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What Were They Thinking? Reducing Sunk-Cost Bias in a Life-Span Sample

(Manuscript accepted by Psychology and Aging)

JoNell Strough
West Virginia University

Wändi Bruine de Bruin
University of Leeds and Carnegie Mellon University

Andrew M. Parker
RAND Corporation

Tara Karns, Philip Lemaster, Nipat Pichayayothin, Rebecca Delaney, & Rachel Stoiko
West Virginia University

JoNell Strough, Department of Psychology, West Virginia University. Wändi Bruine de Bruin, Centre for Decision Research, Leeds University Business School and Department of Engineering and Public Policy, Carnegie Mellon University; Andrew M. Parker, RAND Corporation, Pittsburgh; Tara Karns, Nipat Pichayayothin, Philip Lemaster, Rebecca Delaney and Rachel Stoiko, Department of Psychology, West Virginia University. Tara Karns is now at The University of Texas Health Science Center at San Antonio, Philip Lemaster is now at Department of Psychology, Concordia College, Minnesota, Nipat Pichayayothin is now at Chulalongkorn University, Bangkok. Rachel Stoiko is now at the ADVANCE Center and the Center for Excellence in STEM Education at West Virginia University. Preliminary findings based on these data were presented in an informal seminar at the Max Planck Institute in April 2013. In November 2013, a paper based on these data was presented at the annual meeting of the Gerontological Society of America, in New Orleans, LA as part of the symposium Age differences in decisions involving time: The roles of experience, cognition, and emotion, C. Löckenhoff & J. Strough, (Chairs).

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Correspondence should be addressed to JoNell Strough, Department of Psychology, West Virginia University, 53 Campus Drive, Morgantown, WV 26501-6040. Email: jonell.strough@mail.wvu.edu

Abstract

We tested interventions to reduce “sunk-cost bias,” the tendency to continue investing in failing plans even when those plans have soured and are no longer rewarding. We showed members of a national U.S. life-span panel a hypothetical scenario about a failing plan that was halfway complete. Participants were randomly assigned to an intervention to focus on how to improve the situation, an intervention to focus on thoughts and feelings, or a no-intervention control group. First, we found that the thoughts and feelings intervention reduced sunk-cost bias in decisions about project completion, as compared to the improvement intervention and the no-intervention control. Second, older age was associated with greater willingness to cancel the failing plan across all three groups. Third, we found that introspection processes helped to explain the effectiveness of the interventions. Specifically, the larger reduction in sunk-cost bias as observed in the thoughts and feelings intervention (vs. the improvement intervention) was associated with suppression of future-oriented thoughts of eventual success, and with suppression of augmentations of the scenario that could make it seem reasonable to continue the plan. Fourth, we found that introspection processes were related to age differences in decisions. Older people were less likely to mention future-oriented thoughts of eventual success associated with greater willingness to continue the failing plan. We discuss factors to consider when designing interventions for reducing sunk-cost bias.

Keywords: decision making, sunk costs, age differences, time horizons, intervention

What Were They Thinking? Reducing Sunk-Cost Bias in a Life-Span Sample

Much research in judgment and decision making has focused on understanding decision-making errors. One well-documented error is the tendency to invest in failing plans when there are “sunk costs” or irrecoverable prior investments and projects are close to completion (see Arkes & Ayton, 1999; Sleesman, Conlon, McNamara, & Miles, 2012; Strough, Karns, & Schlosnagle, 2011a for reviews). According to normative theories of decision making, decisions about continuing a course of action should be based solely on future costs and benefits (Edwards, 1954). Yet when presented with scenarios about doomed projects that are nearly complete, or involve irrecoverable investments, people often stick with failing plans (Arkes & Blumer, 1985; Conlon & Garland, 1993; Garland & Conlon, 1998; Moon, 2001). Such decisions can be consequential. For example, sunk-cost bias influenced decisions to escalate commitment to failing wars and problematic bank loans, and to complete ill-fated multi-million dollar projects (Schwartz, 2005; Staw, 1981; Staw et al., 1997). When individuals stick with failing plans, they lose resources that could be invested in rewarding alternatives (Arkes & Blumer, 1985). Interventions that reduce sunk-cost bias could thus have wide-ranging applications for organizations and individuals. The current study tested whether sunk-cost bias in decisions about project completion could be reduced through interventions targeting decision makers’ introspections about decision scenarios. In the following sections, we review research from the literatures on judgement and decision making and adult development and aging that informed our intervention.

Reducing Sunk-Cost Bias in Decisions about Project Completion

Motivation has been posited to affect people’s introspections about decision scenarios, the skills and strategies they use to make decisions, and ultimately the decision itself (see Hess,

Queen, & Ennis, 2012; Molden & Hui, 2010; Strough, Parker, & Bruine de Bruin, 2015b). Hence, altering motivation may be one way to change the decision-making process to improve decisions (Bruine de Bruin, McNair, Taylor, Summers, & Strough, 2015; Strough, Bruine de Bruin, & Peters, 2015a). A few empirical studies support this idea. Inducing motivation to promote gains reduced sunk-cost bias (Molden & Hui, 2010), as did inducing motivation to focus on the present instead of the past or future (Strough, Schlosnagle, Karns, Lemaster, & Pichayayothin, 2014).

