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Positive messaging promotes walking in older adults

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Abstract

Walking is among the most cost-effective and accessible means of exercise. Mounting evidence suggests that walking may help to maintain physical and cognitive independence in old age by preventing a variety of health problems. However, older Americans fall far short of meeting the daily recommendations for walking. In two studies, we examined whether considering older adults' preferential attention to positive information may effectively enhance interventions aimed at promoting walking. In Study 1, we compared the effectiveness of positive, negative, and neutral messages to encourage walking (as measured with pedometers). Older adults who were informed about the *benefits* of walking walked more than those who were informed about the *negative* consequences of failing to walk, whereas younger adults were unaffected by framing valence. In Study 2, we examined within-person change in walking in older adults in response to positively- or negatively-framed messages over a 28-day period. Once again, positively-framed messages more effectively promoted walking than negatively-framed messages, and the effect was sustained across the intervention period. Together, these studies suggest that consideration of age-related changes in preferences for positive and negative information may inform the design of effective interventions to promote healthy lifestyles. Future research is needed to examine the mechanisms underlying the greater effectiveness of positively as opposed to negatively framed messages and the generalizability of findings to other intervention targets and other subpopulations of older adults.

Keywords

walking; health messages; positivity effect; socioemotional selectivity theory; aging

Sedentary lifestyles are increasingly recognized as a threat to public health. Inactivity is second only to cigarette smoking as a contributory cause of death and, if current trends continue, is expected to surpass smoking in coming years (Mokdad, Marks, Stroup, & Gerberding, 2004). Inactivity is linked to obesity and metabolic syndrome, both of which presumably lead to a range of associated illnesses from diabetes to cardiovascular disease (Ford, Giles, & Dietz, 2002; Venables & Asker, 2009), and chronic diseases threaten the potential productivity and engagement of long lived populations.

In stark contrast to the dire effects of inactivity, the benefits of exercise are widely documented. Exercise appears to reduce the risk of cardiovascular disease (e.g., Glazer, et al., 2012; Myers, 2003) and osteoporosis (e.g., Kannus, 1999; Langsetmo, et al., 2012). Mounting evidence also suggests that it improves cognitive functioning (e.g., Churchill, Galvez, Colcombe, Kramer, & Greenough, 2002; Colcombe & Kramer, 2003; Erickson & Kramer, 2009; Hogan, Mata, & Carstensen, 2013) and contributes to higher levels of subjective well-being (e.g., Ruuskanen & Ruoppila, 1995).

Despite widespread dissemination of information about the hazards of sedentary lifestyles, fewer than 20% of Americans meet the U.S. Department of Health and Human Services' minimal daily recommendations for physical activity (e.g., Chastin, et al., 2009; Mudd, Rafferty, Reeves, & Pivarnik, 2008). Moreover, despite clear evidence for benefits across the life span (e.g., Blair, et al., 1995; Christmas & Andersen, 2000), including very old age (e.g., Burke, et al., 2001; Netz, Wu, Becker, & Tenenbaum, 2005; Stathi & Simey, 2007), people 50 and older are the most sedentary in the population (e.g., King, Rejeski, & Buchner, 1998). Elderly Americans are especially sedentary, walking considerably less than their European and Asian counterparts (Bassett et al., 2010). Notably, statistical projections suggest worsening as opposed to improvement of these trends (Pucher & Renne, 2003).

The CDC specifically recommends walking as a means of increasing activity levels. Experts agree. Many consider walking among the best forms of physical activity because it does not require special equipment or training (Morris & Hardman, 1997), and it is convenient and affordable (Lee & Buchner, 2008). With the exception of the very frail or disabled, most people can engage in the activity (Morris & Hardman, 1997).

It remains unclear why older people walk so much less than other age groups (Bohannon, 2007; Pucher & Renne, 2003; Swanson, 2012). When age differences have been considered, they have focused mostly on physical limitations, fears, and environmental barriers to exercise in older adults (Adams, et al., 2012). Fried and colleagues observed, however, that even older adults who are functionally able do not walk on a regular basis (Simonsick, Guralnik, Volpato, Balfour, Fried, 2005). Some experts argue that there is a lack of education about physical activity that targets older adults and that older adults consequently lack knowledge about the benefits of physical activity (Schutzer & Graves, 2004). Still others maintain that the guidelines themselves are not communicated clearly (Chao, Foy, & Farmer, 2000).

Although some attention has been paid to interventions that tailor programs to individuals' goals, to our knowledge, there have been no systematic efforts to link the literature on interventions that target lifestyle modifications with the literature on developmental changes in motivation. A large literature grounded in socioemotional selectivity theory documents reliable changes in motivation that unfold across adulthood, shifting from goals associated with preparation and exploration to ones related to emotional meaning and savoring (Carstensen, 2006). Theoretically, the key mechanism underlying these shifts in goals involves time horizons. When time horizons are perceived as open-ended, which is typically the case in youth and young adulthood, information seeking is highly prioritized. When time horizons grow shorter, which typically occurs as people age, increasingly more priority is

placed on emotional satisfaction. Consistent with these postulates, findings from a number of studies using diverse methodologies converge. Older people, relative to their younger counterparts, mentally represent social networks along emotional dimensions (Fredrickson & Carstensen, 1998; Lang & Carstensen, 2002) and reliably express preferences for social partners who are emotionally meaningful (Fredrickson & Carstensen, 1990; Fung, Lai & Ng, 2001; Fung & Carstensen, 2006; Fung, Carstensen & Lutz, 1999). Consistent with socioemotional selectivity theory, when time horizons are experimentally expanded or constrained, age differences in goals change accordingly (Fung et al. 1999; Fredrickson & Carstensen, 1990).

