and Outcome vary with age, Fs <1. This shows that despite the age differences in affective reactions to framed messages, younger and older adults' perceptions of message effectiveness were similarly impacted by variation in framing.

The Relationship between Affect and Perceived Effectiveness

The dissociation between the framing effects on affect and perceived effectiveness suggests that younger and older adults may differentially use affective cues to gauge effectiveness. To address this question, we conducted analyses of items collapsing across subjects to examine the relationships between affect and perceived effectiveness separately for GF and LF messages. For each message, we calculated average ratings of affect and effectiveness for older and younger adults.[3] Table 3 shows the intercorrelations for these estimates for the sample as a whole (upper panel) and by age group (lower panel).

First, note that for neither the affect ratings nor the effectiveness ratings did the GF and LF versions generally correlate with each other, suggesting some independence in the effects of message content on the ratings across framing condition. There was clear evidence, however, for

[3]We did not break this down further by Outcome condition, given the generally subtle effects of this variable on affect and effectiveness. Collapsing across Outcome also provided us with more reliable estimates of the effects of Frame.

Table 3. Intercorrelations between affect and effectiveness ratings for messages in gain- and loss-framed conditions.

Measure	1	2	3	4
	Overall			
1. Affect – Gain				
2. Affect – Loss	.170			
3. Effectiveness – Gain	.603**	.386**		
4. Effectiveness – Loss	.463**	−.558**	.279	
	By Age Group			
1. Affect – Gain	–	.300*	.653**	.403**
2. Affect – Loss	.013	–	.395**	−.385**
3. Effectiveness – Gain	.369**	.257	–	.214
4. Effectiveness – Loss	.374**	−.636**	0.239	–

The top panel shows correlations collapsed across age groups, and the bottom panel shows correlations broken down by age group (above diagonal is for older adults, and below diagonal is for younger adults). * $p < .05$. ** $p < .01$.

effects of differential affective response across message on perceived effectiveness. For GF messages, the affect ratings showed a moderate positive correlation with the effectiveness ratings, suggesting that for GF messages, more positive emotions translated into increased effectiveness. Importantly, as shown in the upper panel of Figure 3, this positive correlation was stronger among older adults compared to younger adults, based on a Fisher *r*-to-*Z* transformation, $Z = 1.87$, $p = .03$. For LF messages, on the other hand, the affect ratings were *negatively* correlated with effectiveness ratings, suggesting that when the message was framed in terms of loss, it was negative affect that was important for perceived effectiveness. Again, there was an age difference in the strength of this relationship. Specifically, as shown in the lower panel of Figure 3, the correlation for LF messages was *stronger among younger adults* than among older adults, $Z = 1.64$, $p = .05$. These results show that the relationship between affect and effectiveness ratings depended on the framing of messages, such that the more positive GF messages were rated, the more effective they were perceived to be, whereas for LF messages, the more negative they were rated, the more effective they were perceived to be. Furthermore, there was an asymmetry in these effects with age. Strikingly, positive affect was more strongly related to effectiveness of the GF messages for older adults, whereas negative affect was more strongly related to effectiveness of the LF messages for younger adults.

Discussion

Using a web-based study, we replicated the effects of message framing on affective reactions (Mikels et al., 2016; Rothman & Salovey, 1997), extending this work (a) to examine effects on perceived effectiveness, and (b) to show that the effects of gain- and loss-framed messages are further exaggerated by more subtle effects of outcome framing. Gain-framed messages were perceived to be more positive and more effective than loss-framed messages, especially for gain-framed messages that focused on attaining desirable outcomes rather than avoiding undesirable outcomes. These findings are consistent with the idea that affective responses are a mechanism that mediates the effect of perceived risk on internalization of health messages for behavior change.

Consistent with findings from Mikels et al. (2016), older adults were similar to the young in the degree of their positive emotional response to gain-framed messages, but demonstrated less negative reactivity to loss-framed messages. Unlike in the Mikels et al. study who reported a medium size ($\eta_p^2 = .071$) of the age by message frame interaction effect, the interaction in this