Van Putten, Zeelenberg, and van Dijk (2009) showed that inducing motivation to act versus to reflect on thoughts and feelings influenced failure to act when action was preferable (i.e., inaction-inertia bias; Tykocinski, Pittman, & Tuttle, 1995). For example, if a person failed to act to purchase a vacation that was discounted by 50%, they were subsequently less likely to act when the vacation was discounted by 20%. Students who were instructed to think about improving their decisions showed less inaction-inertia bias than students instructed to focus on their thoughts and feelings. Van Putten and colleagues (2009) speculated that instructions to focus on improvements led students to recognize they should act on the second deal. In contrast, focusing on thoughts and feelings about the missed opportunity likely produced ruminations about losing the first deal, which devalued the second deal. However, these introspective processes were not directly assessed. Testing these pathways would have required assessing introspections elicited by the motivational instructions, and then linking them to decisions.

To assess decision biases, researchers have often presented student participants with hypothetical scenarios (Peters & Bruine de Bruin, 2012; Strough et al., 2011a). Typically, researchers have assumed that participants interpret scenarios as intended by experimenters. However, critics have argued that participants engage in introspection and “think beyond” the

presented scenario by filling in context-relevant details that were not actually provided (Bruine de Bruin, 2011; Frisch, 1993). Introspective interpretations of hypothetical and real-world problem scenarios have been shown to reflect age differences in motivation (see Berg & Strough, 2011, Strough & Keener, 2014 for reviews). The importance of introspective processes was shown in a study of students' interpretations of hypothetical decision scenarios—decisions that appeared to show a sunk-cost bias could actually be viewed as unbiased after taking their interpretations of the scenario into account (Frisch, 1993). For example, in Frisch's study, deciding to continue taking tennis lessons even after developing a painful injury seemed to reflect sunk-cost bias. However, the same decision could be deemed unbiased if the participant expressed introspective thoughts about medical remedies that would allow them to play tennis pain-free. As such, a seemingly biased decision could have resulted from unbiased reasoning (Morris & Larrick, 1995; Tetlock, 2000).

Aging and Decisions

Most decision research has been conducted with young-adult college student samples (Peters & Bruine de Bruin, 2012; Strough et al., 2011a). Recent studies that included age-diverse samples found that older adults were better than younger adults at avoiding sunk-cost bias, or cancelling failing plans even when investments were irretrievable (Bruine de Bruin, Parker, & Fischhoff, 2012; Bruine de Bruine, Strough, & Parker, 2014; Del Missier, Mäntylä, Hansson, Bruine de Bruin, & Parker, 2013; Strough, Mehta, McFall, & Schuller, 2008). This age-related improvement typically showed little to no associations with age-related changes in fluid and crystallized cognitive abilities, which suggested the importance of non-cognitive factors (see Strough et al., 2015b for a review).

Theorists have suggested that making good decisions depends on affect and experience as well as cognitive abilities (Reyna, 2004; Stanovich & West, 2008; Yates & Patalano, 1999). For older adults, experience and emotion regulation skills may facilitate the preservation of decision-making competence, even in the face of cognitive declines (Peters & Bruine de Bruin, 2012; Peters, Hess, Vastjfall, & Aumann, 2007; Strough et al., 2011a; Strough et al., 2015b). A growing number of studies have tested this idea (Del Missier et al., 2013; Hess, Osowski, & Leclerc, 2005; Hess et al., 2013; Mikels, Cheung, Cone, & Gilovich, 2012). Emotion regulation was important for understanding why older adults made better decisions about sunk costs (Bruine de Bruin et al., 2014; Strough, Schlosnagle & DiDonato, 2011b). Older adults' experience, as assessed by measures of crystallized intelligence and financial literacy, facilitated good financial decisions despite cognitive declines (Li, Baldassi, Johnson & Weber, 2013; Li, Gao, Kavali, Zaval, Johnson, & Weber, 2014).

Introspective Processes and Decisions

Augment scenario based on experience. Older adults have more life experience (Baltes, Lindenberger & Staudinger, 2006), which could alter their introspections about decision scenarios. If older adults have seen the negative consequences of making continued investments in a failing plan, they might apply their experience when making a subsequent decisions about failing plans. Older adults were more likely than younger adults to reference personal experiences when making hypothetical decisions (Horhota, Mienaltoski, & Blanchard-Fields, 2012; Klaczynski & Robinson, 2000; Woodhead, Lynch, & Edelstein, 2011), although one study found no age differences (Berg, Meegan, & Klaczynski, 1999). Moreover, introspections about experience reduced susceptibility to so-called framing errors, or being influenced by the wording of a decision problem (Woodhead et al., 2011). Hence, one pathway that could explain why older

adults are better able to cancel failing plans, even when costs have been sunk and plans are nearly complete, is that they apply their greater life experience to their decisions.