Goals direct cognitive resources, and in recent years, age-related changes in goals have been linked to cognitive processing in older adults. Specifically, relative to their younger counterparts, older people appear to prefer, attend to, and remember positive information better than negative (Reed & Carstensen, 2012). Importantly, the positivity effect refers to a within-person ratio and can result from either increased preference for positive material or decreased preference for negative material in older as compared to younger adults. When shown positive, negative, and neutral images, for example, older adults remember the positive images relatively better than negative images as compared to the recollections of younger adults (Charles, Mather, & Carstensen, 2003); studies of neural activity show reduced amygdala activation in older adults when viewing negative images, although activation in response to positive images is comparable to younger adults (Mather, et al., 2004; Samanez-Larkin & Carstensen, 2011). The positivity effect has been documented in the health domain as well. Shamaskin and colleagues found that compared to younger adults, older adults prefer health care brochures with positively-framed information over those with negatively-framed information and also better remember information from positively-framed brochures (Shamaskin, Mikels, & Reed, 2010). Similarly, compared to their younger counterparts, older adults appear to consider positive attributes more than negative attributes when making healthcare choices, e.g., choosing among healthcare plans and physicians (Löckenhoff & Carstensen, 2007).

Given evidence for age differences in goals and associated shifts in cognitive processing, we hypothesized that positively-framed messages would be more effective in health promotion. Even though message framing in health promotion has been studied extensively (see Akl et al., 2010), and an independent body of research provides ample support for the positivity effect, to our knowledge, no study has investigated whether the positivity effect observed in information processing is associated with changes in *behavior*. Rather, past research has focused on cognitive processing involved in health decisions (Malloy, Wigton, Meeske, & Tape, 1992) and memory (Shamaskin et al., 2010). Given that a number of studies have demonstrated that even subtle differences in message framing can affect health-related intentions (Mann, Sherman, & Updegraff, 2004; McNeil, Pauker, Sox, & Tversky, 1982) and behavior (Mann, et al, 2004; Updegraff, Sherman, Luyster, & Mann, 2006; Uskul, Sherman, & Fitzgibbon, 2009), testing the relevance of framed messages for health promotion in older adults seemed warranted. That is, we reasoned that because older people appear to attend to and remember positive information better than negative, providing

information about benefits of healthy lifestyles more effectively influences behavior than warning older people about risks associated with unhealthy lifestyles.

Thus, for both practical and theoretical reasons, we examined the relationship of message framing to the effectiveness of interventions aimed at promoting walking. In the two studies described below, we examined whether emphasizing the potential positive outcomes of walking as opposed to negative outcomes of not walking more effectively promotes walking among older adults.

Study 1

In Study 1, we examined the applicability of older adults' preferences for positive information to health behavior promotion among older and younger adults. We hypothesized that emphasizing the potential positive effects of walking (positive framing) more effectively promotes walking among older adults than emphasizing potential negative consequences of not walking (negative framing) or the provision of relatively neutral information. We employed a questionnaire measure of future time perspective to document expected age differences in time horizons. In an exploratory analysis, we also tested whether future time perspective mediated the association between age and walking. We expected that mediation could operate in one or both of the framing conditions, with future time perspective explaining greater effectiveness of positively-framed messages or lesser effectiveness of negatively-framed messages the older participants were.

Method

Participants—Sixty-five younger adults between the ages of 18 and 32 years ($M = 21.43$; $SD = 3.32$) and 61 older adults between the ages of 60 and 89 years ($M = 74.84$; $SD = 6.20$) were recruited from the San Francisco Bay area through fliers posted in the community, advertisements on Craigslist, and a name bank in the Life-Span Development Laboratory that includes people who have indicated that they are interested in participating in research. All participants were screened for cognitive functioning using the telephone version of the Mini-Mental State Examination (Newkirk, et al., 2004) and only those who scored at least 23 out of a possible 26 were included in the study. In the younger group, 62% of the participants were female; in the older age group, 57% were female. Younger adults had 15.12 years of education, on average, and older adults 16.25 years. Both samples were ethnically diverse, although the younger group was slightly more so, $\chi^2(5) = 29.41$, $p < .01$.¹

Expected age differences were observed in short-term and working memory. Younger adults outperformed older adults on the digit span forward task ($M = 10.02$, $SD = 2.06$ and $M = 8.26$, $SD = 2.02$, respectively, $t(124) = 4.83$, $p < .01$) and on the digit span backward task ($M = 8.67$, $SD = 2.07$ and $M = 6.66$, $SD = 2.25$, respectively, $t(124) = 4.97$, $p < .01$).

Performance on the Digit Span Forward and Backward tasks was unrelated to walking. Experimental groups did not differ by age, education, cognitive performance, or time

¹Among younger participants, 12.3% were African American, 1.5% were American-Indian/Alaska Native, 33.8% were Asian American, 41.5% were European American, 4.6% were Hispanic/Latin American, and 6.2% reported other or mixed ethnicities. In the older group, 9.8% were African American, 1.6% were Asian American, 83.6% were European American, 1.6% were Hispanic/Latin American, and 3.3% reported other or mixed ethnicities.

horizons (see Table 1). As expected, there was a negative association between age and future time horizons, $r = -.37$, $p < .01$, indicating that younger people perceived the future as significantly more expansive ($M = 5.72$, $SD = .72$), than older people ($M = 4.40$, $SD = 1.18$), $t(124) = 7.63$, $p < .01$.

Materials and Procedure—Participants were informed that the study was about physical activity, emotion, memory, and attention. After obtaining informed consent, participants were briefed about study procedures and demographic information about participants was collected. Participants completed the Future Time Perspective Scale (FTP) (Carstensen & Lang, 1996; see also Lang & Carstensen, 2002) since observed age differences in cognitive processing are presumably related to age differences in future time horizons. The scale consists of ten statements about the subjective perception of time (e.g., “My future seems infinite to me.”); participants rated their agreement with these statements on a scale from 1 meaning “very untrue” to 7 meaning “very true.”

