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Messages that Matter: Age Differences in Affective Responses to Framed Health Messages

Joseph A. Mikels[1], **Michael M. Shuster**[1], **Sydney T. Thai**[1], **Renae Smith-Ray**[2], **Christian E. Waugh**[3], **Kayla Roth**[1], **Alexis Keilly**[1], and **Elizabeth A. L. Stine-Morrow**[4]

[1]DePaul University

[2]University of Illinois Chicago

[3]Wake Forest University

[4]University of Illinois Urbana-Champaign

Abstract

Age differences in responses to framed health messages – which can influence judgments and decisions – are critical to understand yet relatively unexplored. Age-related emotional shifts toward positivity would be expected to differentially impact the affective responses of older and younger adults to framed messages. In this study, we measured the subjective and physiological affective responses of older and younger adults to gain- and loss-framed exercise promotion messages. Relative to older adults, younger adults exhibited greater negative reactivity to loss-framed health messages. These results suggest that health message framing does matter – but depends on the age of the message recipient.

Keywords

aging; emotion; message framing; positivity

Persuasive health messages, appealing to either the benefits of engaging in a targeted behavior or the consequences of not engaging in that behavior, are often used to motivate healthy behaviors. Human judgment is fundamentally flawed insofar as health information presented with emphasis on benefits in a *gain frame* can have different behavioral effects relative to equivalent information presented with emphasis on costs in a *loss frame* (Rothman & Salovey, 1997). Importantly, though, the precise affective underpinnings of message framing are not well understood. Moreover, such effects will likely differ across the adult life span as a function of shifts in emotional experience and information processing toward positivity in later life (Carstensen & Mikels, 2005). Thus, it is critical to understand how the emotional reactions of younger and older adults differ in response to framed messages.

Correspondence to: Joseph A. Mikels, Department of Psychology, DePaul University, 2219 N. Kenmore Ave. Chicago, IL 60614, Phone: 773.325.8769, Fax: 773.325.7888, jmikels@depaul.edu.

In contrast to earlier parts of the life span, old age is generally characterized by greater positivity (for a review see Mikels, Reed, Hardy, & Loeckenhoff, 2014). Such positivity is evident in older adults' daily reports of positive and negative affect relative to those of the young (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000; Charles, Reynolds, & Gatz, 2001; Mroczek & Kolarz, 1998). Additionally, the age-related positivity effect reveals a developmental pattern in which a preference for negative information in youth shifts toward a preference for positive information in later life, theoretically related to age differences in motivation (Carstensen & Mikels, 2005). A recent meta-analysis confirmed that this effect is indeed reliable and robust in information processing (Reed, Chan, & Mikels, 2014). As such, the age-related positivity effect could result in age differences in reaction to gain- and loss-framed health messages.

Indeed, age differences in reactivity to gains and losses have been documented. Research using different paradigms has shown that older relative to younger adults respond with less reactivity to losses but commensurate reactivity to gains (e.g., Mikels & Reed, 2009; Samanez-Larkin et al., 2007), suggesting that loss frames may be less impactful for older versus younger adults (Samanez-Larkin & Knutson, 2014). Freund and Ebner (2005) have proposed that a lifespan shift in motivational orientation from a focus on gains in youth to a focus on loss prevention in later life is a result of the increase in losses associated with advancing age. However, this perspective does not make clear predictions regarding how older versus younger adults react to losses. It could be reasoned that, with age-related increases in loss, older adults may have more positive responses to loss-framed messages as they may feel better about loss prevention relative to the young. Conversely, as losses are uncommon and unexpected in youth, younger adults may react more negatively to loss-framed messages relative to the old (Depping & Freund, 2011).

Such differences in goal orientation may have implication for the motivational impact of health messages as a function of frame. For example, Notthoff and Carstensen (2014) found that gain- versus loss-framed messages were more effective in increasing walking among older adults, whereas the walking of younger adults was not influenced by frame, though the underlying mechanisms are not well understood. Older adults consider gain- versus loss-framed health-related messages to be more informative and better remember them relative to younger adults (Shamaskin, Mikels, & Reed, 2010). Additionally, Isaacowitz and Choi (2012) found that older adults looked less at negative health material, and as such, better regulated their moods. However, potential *affective* mechanisms for message framing have yet to be fully illuminated.