Future success. Older adults may be more oriented toward the present due to increasing awareness of their own mortality (Carstensen, 2006; Strough et al., 2016), which may explain age differences in decisions (Strough et al., 2014). Sunk-cost bias was more likely when people had positive anticipatory emotions about the future success of a project (Harvey & Victoravich, 2009), an optimistic frame of mind (Juliussen, 2006), or expected the project would succeed (Wong, 2005). Conversely, sunk-cost bias was reduced in the presence of objective information about a project's future budgetary success (Tan & Yates, 1995). When hypothetical projects neared completion, decision makers escalated commitment to failing plans (Conlon & Garland, 1993; Garland & Conlon, 1998; Moon, 2001; Sleesman et al., 2012). Compared to a 10% completed project, when a project was 90% completed, students were more likely to list completing it as a reason to continue, and used a "positive spin" to distort facts and make success seem more likely (Jensen, Conlon, Humphrey, & Moon, 2011). This is consistent with the idea that future-oriented project-completion goals can overwhelm the goal of making a profit (Conlon & Garland, 1993; Garland & Conlon, 1998). Thinking that a failing plan could reverse itself in the future may facilitate persistence "whatever the cost"—even when switching to another option or quitting the project would be more beneficial. This type of future-oriented thinking may become less prevalent with age due to older adults' limited future time horizons (Carstensen, 2006), and could help explain why sunk-cost bias reduces with age.

Following from the above, it is possible that an intervention that prompts a focus on improvements could backfire if it induced future-oriented thoughts about the eventual success of a failing plan (Wong, 2005). Alternatively, building from van Putten and colleagues' (2009)

work, focusing on improvements could elicit an orientation toward productive action that would facilitate decisions to abandon a failing plan.

Past loss. Another temporal aspect of interpretations that could be important for understanding decisions about plans with sunk costs is whether people look back on past investments that would be wasted or lost (Arkes & Blumer, 1985; Moon, 2001; Soman, 2004). Usually, these thoughts have not been directly assessed, but rather have been inferred from the decisions made (Arkes & Ayton, 1999; Moon, 2001). Frisch (1993) did find that some college students mentioned “waste” when they were asked to retrospectively justify sunk-cost decisions. Other work indicated that older adults were less likely to mention past losses when retrospectively describing their decision-making goals, and this helped to explain why their decisions were less biased by sunk costs (Strough et al., 2011b).

Negative affect. De-escalating commitment to sunk-cost options has been shown to result from wanting to avoid negative emotions (Ku, 2008; Wong & Kwong, 2007). Younger adults de-escalated commitment when it was clear that this would allow them to escape negative emotions (Wong, Yik, & Kwong, 2006). When possible, older adults disengaged from tasks or situations that could elicit negative arousal (Bruine de Bruin et al., 2015, 2016; Charles, Piazza, Luong, & Almeida, 2009), which is an emotion regulation strategy referred to as “situation selection” (Gross & John, 2003; Urry & Gross, 2010). If older adults are more motivated to avoid negative affective states (see Carstensen, 2006), then this could help explain why their decisions about project completion have been found to show less sunk-cost bias.

Avoiding rumination. Among college students, avoiding rumination about failure was correlated with less sunk-cost bias (van Putten, Zeelenberg, & van Dijk, 2010). Older age has been linked to less rumination and preoccupation with negative events (Nolen-Hoeksema &

Aldao, 2011; Strough et al., 2016; Sutterlin, Paap, Babic, Kubler, & Vogeles, 2012). Older adults were better than younger adults at managing regret over missed opportunities (Brassen, Gamer, Peters, Gluth, & Büchel, 2012). Older adults' reduced tendency to ruminate about negative events helped to explain their greater willingness to cancel a failing plan with sunk costs, as compared to younger adults (Bruine de Bruin et al., 2014). These studies point to the potential importance of rumination avoidance for understanding reductions in sunk-cost bias.

Research Questions

The current study addressed three research questions:

1. Is sunk-cost bias reduced by (a) interventions that prompt a focus on thoughts and feelings or improvements, and (b) older age?
2. What introspective processes are associated with the effectiveness of interventions for reducing sunk-cost bias?
3. What introspective processes are associated with age differences in sunk-cost bias?

Method

Participants

Members of RAND's American Life Panel responded to an internet survey invitation (N = 397, 87.0% response rate). This national U.S. panel of adults was recruited using probability-based sampling for other national surveys, including the monthly Consumer Survey conducted by the University of Michigan Survey Research Center and augmented using snowball sampling and other methods (see <https://alpdata.rand.org/>). If panel members lacked internet access, RAND mailed a laptop computer and paid for an internet connection (3.7% of the panel); a helpdesk was available to answer questions about equipment use. When they joined the panel,

and annually thereafter, participants provided informed consent to participate as a panel member. They then received invitations to participate in internet surveys for financial compensation.

Participants who completed our survey ranged in age from 18-85 yrs ($M = 47.51$ yrs, $SD = 14.96$, $Mdn = 48$ yrs, 60.8% women).¹ Most identified as White (72.5%) with 22.3% indicating that they were Hispanic or Latino. The majority (53.8%) reported annual family incomes of \$40,000-\$49,000 or less, with 46.3% reporting an associate's degree or other college degree.