At that point, participants were provided pedometers to monitor walking in the following week. During this initial session, along with instructions about how to use the pedometer, participants received information about walking. The information was gathered from scientific articles about walking and physical activity. The goal was to give people information that was new and engaging; technical terms were explained. The content of the informational scripts varied only in the valence of framing (positive, neutral, and negative). Informational scripts are provided in Appendix A. In the positive framing condition, participants were informed about the potential positive outcomes resulting from walking (e.g., “Walking can have important cardiovascular health benefits.”). In the negative framing condition, participants were informed about the potential negative effects resulting from not walking (e.g., “Not walking enough can lead to an increased risk for cardiovascular disease.”). In the control condition, participants received neutral information about walking (e.g., “Walking is an aerobic activity.”). Each participant was randomly assigned to one of three experimental conditions (positive framing, negative framing, or the control condition). The complexity of the messages was analyzed with the widely-used Flesch Readability formula (Flesch, 1948; Hayes, Jenkins, & Walker, 1950). According to this formula, all three of the informational messages were scored in the “standard” to “fairly easy” readability range, which corresponds to about 8th/9th grade reading level (Kincaid, Fishburne Jr, Rogers, & Chissom, 1975).

Information was delivered verbally by a trained experimenter once in a one-on-one session with each participant. In all conditions, participants were simply provided information; they were not asked to change their walking in any way nor were they asked to remember the information. We did not explicitly ask participants to change their walking because our interest was in potential differences in the ways that older and younger people attend to ubiquitous information in their environments. Theoretically, the positivity effect reflects a default preference for positive information. Prior research has shown that the effect is eliminated when older people are asked to engage in deliberative processing of positive and negative information (Kennedy, Mather & Carstensen, 2004; Löckenhoff & Carstensen, 2007). In order to keep exposure to information consistent across participants and conditions, participants were asked to hold questions until they completed the study. Before

leaving the laboratory, participants completed the Digit Span Forward and Backwards tasks to measure short-term memory and working memory, respectively. After one week, participants returned the pedometer to the laboratory, and the number of steps they walked during the week was recorded. Participants were thanked and debriefed

Results

We used the Statistical Software for Social Sciences (SPSS) Versions 20 and 21 to calculate sample characteristics (demographics, cognitive performance, FTP), to test associations between sample characteristics and walking, and to examine walking as a function of age group and experimental condition.

Participants walked between 500 and 134,653 steps during the study week ($M = 44,198$, $SD = 30,478$). Among younger adults, the number of steps per week ranged from 5,013 to 134,653 ($M = 56,691$, $SD = 31,075$), and among older adults from 500 to 93,712 ($M = 31,090$, $SD = 23,764$). This translates to approximately 8,099 steps per day, on average, among younger adults and 4,441 steps per day, on average, among older adults. Younger adults walked significantly more than older adults, $t(123) = 5.16$, $p < .01$. According to a classification system developed by Tudor-Locke and Bassett, Jr. (2004)² that describes walking 0 to 5,000 steps per day as ‘sedentary’, 5,000 to 7,499 steps per day as ‘low active’, 7,500 to 9,999 steps per day as ‘somewhat active’, 10,000 to 12,500 as ‘active’, and more than 12,500 steps per day as ‘highly active’, 24.6% of younger adults were sedentary, 23.1% low active, 16.9% somewhat active, 20.0% active, and 13.8% highly active. Among older adults, the majority (60.7%) were sedentary, 18.0% low active, 13.1% somewhat active, 6.6% active, and 1.6% highly active. According to this classification system, too, younger adults had higher activity levels than older adults overall, $\chi^2(4) = 20.51$, $p < .01$; specifically, the two age groups differed in the proportion of participants who were sedentary, active, and highly active.

Younger participants walked a comparable number of steps regardless of experimental condition, $F(2, 61) = .15$, n.s. In all conditions, average walking levels in younger adults fell into the ‘somewhat active’ category. In contrast, among older adults, there was a marginally significant main effect when all three conditions were included in the analysis, $F(2, 58) = 2.63$, $p = .08$. Planned contrasts indicated that older adults walked significantly more when they were informed about the potential benefits of walking than when they were informed about the potential negative effects of not walking, $t(58) = 2.29$, $p = .03$ (Figure 1). There was not a statistically significant difference between the positive framing condition and the neutral condition ($t(58) = 1.16$, n.s.) or negative framing condition compared to neutral condition ($t(58) = -1.20$, n.s.) where number of steps fell in between those recorded in the positive and negative conditions. In the positive framing condition, older adults’ average walking increased such that it fell in the “low active” category, whereas it fell into the “sedentary” category in the negative framing and neutral conditions. Background characteristics, gender, education level, and ethnicity were not associated with walking in any condition.

²We offer this classification as a way to describe our sample. However, there is some disagreement as to whether or not this classification system is appropriate for older adults.

We also tested whether the relationship between age and walking was mediated by FTP in the whole sample and within each experimental condition. To this end, we 1) examined the association between age and walking, 2) examined the association between age and FTP, 3) examined the relationship between FTP and walking, controlling for age, and 4) compared the size of the effect of age on walking to the size of the effect of age on walking, controlling for FTP. Across the entire sample, participants walked less the older they were, $b = -.43$, $t(123) = -5.34$, $p < .01$. This was also true in the negative ($b = -.53$, $t(38) = -3.82$, $p < .01$) and neutral ($b = -.47$, $t(42) = -3.49$, $p < .01$) conditions, but only marginally in the positive condition ($b = -.27$, $t(39) = -1.77$, $p = .09$). Additionally, across the whole sample, we observed that, as expected, older age was associated with a more constrained view of the future, $b = -.60$, $t(124) = -8.30$, $p < .01$. This association held across the positive ($b = -.51$, $t(39) = -3.66$, $p = .01$), negative ($b = -.74$, $t(39) = -6.93$, $p < .01$), and neutral ($b = -.54$, $t(42) = -4.10$, $p < .01$) conditions. Across the entire sample, there was no significant association between FTP and walking, controlling for age, $b = .09$, $t(122)$, $p = .26$. The same was true when positive ($b = .01$, $t(38) = .05$, $p = .96$), negative ($b = .18$, $t(37) = 1.23$, $p = .23$), and neutral ($b = .06$, $t(41) = .46$, $p = .65$) conditions were examined separately. Thus, the criteria for a mediation of the effect of age on walking through FTP were not met, neither across the entire sample (as expected) nor in the positive or negative framing conditions.