The framing of health recommendations has a particular structure: gain- and loss-framed messages focus on the expected outcomes of a specific behavior (Rothman & Salovey, 1997). Specifically, when constructing health messages, gain-framed messages describe how engaging in a particular behavior can result in a desirable outcome or can result in avoiding an undesirable outcome. In contrast, loss-framed messages illustrate how not engaging in that same behavior can result in not attaining a beneficial desirable outcome or can result in attaining a costly undesirable outcome. Gain- and loss-framed messages clearly have an emotional tone, but the limited research on underlying emotional reactions remains inconclusive (see e.g., Meyerowitz & Chaiken, 1987; Rothman et al., 1993), though such reactions likely underlie the effectiveness of message framing and need to be better understood (Updegraff & Rothman, 2013).

In the current study, participants read a series of messages about exercise, which varied by frame and expected outcome. Participants provided affective ratings after each statement while physiological measures were collected from them. Reasoning from age-related positivity, we predicted an age-by-frame interaction for subjective affective responses. To measure multiple affect channels, we also included measures of facial electromyography (fEMG) and skin conductance. We assessed activity from the *corrugator supercilii* and the *zygomaticus major* as they have been shown to provide measures of negative and positive affect, respectively (Tassinary & Cacioppo, 1992). We also assessed skin conductance level (SCL) as a measure of arousal via sweat gland activity in the skin, which has been shown to predict certain types of decisions (e.g., Bechara, Damasio, Tranel, & Damasio, 1997). Despite these empirical observations, it is important to note that the coherence among measures of subjective affect, fEMG, and SCL across numerous studies is modest at best (see e.g., Barrett, 2006). Moreover, evidence indicates that subjective affect and physiological responding are more strongly correlated for more intense experiences (e.g., Mauss et al., 2005).

Regarding physiology and aging, older adults exhibit diminished reactivity in facial expressions to affective stimuli relative to younger adults (Cuthbert et al., 1988; Smith, Hillman & Duley, 2005) and attenuated autonomic nervous system responses including SCL (see e.g., Levenson, Carstensen, Friesen, & Ekman, 1991; Tsai, Levenson, & Carstensen, 2000). These age differences may reflect general biological weakening of the autonomic and somatic nervous system (see e.g., Kunzmann, Kupperbusch, & Levenson, 2005). Alternatively, these reductions may reflect a tendency among older adults to avoid intense emotions (Levenson et al., 1991), so that blunted arousal and facial expressivity may be a strategy to conserve resources in later life (Lawton, 2001). Therefore, we expected physiological reactivity to be blunted for the older versus younger adults. Moreover, Labouvie-Vief and DeVoe (1991) proposed that older adults' evaluations might rely less on physiological responses, raising the possibility of age differences in the correspondence between physiological measures and affective responses.

Method

Participants

Thirty-one younger adults and thirty-one older adults participated in the study. Older adults participated for monetary compensation and younger adults participated for either payment or course credit. For more complete information about the samples, see Table 1.

Exercise Message Task

For each trial, participants were presented with a message about health and exercise on a computer screen. These messages were developed from the 240-page manual from *Fit & Strong!,* a CDC-recommended, evidence-based physical activity program for older adults intended to increase participants' strength, flexibility, and knowledge of exercise (Hughes et al., 2004; Hughes et al., 2006). In accord with Rothman and Salovey's (1997) framework, four categories of messages were created: gain frame resulting in a desirable outcome (*A life with exercise can increase quality of life in old age*), gain frame avoiding an undesirable outcome (*A life with exercise can prevent frailty in old age*), loss frame resulting in losing a desirable outcome (*A life without exercise can reduce quality of life in old age*), and loss frame leading to an undesirable outcome (*A life without exercise can lead to frailty in old age*). Messages covered a multitude of outcomes from self-esteem to blood pressure and obesity. Each desirable outcome was matched with a comparable undesirable outcome.

There were seventeen messages for each category, for a total of 68 messages. Messages were presented to each participant in a fully randomized unblocked order. Before each message was presented, there was a five-second baseline period during which a blank screen was presented to allow physiological measures to return to a resting point, which was then used as a baseline to compare responses during message presentation. This baseline was followed by a 0.5-second fixation screen during which a black cross appeared in the center of the screen. Each message was then presented for four seconds, after which a probe stating, "How does this statement make you feel?" appeared on the screen below the message along with a 6-point Likert-type scale. The scale that appeared to participants ranged from very negative (−3) to very positive (+3). There was no option for a neutral (0) midpoint.

Assessments of Cognitive Ability

Several standard WAIS-IV (Weschler, 2008) cognitive measures were included in order to compare the cognitive abilities of the older and younger adult samples. In the *Vocabulary* subtest, participants provided brief verbal definitions of words of increasing difficulty. The *Digit Symbol* subtest was used to measure speed of processing. In this task, participants match symbols to corresponding digits as quickly as possible for 120 seconds. The *Digit Span* subtest was used to measure short-term memory (STM). In this task, participants repeat a series of digit strings of increasing length.