Procedure and Measures

Decision scenario. Participants were presented with a hypothetical vignette about a failing plan, following established methods adapted from Bruine de Bruin et al.'s (2007) validated measure of Resistance to Sunk Cost, which is part of a larger battery measuring Adult Decision-Making Competence. Better scores on the Resistance to Sunk Cost and overall Adult Decision-Making Competence measures have been linked to experiencing fewer real-world negative decision outcomes (e.g., going to jail, going bankrupt; Bruine de Bruin et al., 2007; Parker, Bruine de Bruin, & Fischhoff, 2015).

The vignette asked participants to imagine the following: "You have driven halfway to a vacation destination. Your goal is to spend time by yourself. You feel sick. You feel that you would have a much better weekend at home. You think that it is 'too bad' you already drove halfway, because you would much rather spend the time at home." Prior research showed that older adults were better able to terminate the failing plan, and that this age difference was not attributable to age differences in valuing travel (Bruine de Bruin et al., 2014). As is often true in real-world situations (Garland & Conlon, 1998), information about having driven halfway

¹ The distribution of the sample by age was as follows: 18-29 yrs (13.8%), 30-39 yrs (18.5%), 40-49 yrs (20.3%), 50-59 yrs (24%), 60-69 yrs (16.8%), 70-79 yrs (5.3%), and 80-85 yrs (1.5%).

simultaneously served as information about the “sunk cost” and progress toward “project completion,” allowing for varying interpretations.

After the vignette about the failing plan, instructions (described in the next section) were presented that differed depending on intervention group assignment. After responding to these instructions, participants indicated their decisions about canceling the plan or remaining committed, they then rated their coping strategies for avoiding rumination.

Intervention groups. Based on the work of van Putten and colleagues (2009), participants were randomly assigned to one of three intervention groups: (1) the “improvement” intervention group (N = 137) was asked to “describe all the things you could do to improve this situation,” which aimed to promote action orientation; (2) the “thoughts and feelings” intervention group (N = 126) was asked to “describe the thoughts and feelings you would have in this situation,” which aimed to promote a ruminative orientation; and (3) a no-intervention “control” group received no instructions (N = 134). Instructions were presented immediately following the vignette about the failing plan. Participants assigned to groups (1) or (2) entered their responses into a text box that appeared on the same screen as the vignette and the instruction. Trained coders used established procedures to categorize these responses to the instructions; details are provided below.

Decision. Following prior research (Bruine de Bruin et al., 2014), participants reported their willingness to cancel a failing plan with sunk costs in response to the vignette, on a scale from 1 (most likely to stick with plans) to 6 (most likely to cancel plans). Higher ratings indicated decisions that showed less sunk-cost bias toward completing the failing plan.

Introspective processes. In addition to their introspective text-box responses (described above), participants indicated how they would “feel while deciding” using 14 items used by

Bruine de Bruin et al. (2014) to assess coping through rumination avoidance. Eight items were from the disengagement versus preoccupation dimension of the Action Control Scale which assesses responses to failure (e.g., “It would take me a long time to adjust myself to it;” Dieffendorf, Hall, Lord, & Streat, 2000). The other six items were from the Constructive Thinking Inventory, (e.g., “I would waste a lot of time worrying about it instead of just doing something about it;” Epstein & Meier, 1989; Katz & Epstein, 1991). Ratings were made on 1 (definitely false) to 6 (definitely true) scales with some items reverse scored. Higher scores indicated being more likely to disengage from rumination and greater action-oriented behavioral coping.² Cronbach’s alpha for the eight Action Control Scale items was .76; for the six Constructive Thinking Inventory items was .75; and for the 14 items combined was .82.

Classification of Introspective Responses

Coding scheme development. Categories used to classify participants’ typed responses to the intervention (what could be done to improve the situation vs. describe thoughts and feelings) were derived using standard methods (King, 2004). Induction (“top down”, based on prior theory and research; Frisch, 1993; Strough et al., 2011b) and deduction (“bottom up”, based on emergent themes) were used to develop categories that captured the richness of responses. For some categories, meaningful subcategories emerged. These were coded to illustrate common exemplars of the category, but were not meant to be exhaustive. Coders determined whether a given category was present or absent by making a binary judgment for each category. Categories were not mutually exclusive. A response could be assigned to multiple categories. For example,

² We used the Action Control Scale items because these items were used by van Putten et al. (2009) as an intervention check. The intervention we used was taken verbatim from van Putten et al.’s work. We added behavioral coping items from the Constructive Thinking Inventory because these items have been shown to be associated with sunk-cost bias (Bruine de Bruin et al., 2007), and when combined with items from the Action Control Scale, the items statistically accounted for age differences in willingness to cancel a failing plan (Bruine de Bruin et al., 2014).

the response “I would feel bad about wasting time and energy” included two categories detailed below—negative affect (feeling bad) and focusing on past losses (wasting time and energy).