Discussion

Findings from Study 1 suggest that informing older people about the potential benefits of walking may be more effective than warning them about the risks of inactivity. Whereas previous studies have shown that compared to younger adults, older adults attend relatively more to positive than negative information and remember it better, this study is the first to examine effects of framing valence on behavior. Among younger adults, no particular type of message framing conferred advantages over the others. In contrast, the behavioral effects in the older adults were striking: Older people who were informed about the potential positive outcomes of walking walked significantly more than those informed about the potential negative outcomes of failing to walk.

Consistent with our theoretical reasoning and prior research, younger and older adults differed in their future time horizons. The exploratory analysis showed that future time perspective, as measured by FTP, did not account for greater effectiveness of positively-framed messages or lesser effectiveness of negatively-framed messages for promoting walking the older participants were. We suspect that this reflects the relatively crude measurement of time horizons that FTP provides. All of our earlier research on time horizons and preferences has been based on experimental manipulations of time (Fredrickson & Carstensen, 1990; Fung, Carstensen & Lutz, 1999) or observations of preferences during naturally occurring events, such as 9/11 (Fung & Carstensen, 2006). The FTP scale was developed to document age trends postulated in SST, and while it does so reliably, the measure may lack sensitivity of time perspective above and beyond that conveyed by age.

Novel findings demand replication. Study 1 also had two key limitations. Even though participants were randomly assigned to experimental condition, the absence of baseline walking in Study 1 left open the possibility that baseline differences among subgroups (other than the ones we measured) still operated. Second, the one week observation period in Study 1 was relatively short, so questions about the duration of the effects remained.

Study 2

The purpose of Study 2 was twofold: (1) to examine within-person changes in walking as a function of message framing; (2) to examine whether behavioral changes endured over the course of one month. We hypothesized that, controlling for baseline walking, positively-framed messages would more effectively increase older adults' walking than negatively-framed messages and that effects would endure over time. Because Study 1 had not revealed differences in younger adults as a function of message framing, Study 2 focused only on older adults.

In Study 2, we also included a measure of exercise-related self-efficacy. A large body of research suggests that self-efficacy influences the activities people choose, the effort they expend on chosen activities, and how much they persist in reaching their goals (e.g., Anderson, Winnett, Wojcik, & Williams, 2010; Bandura, 2004; Bandura, 1998; Bandura, 1977). Many studies have documented the relevance of self-efficacy for health behavior change (for a review, see Strecher, DeVellis, Becker, & Rosenstock, 1986) and physical activity (for a review, see Lewis, Marcus, Pate, & Dunn, 2002). Thus, in Study 2 we asked whether positive message framing might interact with changes in self-efficacy to produce increases in walking. Specifically, we tested whether exercise-related self-efficacy levels changed in response to the messages.

Method

Participants—Sixty-six older adults between the ages of 61 and 95 years ($M = 75.79$, $SD = 8.34$) were recruited from a senior center in the San Francisco Bay area by posting fliers at the center and making announcements at the center's adult education and physical activity classes. We used the same method to screen participants for cognitive functioning as in Study 1. Fifty-nine participants were included in the analyses (seven were eliminated because they participated only in the initial session). Twelve participants were male and 47 were female. Participants had 17.24 years of education, on average. Most (89.8%) of the participants were European American, 1.7% were African American, 5.1% were Asian American, and 3.4% reported other/mixed or no ethnicity.

Participants rated their general health as good ($M = 2.51$, $SD = .92$), on average, on a scale from 1 to 5, where 1 = "excellent" and 5 = "poor." They rated their health now as about the same as one year ago ($M = 2.90$, $SD = .90$), on average, on a scale from 1 to 5, where 1 = "much better now than one year ago" and 5 = "much worse now than one year ago." Health ratings were not associated with walking at baseline. At baseline, participants rated their exercise-related self-efficacy on a scale from 0 to 10, where 0 = "not confident" and 10 = "very confident" as $M = 6.11$, on average ($SD = 1.97$, Range = 2.09–10.00), and at the end of the intervention as $M = 6.28$, on average ($SD = 2.04$, Range = 1.80–10.00). There was a

positive association between exercise-related self-efficacy and walking at baseline, $r = .32$, $p = .02$. Experimental groups did not differ in age, education, health, or self-efficacy (see Table 2).

Materials and Procedure—All sessions were conducted at the senior center. Procedures were similar to those in Study 1; they differed in that participants were enrolled in the study for five weeks as opposed to one week, attended a total of six study sessions as opposed to two study sessions, and recorded pedometer tracked steps on a paper log each day. The study design is illustrated in Figure 2. We did not measure future time horizons given that only older adults were included in the study.

Participants were informed that the study was about physical activity, emotion, and attention. In session 1, participants completed two questionnaires that assessed potentially meaningful individual differences, health and self-efficacy, after the experimenter obtained informed consent. To assess attitudes toward health and health-related behaviors we used the Self-Efficacy for Exercise Questionnaire (Resnick & Jenkins, 2000). Participants rated their health compared to others their age and health today compared to one year ago using two items from the Short Form 36 (Ware & Sherbourne, 1992). Participants also reported their education level.