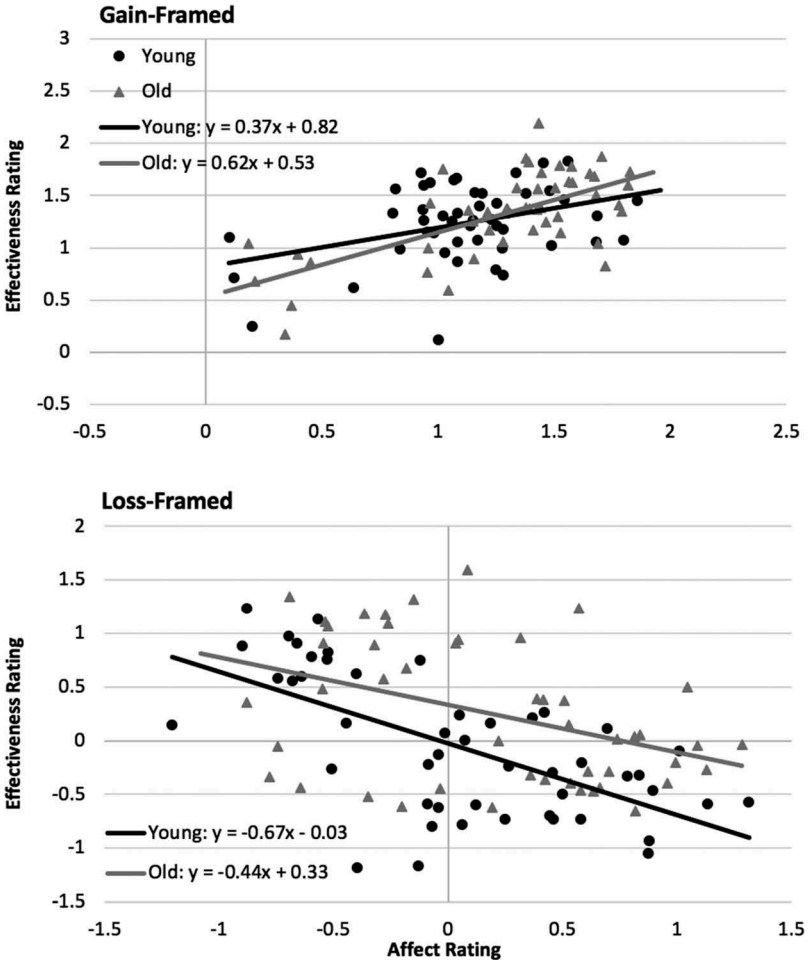

Figure 3. Correlations between affect and effectiveness ratings for gain-framed (upper panel) and loss-framed (lower panel) messages among younger and older adults.

study was not significant. In addition, the effect size of the age difference in affective response to LF messages found in this study (d = 0.23) was smaller than the one in Mikels et al. (d = 0.83). Generally, data in the current study produced stronger negative ratings to loss-framed messages relative to those in the earlier study ($M_{\text{current}} = -0.35$, $SD = 1.30$, $M_{\text{Mikels et al.}} = 0.32$, $SD = 1.59$, $t(298) = 3.44$, $p < .01$), a subtle difference that might be attributable to differences in subjects, materials, or both. It is worth noting that the age range of our sample was a bit different from the one in the Mikels et al. study. Our younger sample was somewhat older than that of the earlier study (29 vs. 21 yrs), and our older sample was younger (65 vs. 74 yrs). Thus, a weaker age difference in the effects of message framing on emotional responses in the current study might be due to the less extreme age difference. Nevertheless, we replicated the pattern found by Mikels et al. (2016), and with a sample that is quite different from the typical contrast between undergraduate students and community volunteers recruited for testing on a university campus. The use of electronic platforms for data collection is becoming more typical in psychological science and has shown promise for the acquisition of high-quality data

from broader samples of participants than is typically possible in psychology labs (Buhrmester, Kwang, & Gosling, 2011). Despite the strength of using electronic platforms, there are also limitations of online recruitment, especially for older adults. Although the population of adult Internet users over the age of 65 is expanding (Zickuhr & Madden, 2012), the proportion of older users on web-based platforms for experimental research like Amazon's Mechanical Turk is still lower than the proportion of younger users (Huff & Tingley, 2015). Thus, some may worry about the representativeness of the older adults sample obtained from the online platforms. However, recent studies comparing data collected through Mechanical Turk and in laboratory have suggested more similarities than differences both demographically and psychometrically (Buhrmester et al., 2011; Crump, McDonnell, & Gureckis, 2013), including several studies in aging research (Graf & Patrick, 2014; Stothart, Boot, & Simons, 2015). Despite these concerns, the extent to which age differences in message framing effects depend on participant differences and/or subtle differences in message content certainly deserves further examination.

Interestingly, compared to the young, older adults responded more positively to messages with undesirable outcomes, but did not differ from the young on ratings of messages with desirable outcomes. According to the Strength and Vulnerability Integration (SAVI) model (Charles, 2010), the enhancement of emotional well-being with aging is due to an increase in the use of strategies to avoid or limit the elicitation of negative emotions. Charles (2010) suggests that after encountering a negative situation or event (e.g., reading messages with undesirable health outcomes), older adults regulate their emotions by disengaging or de-escalating negative experiences. Therefore, in this study, relative to the young, older participants regulated their emotional responses to messages with undesirable outcomes through less negative reactions towards those messages. The SAVI model posits that one of the mechanisms underlying these age differences is an age-related change in perceived time left to live, as suggested by the SST (Carstensen et al., 1999). Another possible mechanism is the increased use of emotional regulation strategies due to the accumulated experience and knowledge from years lived. Future research can test these mechanisms by assessing time perception of future, as well as comparing evaluations of desirable and undesirable outcomes with medical histories and current health statuses.