Training and reliability of coders. Recommended procedures were used to familiarize coders with the coding scheme and train them to use it reliably (King, 2004). First, prior to coding any data, five coders practiced using the coding scheme to classify responses from 72 participants in a different study. Coders met three times during training.

Second, after all coders were deemed to be sufficiently familiar with the coding scheme, 39 transcripts (14.8% of the sample) were used to establish inter-rater reliability between pairs of coders (average $\kappa = .92$). Subsequently, each coder coded a subset of the remaining transcripts. A reliability check based on 18 additional randomly-selected transcripts (7% of the data) indicated that reliability was maintained (average $\kappa = .90$). Disagreements between coders were resolved through discussion until consensus was achieved. Coders were blind to participants’ ages, intervention group, and decisions. Coders conducted their coding independently after establishing reliability. Coded data was from 258 participants randomly assigned to the two intervention groups; there were no responses to code for the control group.

Categories of Introspective Responses

Definitions, examples, and kappa coefficients for each category are detailed in the following sections. The percentage of the sample ($N=258$) who mentioned each category is shown in Table 1. The percentage of the sample whose response fell into one of the specific subcategories is shown within the text.

Future success. The introspective response indicated a future-oriented focus on how the situation could eventually become a good experience ($\kappa = .86$). Common subcategories included statements about having a good time (“...enjoy the rest of my vacation,” $\kappa = .94$) mentioned by

10.4%; “hoping” for the best (“hope to feel better at some point,” $\kappa = .86$), mentioned by 7.3%; making the best of the situation (“make the best of the vacation,” $\kappa = 1.00$), mentioned by 8.5%; and other comments mentioned by 8.9% indicating that the person was thinking about how soured plans could eventually succeed.

Negative affect. The introspective response referenced negative affective states such as disappointment, frustration, or being upset (“I would be upset,” $\kappa = .81$).

Past loss. Past investments were mentioned in the introspective response (“I have already driven halfway,” $\kappa = .86$), with 3.5% explicitly noting concerns about waste (“I wasted time and money,” $\kappa = 1.00$).

Augment scenario. Introspective responses included information not stated in the vignette, suggesting a reliance on knowledge and experience to interpret the scenario ($\kappa = .86$). This category followed logic outlined in Frisch (1993), such that the response changed the objective parameters of the decision situation. The added information made it so that continuing to the vacation destination could be viewed as objectively better (more logical) than returning home. Common subcategories included stopping at a motel at the halfway point (“stop at a motel and get some rest,” $\kappa = .86$) mentioned by 19.3%; taking medication or seeking medical treatment (“try to find medicine to feel better,” $\kappa = .86$), mentioned by 18.6%; using the vacation to recuperate from illness (“rest once at destination,” $\kappa = .98$), mentioned by 12%; with 6.6% augmenting the vignette in some other way.

Results

Descriptive statistics and intercorrelations among study variables are shown in Table 1.

1. Is sunk cost bias reduced by (a) interventions that prompt a focus on thoughts and feelings or improvements, and (b) older age?

To address the first research question, we conducted a linear regression predicting willingness to cancel the failing plan from intervention group, age, and the intervention group by age interaction (see Table 2). Planned contrast codes tested for differences between intervention groups. The first contrast distinguished the thoughts and feelings intervention from the improvement intervention and the no-intervention control group. The second contrast distinguished the improvement intervention from the thoughts and feelings intervention and the no-intervention control group. Age and intervention group were entered in the first step, and the age by group interaction terms were entered second. The model was significant, $F(3,393) = 5.71$, $p = .001$, $R^2 = .04$.

Interventions. The main effect of intervention group was significant, as was the contrast that distinguished the thoughts and feelings intervention ($M = 3.45$, $SD = 1.92$) from the improvement intervention ($M = 2.69$, $SD = 1.75$) and the no-intervention control ($M = 2.91$, $SD = 1.78$) groups ($B = .554$, $SE = .225$, $t = 2.47$, $p = .01$).³ The thoughts and feelings intervention group was significantly more willing to cancel the failing plan than the other two groups. The planned contrast that distinguished the improvement intervention from the other two groups was not significant. Hence, compared to the no-intervention control and the improvement intervention, the thoughts and feelings intervention was most effective for reducing sunk-cost bias in decisions about project completion.

Age. Replicating prior research, older adults were more likely to appropriately cancel the failing plan ($B = .013$, $SE = .006$, $t = 2.19$, $p = .03$). When interaction terms between age and the

³ We also tested the effectiveness of the intervention by using one-sample t-tests to compare the observed means for each group to the scale midpoint. On the 6-point scale, a score significantly less than the midpoint of 3.5 would indicate a bias toward continuing the failing plan. For the no-intervention control group, the comparison was significant, $t(133)=3.84$, $p = .0002$, indicating bias toward continuing the failing plan. For the improvement intervention, the comparison was significant, $t(136)=5.41$, $p < .0001$, indicating bias toward continuing the failing plan. The thoughts and feelings intervention group did not differ significantly from the scale midpoint, $t(125)=.29$, $p=.77$, which is consistent with the interpretation that this intervention reduced decision bias.

two planned between-groups contrasts were entered at step two, neither was significant (see Table 2). Thus, age differences were consistent across intervention groups and the interventions were similarly effective across age.