Affect Grid

The affect grid (Russell, Weiss, & Mendelsohn, 1989) measures participants' current affective state in a two-dimensional space with valence on the x-axis and arousal on the y-axis. Participants place a single mark on the nine-by-nine grid. Valence is measured along the horizontal axis, and arousal along the vertical axis.

Physiological Acquisition

Facial electromyography (fEMG) and skin conductance level (SCL) measures were collected during the baseline periods before each message presentation and during the message presentations. Pairs of 4 mm Ag/AgCl electrodes were attached to the *corrugator supercilli* and *zygomaticus major* muscle sites in accordance with the guidelines set forth by Fridlund and Cacioppo (1986). SCL was measured using 11mm Ag/AgCl electrodes attached to the anterior tips of the phalanges of the middle and ring fingers on participants' non-dominant hand in accordance with Figner and Murphy (2011). Muscle and electrodermal activity were recorded at a sampling rate of 1 kHz with an integrated wireless system and software package (Biopac MP150, AcqKnowledge; Biopac Systems, Goleta, CA).

Physiological Processing

The physiological data were processed in accordance with standard procedures used in physiological examinations of affect (e.g., Waugh, Thompson, and Gotlib, 2011). Using AcqKnowledge software, the raw corrugator and zygomaticus fEMG waveforms were high-pass (400hz), low-pass (28hz), and notch filtered (60hz to reduce electrical noise). Using ANSlab software (Wilhelm & Peyk, 2007), the waveforms were rectified and smoothed with a moving average window of 50ms for analysis. Each participant's waveforms were separated into half-second windows, thus forming 16 500ms windows for each message presentation. Windows with absolute values greater than three standard deviations from the mean of all of the muscle activity were replaced with values representing three standard deviations from the mean for that participants' muscle activity (Tukey, 1977). To calculate a score representing change in muscle activity from the baseline, fEMG activity in each 500ms window during the message presentation was converted into a z-score using the mean and standard deviation of the facial muscle activity during all pre-message baseline periods and averaged. Skin conductance activity was first low-pass filtered at 1 Hz. SCLs were calculated as the difference between the maximum skin conductance change within the message viewing period (4s) and the last 4s of the proximal baseline which ended .5s before the message period. Negative changes from the proximal baseline were assumed to reflect a lack of a SCL and were accordingly set to zero. SCLs were then log-transformed to correct for positive skew and averaged for each message type.

Procedure

The protocol consisted of several tasks designed to assess various emotional responses and lasted approximately two hours. After consenting to participate and completing unrelated tasks, participants were fitted with fEMG and SCL sensors. Participants then completed a ten-minute acclimation period for them to get used to the sensors. Then instructions were presented to the participant stating that they would be reading a series of messages related to health and exercise and would be asked to indicate how they feel about each message. After participants advanced through the instructions, the Exercise Messages Task began. Upon completion of the task, sensors were removed, and the researchers administered other unrelated tasks and the WAIS-IV cognitive measures and a demographic form.

Results

Behavioral Results

Affective ratings were analyzed in a 2 x 2 x 2 mixed model analysis of variance (ANOVA) in which within-subject factors included message frame (gain, loss) and message outcome (desirable, undesirable), and age (young, old) was a between-subject factor. As predicted, older adults ($M = 1.20$, $SD = 1.36$) responded more positively to the messages than younger adults ($M = 0.58$, $SD = 1.49$), $F(1,60) = 12.33$, $p = 0.001$, $\eta_p^2 = .170$. A main effect of frame also emerged, such that participants responded more positively to gain-framed messages ($M = 1.46$, $SD = 1.04$) than loss-framed messages ($M = 0.32$, $SD = 1.59$), $F(1,60) = 53.35$, $p <$

0.001, η_p^2 = .471. No main effect of outcome was found, $F(1,60) = 2.15$, $p = 0.15$, η_p^2 = .035.

Most importantly, there was a significant interaction between age group and message frame, which is displayed in Figure 1, $F(1,60) = 4.59$, $p = 0.04$, η_p^2=.071. The younger adults responded more negatively to loss-framed messages ($M = -0.15$, $SD = 1.14$) relative to the older adults ($M = 0.80$, $SD = 1.17$), $t(60) = -3.21$, $p = 0.002$, $d = 0.83$. However, the affective responses of the younger adults to gain-framed messages ($M = 1.32$, $SD = 0.59$) did not differ from those of the older adults ($M = 1.60$, $SD = 0.58$), $t(60) = -1.88$, $p = 0.07$, $d = 0.49$. This interaction remained significant when the analysis was re-run with baseline valence and arousal as a covariate, $F(1,57) = 4.56$, $p = 0.04$, η_p^2=.074, showing that incidental affect did not influence this pattern.