Participants were then provided a pedometer to track walking. They recorded the number of steps that the pedometer measured on a log sheet every day. Research staff met with participants on a weekly basis at the senior center for ten to fifteen minutes in four one-on-one sessions each of the four study weeks to ensure that the pedometers were working properly and to answer any questions that participants might have (sessions 2 to 5). During these meetings, research assistants verbally provided participants with information about walking, but never asked participants explicitly to remember the information. Participants were randomly assigned to one of two conditions. In one condition, they were told about the potential benefits of walking (positive framing), and in the other condition, they were told about the potential negative consequences of not walking (negative framing). The first message about walking was identical to the single message about walking used in Study 1. The subsequent messages were slightly shorter variations on the same topics (see Appendix B). The readability of all messages according to the Flesch Readability scale (Flesch, 1948) was of standard difficulty, meaning it corresponded to reading proficiency at the 8th or 9th grade level. In session 6, at the end of the four-week intervention period, participants completed the Self-Efficacy for Exercise Scale. They were thanked and debriefed with information about the hypotheses and provided the findings from Study 1.

Analyses—In contrast to the first study, in which we obtained only a weekly aggregate of walking, in Study 2 we tracked walking on a daily basis across the five-week study period. This approach provided two levels of data, a within-participant level (daily walking) and a between-participant level (participant characteristics, health, self-efficacy). We used hierarchical linear modeling (HLM 7; Raudenbush, Bryk, & Congdon, 2004) to examine changes in walking as a function of message framing condition. We ran two-level models for number of steps, the main outcome variable of interest. Level 1 represented repeated observations, and level 2 represented participants. We entered day as a level 1 predictor

(grand-centered; first day after the first message = 1). At level 2, for both the intercept and the time slope, we entered message framing condition as a predictor (uncentered; positive framing coded as 0 and negative framing coded as 1), and also included baseline walking as a covariate (grand-centered). The equations for the models are as follows:

Level 1 Model:

$$Steps_{ij} = B_{0j} + B_{1j} * Day_{ij} + R_{ij}$$

Level 2 Model:

$$\begin{aligned} B_{0j} &= G_{00} + G_{01} * Baseline Walking_j + G_{02} * Condition_j + U_{0j} \\ B_{1j} &= G_{10} + G_{11} * Baseline Walking_j + G_{12} * Condition_j \end{aligned}$$

We examined the intercept to test whether participants in the positive and negative framing conditions differed in how many steps they walked per day, on average, during the intervention period. We also examined the time slope to test whether participants' walking changed continuously throughout the intervention and whether this change differed between the experimental conditions.

We examined changes in self-efficacy in response to the messages by computing a difference score between self-efficacy assessed at session 6 and self-efficacy assessed at baseline for each participant and submitting this difference score to a one-sample t-test to test whether the change was significantly different from zero. In addition, we compared average change in self-efficacy between the positive and negative framing conditions using an independent-samples t-test.

Results

Participants walked between 129 and 28,207 steps per day during the baseline week ($M = 5,973$, $SD = 4,384$). According to the classification system developed by Tudor-Locke and Bassett, Jr. (2004), 40.7% of the participants were sedentary, 39.0% low active, 10.2% somewhat active, 5.1% active, and 5.1% highly active.

Just as in Study 1, there was a significant main effect of condition, such that participants who received positive as opposed to negative information walked more steps per day, on average ($M_{Positive} = 6,883.41$, $SE = 435.07$, $M_{Negative} = 5,705.69$, $SE = 378.37$, $t(56) = -2.08$, $p = .04$), after controlling for baseline walking. Although both of these numbers fell into the "low active" category, participants in the positive framing condition were much closer to being "active", whereas participants in the negative framing condition were much closer to being "sedentary." Although we observed considerable day-to-day variation in walking in the positive framing condition, the time slope that differed significantly from zero indicated that overall, walking increased throughout the intervention, $G_{10} = 47.09$, $SE = 22.06$, $t(1590) = 2.14$, $p = .03$ (Figure 3). The time slope in the negative framing condition was not significantly different from zero (when negative framing = 0: $G_{10} = 14.96$, $t(1590) = .64$, n.s.), suggesting that participants in the negative framing condition did not increase walking throughout the intervention. In addition, the more participants walked at baseline,

the more they walked, on average, during the intervention, $G_{OI} = .47$, $SE = .17$, $t(56) = 2.79$, $p < .01$. Changes in walking were not associated with health ratings or baseline exercise-related self-efficacy. Exercise-related self-efficacy did not change from baseline to the end of the intervention ($t(58) = .57$, $p = .57$), and it did not distinguish the positive and negative framing conditions ($t(57) = 1.20$, $p = .23$).

Discussion

This study replicated and extended findings from Study 1 suggesting that positively-framed messages are more effective than negatively-framed messages in promoting walking among older adults. Study 2 extended findings in two important ways: First, in Study 2 we replicated findings from Study 1, controlling for participants' levels of baseline walking. We observed that, on average, participants who were informed about the potential positive effects of walking increased the number of steps they walked, whereas participants who were informed about the potential negative effects of not walking did not change how much they walked.

Second, findings from Study 2 suggest that messages about the potential benefits of walking result in increases that may endure over time. Participants in the positive framing condition increased walking across the four-week intervention period. Participants in the negative framing condition did not. This suggests that instructing older adults about the potential benefits of health behaviors may be especially effective in promoting healthier lifestyles in this age group. Such a strategy could be adopted by healthcare providers, organizations that design informational materials about health, e.g., the CDC, and families who want to encourage older relatives to be more active. Contrary to our hypothesis, we did not observe evidence that changes in walking were mediated by self-efficacy. This may be due to our use of a rather general measure of exercise self-efficacy; conceivably a measure more precisely targeted to walking would have been related.