2. What introspective processes are associated with the effectiveness of interventions for reducing sunk-cost bias?

To address the second research question, we examined whether introspective processes (text-box responses, and ratings of coping through avoiding rumination) differed between groups. We then tested whether these introspective processes statistically contributed to the effect of the interventions on decisions.

Differences between intervention groups in introspective processes. As shown in Table 3, for the improvement intervention, the most common response was to augment the scenario, followed by future-oriented thoughts about how soured plans could become successful. For the thoughts and feelings intervention, about one-fourth of participants augmented the scenario, focused on past loss, or future success, whereas about one-third mentioned negative affect. To determine if these introspective text-box responses differed significantly between the improvement versus the thoughts and feelings intervention groups, we used chi-square tests. Compared to the improvement intervention, the thoughts and feelings intervention was significantly more likely to induce introspections about past losses and negative affect, and less likely to induce introspections about augmentations of the scenario and future success (see Table 3).

To determine if coping through avoiding rumination (assessed by the 14-item scale) differed between the two intervention groups and the no-intervention control, we conducted an ANOVA for which group (improvement, thoughts and feelings, no-intervention control) was the

between-subjects factor. In contrast to prior research on inaction-inertia bias, there were no significant differences between the improvement intervention, the thoughts and feelings intervention and the no-intervention control group ($M = 3.93$, $SD = .63$), $F(2, 394) = .78$, $p = .45$ (see Table 3) Another analysis was conducted to examine potential interactions between age and the intervention groups on avoiding rumination. The main effect of age, the main effect of the intervention, and the age by intervention interaction were all nonsignificant (all $p > .20$).⁴

The role of introspective processes in intervention effectiveness. To test whether the intervention changed decisions by changing introspective processes, we examined direct and indirect pathways between the intervention groups and willingness to cancel the failing plan. We used Preacher and Hayes's (2008) "indirect" SPSS macro with 5,000 resamples to examine all pathways in a single analysis. This analysis only included people randomly assigned to one of the two interventions (because the control group did not provide written responses, there were no introspective text-box responses to assess).⁵ Intervention group (improvement or thoughts and feelings) was the predictor, introspective processes (introspective text-box responses and coping strategies) were potential mediators, and willingness to cancel the failing plan was the criterion; age was controlled.

The direct effects between intervention group (improvement; thoughts and feelings) and canceling the failing plan, between group and the mediators (introspective processes), and between the mediators and canceling the failing plan are shown in Figure 1. When the indirect

⁴ We repeated the analyses using scores derived from the Action Control Scale and the Constructive Thinking Inventory in separate analyses. No significant differences were found. Thus, null results were not due to combining two scales.

⁵ Because introspective text-box responses were coded as categorical variables and Preacher and Hayes (2008) recommend against using the indirect macro with categorical mediators, we replicated the results using Mplus. The significance was the same except when using the indirect macro there were two significant direct effects (between negative affect and canceling the failing plan, and between focusing on the past and canceling the failing plan) that were not significant when using Mplus.

effects of the interventions on canceling the failing plan through the mediating variables were tested to pinpoint pathways whereby the interventions changed decisions, two significant indirect pathways were found (see Table 4). One of the significant indirect paths indicated that the reason why the thoughts and feelings intervention group was more likely than the improvement group to cancel the failing plan was because this intervention suppressed thoughts of future success. The other significant indirect path indicated that the thoughts and feelings intervention group was more likely to cancel the failing plan because this group was less likely to augment the scenario (compared to the improvement group). Other indirect pathways from the interventions to decisions through introspective processes of past losses, negative affect, and avoiding rumination were not significant.⁶ Thus, the thoughts and feelings intervention was more effective than the improvement intervention for reducing sunk-cost bias in decisions about project completion because it suppressed thoughts of future success and augmentations of the scenario that could make it seem reasonable to continue the failing plan.⁷

⁶ We conducted additional coding and analyses to examine whether indirect paths through negative affect and past loss would be significant if these two aspects of participants' introspections were measured as continuous variables (by counting the frequency of occurrence) instead of dichotomous variables. Interrater agreement, assessed via intraclass correlation coefficients between two coders, was excellent for both categories, ($r_s = .97$). When the continuous measure was used instead of the dichotomous measure, the paths were nonsignificant: for past loss, $b = -.07$, $p = .78$ and for negative affect, $b = .22$, $p = .17$. Thus, null results were not due to using a dichotomous variable.