There was also a significant interaction between message outcome and message frame, $F(1, 60) = 18.60$, $p < 0.001$, η_p^2 = .237. In the gain frame, messages with desirable outcomes ($M = 1.55$, $SD = 0.58$) were rated significantly higher than messages with undesirable outcomes ($M = 1.36$, $SD = 0.65$), $t(61) = 4.96$, $p < 0.001$, $d = 0.31$. In the loss frame, messages with desirable outcomes ($M = 0.28$, $SD = 1.24$) were not rated significantly differently than messages with undesirable outcomes ($M = 0.37$, $SD = 1.28$), $t(61) = -1.29$, $p = 0.07$, $d = 0.07$. The age by outcome interaction was not significant, $F(1, 60) = 1.42$, $p = 0.24$, η_p^2 = .023, nor was the interaction of age, frame, and outcome, $F(1, 60) = 0.21$, $p = 0.65$, η_p^2 = .004.

Physiological Results

A repeated-measures ANOVA was conducted on fEMG and SCL during the four-second message presentation windows (as calculated relative to the proximal baselines). For each of the three physiological outcome variables, a 2 (age) x 2 (frame) x 2 (outcome) repeated-measures ANOVAs was conducted.[1] The repeated-measures ANOVAs indicated that relative to younger adults, older adults showed lower levels of *corrugator* activity ($F(1, 58) = 6.86$, $p = .011$, η_p^2 = .106), lower levels of *zygomaticus* activity ($F(1, 58) = 19.11$, $p < .001$, η_p^2 = .248), and weaker SCL ($F(1,58) = 15.30$, $p < .001$, η_p^2 = .209). See Table 1 for descriptive statistics. No other significant effects emerged (all p's > .05).

Correlations were conducted to examine if physiological responses were related to the subjective ratings of the gain- and loss-framed messages. For younger adults, *zygomaticus* activity in response to gain-framed messages was positively related to subjective affective responses to those messages ($r(29) = .48$, $p = .008$), whereas this correlation was not significant for the older adults ($r(31) = -.02$, $p = .92$). The correlation for the younger adults was significantly different from that of the older adults, as determined by a Fisher r-to-Z transformation, $Z = 1.99$, $p = .023$. No other significant correlations emerged for younger or older adults (all p's > .05).

[1]The sample size for the physiological data analyses is reduced by two, due to equipment failure with two younger adult participants.

Discussion

The findings of the current study revealed that whereas the subjective affect ratings of the older adults did not differ from those of the younger adults for gain-framed messages, younger adults rated the loss-framed messages more negatively than did the older adults, consistent with age-related increases in positivity. Additionally, insofar as younger adults felt more negatively about the loss-framed messages relative to the older adults, these results suggest that the loss-orientation of older adults leads them to feel more positively about loss-framed messages relative to younger adults (Depping & Freund, 2011). The physiological data indicate that the older adults had less physiological reactivity overall relative to the young, consistent with previous research (e.g., Levenson et al., 1991). The significant correlation between *zygomaticus* activity and subjective responses to gain-framed messages in younger, but not older, adults indicates greater affective coherence for younger versus older adults. Overall, these results suggest that older adults may not be as influenced by framing, while also suggesting that younger adults may be particularly sensitive to loss-framed messages. Moreover, these findings support a general trend in the literature showing that although losses loom large for younger adults, they may not for older adults (Mikels & Reed, 2009; Samanez-Larkin et al., 2007).

The lack of an effect of frame on physiological reactivity may have been a result of the stimuli used in this study. Although the messages did elicit subjective affective reactions, the affective impact of these messages is likely less than that elicited by stimuli specifically designed to induce emotional reactions such as video clips or pictures. The current findings are thus consistent with findings that coherence between subjective affect and physiological responding is weaker for less intense experiences (e.g., Mauss et al., 2005). Also, although the current sample was sufficient for detecting a difference in the affect ratings, given the greater variability inherent in physiological data, future research is needed with larger samples that are exposed to different forms of stimuli. Another limitation of the current study is the lack of a behavioral measure. Though the current results provide an affective mechanism for findings that gain-frame messages relative to loss-framed messages disproportionately increase the physical activity of older versus younger adults (Notthoff & Carstensen, 2014), the direct connection is speculative.