In Study 2, participants met weekly with experimenters to receive additional information about walking. Future research is needed to see whether such sessions are essential to maintain effects or whether they would have been maintained without them. It is possible that walking generates a positive feedback loop that reinforces increased levels of activity. It is also possible, however, that the weekly meetings played a causal role in maintaining improvements. The latter idea is consistent with the occurrence of peaks in walking around the intervention days, as illustrated in Figure 3.

General Discussion

Sedentary behavior is associated with a range of health risks, and older Americans are relatively inactive. The CDC recommends walking due to its ease and accessibility; yet, fewer than 20% of Americans meet daily recommendations. In two studies, we observed that messages about the benefits of walking more effectively promoted walking in older adults than messages that communicated risks associated with not walking. The magnitude of the effects suggests that findings have practical in addition to statistical significance. In Study 1, older adults who were informed about the benefits of walking walked approximately 17,000 steps (i.e., approximately 8 miles) more, on average, during the one-week study period than

those who had been informed about the risks associated with failing to walk. In Study 2, which generated day-level data, participants in the positive framing condition walked approximately 1,000 steps per day more, on average, than those in the negative framing condition.

The studies described herein were motivated conceptually and empirically by evidence for an age-related positivity effect in cognitive processing. Considerable evidence suggests constraints on future time, associated with age, lead to a prioritization of goals related to emotional well-being. Older adults, relative to their younger counterparts, attend to and remember relatively more positive than negative information (Reed & Carstensen, 2012). In light of this literature, we reasoned that positive messaging about exercise may be processed more deeply than negative information and consequently be more influential in interventions targeting behavior change. Findings from these studies suggest that this may be the case. In future research, it will be important to directly measure cognitive processing of positive and negative messages, for example, by assessing attention to and memory for the information, and examine whether differences in processing predict changes in walking. Participants' mood also should be assessed. Differences in mood states offer a viable alternative explanation for age differences. That is, mood congruence could account for differences in the effectiveness of positively-framed and negatively-framed messages. Previous research on the positivity effect in cognitive processing suggests that mood congruence does not account for age differences in laboratory based studies (Isaacowitz, Toner, Goren, & Wilson, 2008) but the possibility deserves further attention. The role of future time horizons in explaining differences in message effectiveness between younger and older adults also demands further examination. In the present study, we included a measure of time horizons in order to confirm expected age differences in the perception of future time, given that theoretically it is the presumed mechanism underlying age differences in goals. As predicted, time horizons in younger and older people differed significantly. In the absence of experimental manipulation of time horizons, however, we can only speculate about the role that time horizons played in the present studies. Because the present studies spanned a week, and we know of no way to experimentally manipulate time horizons in an enduring way, we cannot explicitly examine the presumed theoretical mechanism.

In better understanding how framed messages like the ones utilized in the studies reported here increase walking, it may be useful to further consider the role of self-efficacy. In Study 2, we did not find that the messages influenced participants' levels of self-efficacy. However, we used a measure of self-efficacy targeting exercise in general, whereas the messages were specifically about walking; different effects may be observed with a self-efficacy measure specifically about walking. Furthermore, participants in Study 2 had relatively high levels of exercise-related self-efficacy, on average; there may have been little room for further increases. Making the health benefits of walking salient with the messages (that – in accordance with prior research – presumably were processed better when they were positively-framed than negatively-framed) may have been the only impetus that participants who seemed already confident in their abilities needed to increase their walking.

In the future, it will be important to extend this approach to other types of health behaviors. In the present studies, positive messaging was more effective in *activating* older adults to

engage in positive health behaviors. It is unclear whether positive messaging will be as effective when attempting to *reduce* risky behaviors or encourage potentially threatening behaviors, such as seeking screening for diseases. Whereas negatively-framed messages more effectively prompt disease screening than positively-framed messages in younger adults (e.g., Bartels, Kelly, & Rothman, 2010), these findings suggest that this may not be the case with older adults. Encouraging screening by reinforcing the benefits, such as emphasizing the reassurance that may come from knowing that you do not have a disease or even that knowledge is empowering, may be more effective with older adults than emphasizing threatening information. Still, details of the message composition should be considered further. Using terms like “inactivity” and/or “sedentary behavior” instead of “not walking (enough/regularly)” in the negative framing condition might better equate the experimental conditions in terms of the presence or absence of an activity (walking vs. being sedentary) and also reduce cognitive demand in light of evidence that negations can be harder to process (Gilbert, 1991; Mayo, Schul, & Burnstein, 2004).

In future research, it will be important to examine the effects of messaging in groups of older adults who are very inactive, especially largely homebound elderly. In the present studies, participants responded to requests to participate in research on physical activity, and in Study 2, they were recruited in part from exercise classes (though not focused on walking). Thus, participants showed an interest in physical activity. Of course, selection will operate in all studies that require significant participation in physical activity. Nonetheless, the range of baseline walking shows that a good number of participants in the present studies probably walked more than average at the start of the study because the proportion of participants with high activity levels was higher than in many other published studies (e.g., Chastin, et al., 2009; Mudd, Rafferty, Reeves, & Pivarnik, 2008; Schiller, Jucas, Ward, & Peregoy, 2010). The geographical region may have been a factor in the relatively high level of physical activity in this sample. Californians participate in physical activities to a greater degree than residents of most other states (United Health Foundation, 2013). Very few of the participants, however, were “active” according to the Tudor-Locke et al. (2011) classification system. Because there is evidence that increasing people’s level of physical activity from sedentary to slightly active yields more benefits than increasing the level of physical activity of people who are already somewhat active (Woodcock, Franco, Orsini, & Roberts, 2010), sedentary populations are important to target.

Another question for future research is how participants achieved the increase in activity. One could imagine that they built more walking-based activities into their daily routines (e.g., walking to the grocery store instead of driving) or that they added new activities to their lives in order to accumulate more steps (e.g., going for a walk after dinner). In our studies, we measured total walking per day; in the future, it will be important to gain a clearer understanding of when and how people increase their walking.