⁷ A model that included only two pathways, through focusing on future success of the doomed plan and augmenting the scenario, indicated these paths accounted for the effectiveness of the intervention. Compared to the improvement group, the thoughts and feelings intervention group was significantly less likely to focus on future success ($b = -.14$, $se = .06$, $p < .01$) and to augment the scenario ($b = -.40$, $se = .06$, $p < .001$). Focusing on future success ($b = -1.17$, $se = .23$, $p < .001$) and augmenting the scenario ($b = -.89$, $se = .23$, $p < .001$) were each associated with being significantly less likely to cancel the failing plan, controlling for the interventions. Before controlling for these two paths, the intervention was significantly associated with decisions to cancel the failing plan ($b = .81$, $se = .23$, $p = .005$). After controlling for the two indirect paths, the intervention was no longer significant ($b = .28$, $se = .22$, $p = .23$). The 95% bias-corrected confidence intervals for the bootstrapped estimates of the two indirect effects (focus on future success ($b = .17$, $se = .07$), augmenting the scenario ($b = .36$, $se = .11$)) did not include zero. Thus, the thoughts and feelings intervention was more effective than the improvement intervention for reducing sunk-cost bias because it suppressed thoughts of future success and augmentations of the scenario that could make it seem reasonable to continue the failing plan.

3. What introspective processes are associated with age differences in sunk-cost bias?

To address the third research question, we computed correlations between age and introspective processes (text-box responses, and ratings of coping through avoiding rumination). Next, for introspective processes that were significantly correlated with age, we examined partial correlations to determine if associations among variables were consistent with mediation. We used partial correlations instead of Preacher and Hayes's (2008) bootstrapping procedure due to concerns about cross-sectional age variance extraction (Lindenberger, von Oertzen, Ghisletta, & Hertzog, 2011). Correlations and partial correlations are shown in Table 5.

Future success. As expected, temporal aspects of introspections were correlated with age. Those who were older were significantly less likely to mention future-oriented thoughts about how the soured plans could become successful (see Table 5). After controlling for age, a greater focus on future success was still significantly associated with being less willing to cancel the failing plan (see Table 5). Together, these results along with a follow-up test reported in the footnote, provide evidence consistent with mediation.⁸ Older adults may be less biased by sunk costs due to focusing less on the future success of a failing plan

Past loss. Those who were older were also significantly less likely to interpret the scenario in terms of past losses. However, after controlling for age, a greater focus on past losses was not significantly correlated with willingness to cancel the failing plan. Thus, these results did not provide evidence consistent with mediation.

⁸ When we examined potential paths from age to willingness to cancel the failing plan through all introspective processes in a single analysis using Preacher and Hayes' (2008) bootstrapping procedure with 5,000 resamples, the only significant ($p < .05$) indirect pathway was the one through focusing on future success. Examination of the direct and indirect coefficients for age indicated that after accounting for focusing on future success, the significant association between age and greater willingness to cancel the failing plan ($b = .015, p < .05$) was no longer significant ($b = .012, p > .05$). This indicates that age-related variance in willingness to cancel the failing plan was partly accounted for by older people being less likely to interpret the scenario in terms of future-oriented thoughts about the plan could succeed.

Negative affect, augmenting the scenario, and coping through rumination

avoidance. Age was not significantly correlated with negative affect, augmenting the scenario, or coping through rumination avoidance.

Discussion

Discovering how to reduce bias toward completing failing “sunk-cost” plans has wide-ranging applications for organizations and individuals. Sticking with a failing plan due to irretrievable prior investments can result in significant losses when governments escalate involvement in unwinnable wars, when banks fail to write off problematic loans, or when individuals forgo more rewarding alternatives to stick with failing plans (Arkes & Blumer, 1985; Schwartz, 2005; Staw 1981, 1997). Our study shows that in an age-diverse sample, an intervention that prompts thoughts and feelings about a decision is more effective than an intervention that prompts focusing on improvements due to differences in the introspection processes elicited. Our study also uncovers introspection processes that help explain why older age is advantageous when decisions involve sunk costs. This shows how studying decision making in older adulthood can identify ways to improve the decision making of younger adults. In the following sections, we elaborate on these contributions.

1. Is sunk-cost bias reduced by (a) interventions that prompt a focus on thoughts and feelings or improvements, and (b) older age?

The intervention that instructed participants to write about thoughts and feelings reduced bias toward continuing the failing plan compared to the intervention that instructed participants to write about improvements, as well as the no-instruction control group. Our findings contrast with prior research that used these same interventions with a college student sample and found that focusing on improvements was more likely than focusing on thoughts and feelings to reduce

inaction-inertia bias (van Putten et al., 2009, 2010). Together, these findings suggest that interventions do not have uniform consequences across different decision biases. Our findings highlight that when designing interventions, it is important to first understand people's existing beliefs or "mental models" because these beliefs will shape how interventions are interpreted (Bruine de Bruin & Bostrom, 2013; Strough, Bruine de Bruin & Peters, 2015). When thinking about a sunk-cost scenario, focusing on improvements cued beliefs about reversing the failing plan and sticking with it instead of abandoning the plan to pursue more rewarding alternatives. For other decision biases, such as inaction inertia, focusing on improvements may cue existing beliefs that align with normative theories (van Putten et al., 2009, 2010).

Our findings showed that older age was associated with being more willing to cancel sourced vacation plans across the intervention and control groups. Thus, the effectiveness of interventions did not differ by age. The greater willingness of older adults to cancel a failing plan replicates research using the same (Bruine de Bruin et al., 2014) and a larger, different set of scenarios, including ones that portray sunk costs as distinct from project completion (Bruine de Bruin et al., 2012; Strough et al., 2008; Strough, et al., 2011b). Thus, when dealing with sunk costs, older age appears to provide an advantage although an intervention can still boost performance. As such, organizations may benefit from seeking advice from senior employees when facing decisions that involve sunk costs.