Perhaps the most compelling age difference was the way in which the emotional reaction played a role in how effective the message was perceived to be. Regardless of age, gain-framed messages were perceived to be more effective when they engendered positive emotions; and loss-framed message, when they engendered negative emotions. However, age moderated how these affective cues were used to determine effectiveness. The positive emotions engendered in gain-framed messages contributed more to a sense of effectiveness among older adults, whereas the negative emotions engendered by loss-framed messages contributed more to a sense of effectiveness among younger adults. These findings seem to be consistent with the postulate of SST (Carstensen et al., 1999) that older adults are more motivated than younger adults to shift their attention to positive information in order to achieve their goals. The stronger relationship between emotional response and perception of effectiveness of gain-framed messages may contribute to the age-related tendency among older adults to focus on gain-framed information when reaching the goal of engaging in physical activity, whereas younger adults are more likely to relate their negative emotional reactions evoked in loss-framed messages to the perceived effectiveness.

The overall pattern of results is interesting to consider in relation to Notthoff and Carstensen's (2014) findings on effectiveness assessed by actual behavior change. Notthoff and Carstensen (2014) presented gain-framed, loss-framed, or neutral messages about walking to younger and older participants. Gain-framed messages were more effective than loss-framed messages in promoting walking among older adults, but message framing did not impact younger adults' walking. However, in our study, both younger and older adults perceived gain-framed messages to be more effective than loss-framed messages. Very few studies have directly investigated the relationship between perceived effectiveness and actual behavioral change, but the findings from these two studies may imply that message framing might have more consistent effects among older adults compared to younger adults, suggesting that framing messages in terms of gains could be a very powerful approach to promote healthy behaviors among older adults. It is also important to note that Notthoff and Carstensen (2014) reasoned the age differences in the framing effect on message effectiveness were due to the age differences in processing emotional information, but emotional reactions to framed messages were not measured in their study. Thus, it is unclear in Notthoff and Carstensen (2014) whether the framed messages evoked different emotional responses between younger and older adults, and whether the observed age differences in behavioral change in walking could be related to the affective reactions to framed messages. Despite the lack of evidence for age differences in effectiveness ratings in our study, the age asymmetry in the intercorrelations between emotional reactions and perceived effectiveness does suggest a linkage between affective reactions to framed messages and the effectiveness of using framed messages to promote physical activity among older adults (Mikels et al., 2016; Notthoff & Carstensen, 2014).

Previous studies have suggested that the fact that older adults are more impacted by gain-framed messages may be a result of deeper information processing compared to loss-framed information (Notthoff & Carstensen, 2014; Rothman & Salovey, 1997). However, very few studies have directly examined the age differences in cognitive processing, such as attention and memory, of framed messages and its relation to emotion. It is important to note that syntactic complexity differs between GF and LF messages, as LF messages tend to have more negations (i.e., doing exercise vs. not doing exercise). Thus, GF messages are relatively easier to process cognitively compared to LF messages, which could influence the emotional reaction and effectiveness evaluation of the messages. Unfortunately, this current study cannot provide evidence to differentiate the mechanisms of syntactic complexity from risk perception in the effects of framing on affective reactions towards framed messages. Because most of the previous research was based on post-reading measures (i.e., rating and memory tasks after reading the framed messages), future studies can focus on the moment-to-moment processing of those messages with methodologies such as eye-tracking measures with memory recall tasks, so that the mechanisms of age differences in message processing can be investigated systematically.

This present research was subject to several limitations. First, we used a single item rather than multiple items of distinctive-specific emotions to measure participants' affective responses to messages, which may limit the reliability of the measure. However, we were interested in the general emotional valence (i.e., positive vs. negative) that evoked from reading framed messages, and the discrimination of specific emotions was not critical to the goal of our investigation. In addition, participants in this study needed to read and evaluate 48 messages online, so the use of single item can reduce the burden and confusion that

participants may have when giving multiple rating responses. Therefore, using a single item seems to be sufficient to capture the construct of valence in this web-based study. Future studies could include additional items to measure affective responses to improve measure validity and sensitivity, which will also provide the opportunity to investigate more specifically which type of message framing leads to which emotion. Another issue is that older sample in this study was not screened for cognitive impairments. It has been demonstrated that cognitive functions change with age, such that fluid abilities show a monotonic decline, whereas knowledge or crystalized abilities tend to grow and stabilize across the lifespan (Salthouse, 2012). It is possible that these age-related cognitive changes may influence people's ability to process framed messages, which could also have an impact on people's response to those messages. This is not very well investigated in existing literature, and future studies should include measures of cognitive functions to study the possible mechanisms, and at the same time to better characterize the sample.

Our findings have implications for design of exercise intervention programs among older adults. Given that older adults appear to adopt a different strategy from younger adults in using emotional cues to judge the effectiveness of framed health messages, information provided in intervention programs should be tailored to match their preference. That is, gain-framed messages should be used more among older adults as they tend to relate their positive feelings resulting from the information to the perceived effectiveness of the message, which could influence their decisions in getting involved in such programs and ultimately their engagement in physical activity.

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