Although several theoretical and practical questions remain to be addressed in future research, findings from the two studies reported herein suggest that simple variations in how health information is communicated can have practical relevance. Consideration of motivational changes that occur with age may help to inform the design of simple and affordable interventions that promote healthier lifestyles.

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Appendix A: Messages about Walking from Study 1

Introduction (this part was the same in all conditions; this was the only information provided in the control (neutral condition))

As part of this study, we are asking you to wear a pedometer for a week. We want to measure how much you walk. Before you begin using the pedometer let me give you some information on pedometers and walking. Please listen carefully. You will need this information in order to use the pedometer best.

Pedometers are simple motion sensors that people can wear on their body. They are used to assess physical activity.

Walking is a rhythmic, dynamic, aerobic activity. It uses all of the large muscle groups. Walking has many benefits, but close to no side effects. When people walk regularly, at a fast pace, and far enough, they can reach the 'training zone' of over 70% of maximal heart rate. This improves and sustains physical fitness. It trains the heart, lung, and overall endurance. This is important for bodily work and movement in everyday life. In addition, it prepares people to meet exceptional demands.

Walking is the most natural activity. It is the only sustained dynamic aerobic exercise that all people can do except for the seriously disabled or very frail. No special skills or equipment are needed. Walking is convenient. It can be done in the workplace and at home. People can decide what their needs are in terms of walking. They can choose how fast, how long, and how often to walk. Walking is inherently safe because it has a low ground impact. There is very little, if any, decline in middle age, unlike for other types of physical activity. Walking is a year-round, readily repeatable, habit-forming activity. It is the main option for increasing physical activity in inactive populations.

Positive Framing Condition (this part came after the introduction)

Walking has many benefits for people of all ages. It strengthens the muscles of the legs, limb girdle, and lower trunk. It also helps you to preserve the flexibility of the joints and slows the process of osteoporosis. Furthermore, walking can improve your posture.

Any amount of walking, and at any pace, expends energy. Hence, in the long term, walking has the potential for weight control. Not only does it aid in weight loss, it also helps to control cholesterol and hypertension. Even at low and moderate intensity, walking can have important cardiovascular health benefits. In addition, walking can reduce anxiety and tension.

Walking also has a positive impact on the brain. It results in selective improvements in executive control processes, such as planning, scheduling, overriding automatic responses, and temporarily storing and manipulating information. These executive control processes often decline when people age, but walking can slow down this process. In fact, taking up walking can sometimes even recover some of the lost function.

Walking is a good predictor of how well off people are both physically and cognitively throughout their lives.

Negative Framing Condition (this part came after the introduction)

Not walking enough has many dangers for people of all ages. It results in weakened muscles of the legs, limb girdle, and lower trunk. You can lose the flexibility of your joints and speed up the process of osteoporosis. Furthermore, not walking enough can let your posture deteriorate.

Any amount of walking, and at any pace, expends energy. Hence, in the long term, not walking enough can present a problem for weight control. It can result in weight gain, uncontrollable cholesterol and hypertension. Not walking enough can lead to increased risk for cardiovascular disease. In addition, not walking enough can increase anxiety and tension.

Not walking enough also can have a negative impact on the brain. It can result in selective declines in executive control processes, such as planning, scheduling, overriding automatic responses, and temporarily storing and manipulating information. These executive control processes often decline when people age, and not walking enough can speed up this process. In fact, people who do not walk enough will have a hard time recovering any of the lost function.

Not walking enough is a good predictor of how poorly off people are both physically and cognitively throughout their lives.

Appendix B: Messages about Walking from Study 2

Message 1 at Session 2 Introduction (this part was the same in both conditions)

First of all, I'd just like to make sure everything is going well for you with the pedometer and logging your steps and exercise classes. Do you have any questions? As you know, in this study, we want to learn more about the interaction of physical activity and emotions and well-being. So we are collecting a lot of information from you, but we would also like to give you some background information. So let me start by telling you some basic information about walking.

Walking is a rhythmic, dynamic, aerobic activity. It uses all of the large muscle groups. Walking has many benefits, but close to no side effects. When people walk regularly, at a fast pace, and far enough, they can reach the 'training zone' of over 70% of maximal heart rate. This improves and sustains physical fitness. It trains the heart, lung, and overall endurance. This is important for bodily work and movement in everyday life. In addition, it prepares people to meet exceptional demands.

Walking is the most natural activity. It is the only sustained dynamic aerobic exercise that all people can do except for the seriously disabled or very frail. No special skills or equipment are needed. Walking is convenient. It can be done in the workplace and at home.

People can decide what their needs are in terms of walking. They can choose how fast, how long, and how often to walk. Walking is inherently safe because it has a low ground impact. There is very little, if any, decline in middle age, unlike for other types of physical activity. Walking is a year-round, readily repeatable, habit-forming activity. It is the main option for increasing physical activity in inactive populations.

Positive Framing (this part came after the introduction)

Walking has many benefits for people of all ages. It strengthens the muscles of the legs, limb girdle, and lower trunk. It also helps you to preserve the flexibility of the joints and slows the process of osteoporosis. Furthermore, walking can improve your posture.

Any amount of walking, and at any pace, expends energy. Hence, in the long term, walking has the potential for weight control. Not only does it aid in weight loss, it also helps to control cholesterol and hypertension. Even at low and moderate intensity, walking can have important cardiovascular health benefits. In addition, walking can reduce anxiety and tension.

Walking also has a positive impact on the brain. It results in selective improvements in executive control processes, such as planning, scheduling, overriding automatic responses, and temporarily storing and manipulating information. These executive control processes often decline when people age, but walking can slow down this process. In fact, taking up walking can sometimes even recover some of the lost function.