The specific linkage between affective responses to message framing and behavior is important but has yet to be fully established (see e.g., Updegraff & Rothman, 2013). The current findings suggest that gain-framed messages might be effective for both younger and older adults given that both age groups responded with similar levels of positive affect. However, given the greater differential emotional reactivity of younger adults to gain- and loss-framed messages, both types of framing may be motivating for them. Such negativity may serve as an important signal for heightened attention and behavioral change for younger adults, and it may also motivate an effort to avoid losses for them (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). In contrast, given the smaller differential impact of message frame for the older adults, their behavior may be less impacted by loss frames. These considerations are consistent with the findings of Notthoff and Carstensen (2014), such that gain- versus loss-framed messages resulted in more walking for older adults, but that frame did not have an effect on younger adults. Taken together, the current evidence suggests that loss-framed messages are less impactful for older adults.

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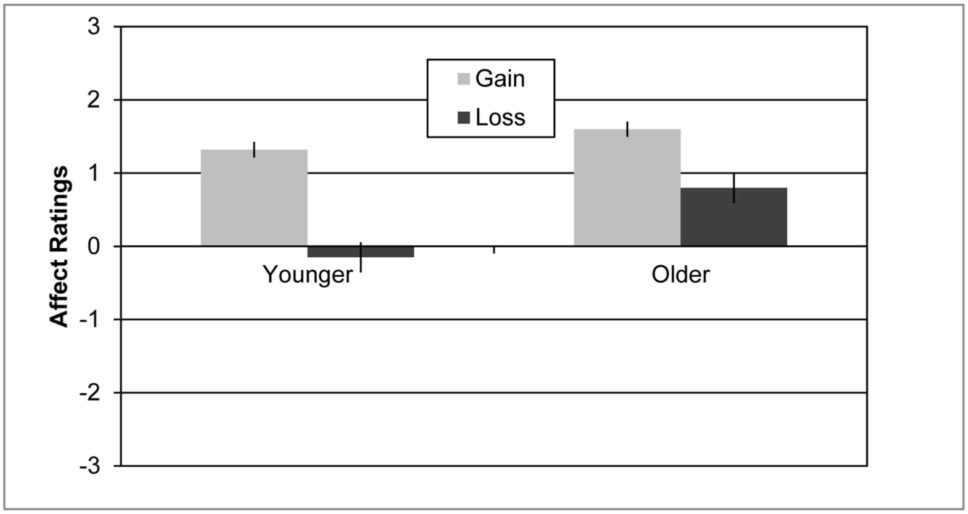

Figure 1.
Mean affect ratings for younger and older adults, separated by gain- and loss-framed messages (error bars represent the standard error).

Table 1

Participant Characteristics by Age Group.

	Younger		Older		Statistic	
	M	**(SD)**	**M**	**(SD)**	***t***	***p***
Age (in years)	20.93	(3.23)	73.77	(7.37)		
Sex	76.7% F, 23.3% M		74.2% F, 25.8% M			
Education (in years)	13.43	(3.27)	15.55	(3.22)	−2.55	.01
Socioeconomic Level	2.84	(1.10)	2.87	(0.96)	−0.12	.90
Vocabulary (WAIS-IV)	32.45	(8.99)	43.06	(9.03)	−4.64	<.001
Digit Symbol (WAIS-IV)	81.68	(12.76)	59.58	(15.10)	6.22	<.001
Digit Span (WAIS-IV)	28.10	(4.94)	25.84	(6.06)	1.61	.11
Baseline Affective Valence	6.17	(1.53)	6.48	(1.63)	−0.78	.44
Baseline Affective Arousal	4.80	(1.37)	4.45	(1.93)	0.81	.42
Affect Ratings	0.58	(1.49)	1.20	(1.36)	−3.51	<.001
Corrugator Activity	0.25	(0.30)	−0.004	(0.43)	2.62	.011
Zygomaticus Activity	−0.15	(0.12)	−0.34	(0.21)	4.45	<.001
SCL	0.09	(0.10)	0.02	(0.36)	3.81	.001

Note. Sex: F = Female, M = Male; Socioeconomic Level: on a scale of 1–5 (with 1 indicating “lower income” and 5 indicating “upper income”); Vocabulary from the Wechsler Adult Intelligence Scale (WAIS–IV; Wechsler, 2008): maximum score = 57; Digit-Symbol Coding from the WAIS-IV: maximum score = 135; Digit Span from the WAIS-III: maximum score = 48; Affective Valence was measured on a scale of 1 (unpleasant) to 9 (pleasant); Affective Arousal was measured on a scale of 1 (sleepiness) to 9 (high arousal).