Walking is a good predictor of how well off people are both physically and cognitively throughout their lives.

Negative Framing (this part came after the introduction)

Not walking enough has many dangers for people of all ages. It results in weakened muscles of the legs, limb girdle, and lower trunk. You can lose the flexibility of your joints and speed up the process of osteoporosis. Furthermore, not walking enough can let your posture deteriorate.

Any amount of walking, and at any pace, expends energy. Hence, in the long term, not walking enough can present a problem for weight control. It can result in weight gain, uncontrollable cholesterol and hypertension. Not walking enough can lead to increased risk for cardiovascular disease. In addition, not walking enough can increase anxiety and tension.

Not walking enough also can have a negative impact on the brain. It can result in selective declines in executive control processes, such as planning, scheduling, overriding automatic responses, and temporarily storing and manipulating information. These executive control processes often decline when people age, and not walking enough can speed up this process. In fact, people who do not walk enough will have a hard time recovering any of the lost function.

Not walking enough is a good predictor of how poorly off people are both physically and cognitively throughout their lives.

Message 2 at Session 3 Introduction (this part was the same in both conditions)

Do you have any questions about your pedometer? Have you been regularly recording how many steps you've been taking over the course of a day? As part of the study, we'd also like to give you some background information about walking so you have a better idea of what's going on.

Positive Framing (this part came after the introduction)

Performing aerobic exercises such as walking enhances your general fitness and overall functioning. More specifically, walking improves lung capacity, muscle strength and flexibility, and blood flow to the brain. Walking can help prevent bone density loss, loss of coordination, and loss of balance.

Negative Framing (this part came after the introduction)

Not performing aerobic exercises such as walking detracts from your general physiologic capacity and overall functioning. More specifically, not walking reduces lung capacity, muscle strength and flexibility, and blood flow to the brain. Not walking can increase bone density loss, loss of coordination, and loss of balance.

Message 3 at Session 4 Introduction (this part was the same in both conditions)

Do you have any questions about your pedometer? Have you been regularly recording how many steps you've been taking over the course of a day? As part of the study, we'd also like to give you some background information about walking so you have a better idea of what's going on.

Positive Framing (this part came after the introduction)

Taking up walking even later in life can significantly postpone disability. Individuals who started walking for the first time significantly increased their health and had lower rates of diseases such as type II diabetes. People who regularly walk reduce their risk of stroke and heart attack.

Negative Framing (this part came after the introduction)

Not taking up walking, even later in life, can significantly hasten disability. Individuals who started walking for the first time significantly harmed their health and had higher rates of diseases such as type II diabetes. People who don't regularly walk increase their risk of stroke and heart attack.

Message 4 at Session 5 Introduction (this part was the same in both conditions)

Do you have any questions about your pedometer? Have you been regularly recording how many steps you've been taking over the course of a day? As part of the study, we'd also like to give you some background information about walking so you have a better idea of what's going on.

Positive Framing (this part came after the introduction)

Walking is associated with better subjective health and a greater sense of meaningfulness in life. Walkers are less likely to have depression or dementia than non-walkers. They also perform better on numerous cognitive tasks such as reasoning and memory because the brain becomes more alert and active. Walking provides numerous benefits for your physical, cognitive and psychological health.

Negative Framing (this part came after the introduction)

Not walking is associated with worse subjective health and a decreased sense of meaningfulness in life. Non-walkers are more likely to have depression or dementia than walkers. They also perform worse on numerous cognitive tasks such as reasoning and memory because the brain becomes less alert and active. Not walking significantly detracts from your physical, cognitive and psychological health.

Figure 1.
Average walking per week by age group and experimental condition in Study 1.

Figure 2.
Illustration of study design in Study 2.

Figure 3.

Raw data showing average change in walking from baseline (0) during the 4-week intervention by experimental condition in Study 2. Study sessions during which information about walking was provided took place on days 1, 8, 15, and 22.

Study 1 Sample Characteristics and Cognitive Performance by Experimental Condition and Age Group

Table 1

Digit Span	Positive Framing		Negative Framing		Control (Neutral)		p
	M	SD	M	SD	M	SD	
Younger Adults							
Age	21.95	3.53	20.87	2.74	21.55	3.71	n.s.
Education (years)	15.70	2.54	15.17	2.08	14.55	1.57	n.s.
Forward Digit Span	10.15	2.08	9.96	2.31	9.95	1.84	n.s.
Backward Digit Span	8.90	1.97	8.22	2.02	8.64	2.24	n.s.
FTP	5.52	.91	5.91	.51	5.71	.70	n.s.
Older Adults							
Age	73.52	5.85	76.61	5.72	74.64	6.79	n.s.
Education	16.86	2.03	15.39	3.01	16.36	2.92	n.s.
Forward Digit Span	8.38	1.80	8.28	1.74	8.14	2.46	n.s.
Backward Digit Span	7.14	2.29	6.56	2.04	6.27	2.39	n.s.
FTP	4.47	1.26	4.10	1.18	4.58	1.12	n.s.
p Education	n.s.		n.s.		*		
p Forward Digit Span	**		*		**		
p Backward Digit Span	*		*		**		
p FTP	**		**		**		

Note. Independent sample t-tests were used to compare groups.

*** $p < .01$
* $p < .05$

Table 2**Study 2 Sample Characteristics by Experimental Condition**

Digit Span	Positive Framing		Negative Framing		p
	M	SD	M	SD	
Age	75.97	8.99	75.62	7.79	n.s.
Education (years)	17.18	3.01	17.31	3.06	n.s.
General Health	2.63	.85	2.38	.98	n.s.
Comparative Health	2.97	.85	2.83	.97	n.s.
Baseline Exercise-related self-efficacy	6.03	1.88	6.20	2.09	n.s.
Post-test exercise-related self-efficacy	6.53	1.93	6.01	2.16	n.s.