2. What introspective processes are associated with the effectiveness of interventions for reducing sunk-cost bias?

Future success. Interventions were differentially effective because they elicited different introspective processes. Instructions to focus on thoughts and feelings decreased bias toward continuing a failing plan because they suppressed future-oriented thoughts about how the plan

might succeed. This fits with research which showed that inducing optimism (Juliusson, 2006) and having positive anticipatory emotions about project success (Harvey & Victoravich, 2009; Wong, 2005) increased escalation of commitment. Whereas prior research manipulated project completion to show how looking forward to completion increased commitment to a failing plan (Conlon & Garland, 1993; Garland & Conlon, 1998; Moon, 2001), our methods revealed that when collapsed across both intervention groups, thoughts of future success were mentioned by about one-third of participants, even when a project was only halfway complete. Notably, similarities in decisions between the improvement intervention group and the control group suggested people may think about how to improve a failing plan when left to their own devices. Taking into account the need to counteract such thoughts when designing interventions to reduce sunk-cost bias may improve their efficacy.

Augmenting the scenario. Another reason why instructions to focus on thoughts and feelings decreased bias toward continuing the failing plan was because these instructions suppressed augmentations that could make sticking with that plan seem like a good idea. Augmenting the scenario was the most common response to the instructions overall, but it was less pronounced in the thoughts and feelings intervention group than the improvement intervention group.

The augmentations we uncovered are similar to findings indicating that business students gave facts a “positive spin” or even fabricated information to justify finishing a doomed project (Jensen et al., 2011). Our findings also fit with research which suggested that wishful thinking or fantasizing about reversing a negative situation was unproductive (Folkman & Lazarus, 1985; Penley, Tomaka, & Weibe, 2002). Wishful thinking could lead people of all ages to undervalue

the future costs of continuing with a bad plan. Targeting such thoughts may be essential when intervening to reduce sunk-cost bias.

Our findings for augmentations showed that participants applied their knowledge and experience to “go beyond” the scenario and task instructions (Bruine de Bruin, 2011). As such, seemingly biased decisions may have resulted from logical reasoning (Morris & Larrick, 1995; Tetlock, 2000). Many decisions to continue with a failing plan could be viewed as reasonable after taking into account details people used to augment the scenario (see also Frisch, 1993). Stopping at a motel or taking medicine to feel better are reasonable actions in a real-world scenario corresponding to the hypothetical scenario we used—driving to a vacation destination. Pending the outcomes of these actions, it could be reasonable to continue with vacation plans or to cancel them. Indeed, augmentations may have been more prevalent when participants used logical reasoning (see Wong, Kwong, & Ng, 2008). Our findings suggested that augmentations were more prevalent when decision makers were motivated to act to improve a failing situation, which may be a common reaction to failure in everyday life.

Past loss, negative affect, and avoiding rumination. Pathways through introspective processes of focusing on past losses, negative affect, and avoiding rumination did not explain why the thoughts and feelings intervention was more effective than the improvement intervention for eliciting decisions to cancel the failing plan. Although the pathway through negative affect was not significant, its association with greater willingness to cancel the failing plan is consistent with research suggesting that people deescalate commitment to escape negative emotions (Ku, 2008; Wong et al., 2006; Wong & Kwong, 2007). For past losses, our results contrast with the idea that concerns about “waste” underlie sunk-cost bias (Arkes & Ayton, 1999; Hastie & Dawes, 2001) and that the ability to avoid rumination about losses facilitates

canceling failing plans (Bruine de Bruin et al., 2014). Being halfway to a vacation destination (the scenario we used) may not have been seen as sufficient progress toward completion to foster concerns about waste or loss (Garland & Conlon, 1998; Sleesman et al., 2012). In addition, prior research has shown that investments of time and effort (such as the driving investment in our scenario) are less fungible than monetary investments (Soman, 2001) and more difficult to track in mental accounts (Heath, 1999). If the driving investment was intangible to participants, this could explain why introspective processes corresponding to loss and avoiding rumination did not account for intervention group differences in decisions.

3. What introspective processes are associated with age differences in sunk-cost bias?

Future Success. Older adults were more willing to cancel soured plans and they focused less on how the plan could eventually become successful in the future. Focusing on the future success of the failing plan was associated with sunk-cost bias, even after controlling for age (see also Strough et al., 2014). Together, these findings suggest that older adults were less likely to use unproductive wishful thinking to deal with the failing plan and that this helped them avoid sunk-cost bias. Older adults' lesser focus on future possibilities is consistent with life-span theory suggesting that older adults are motivated to focus on the "here and now" due to having a limited life-span time horizon (Carstensen, 2006). When designing interventions to reduce other decision biases, it will be important to take age differences in temporal orientations into account (Strough et al., 2015a; Strough, Bruine de Bruin, Parker, Lemaster, Pichayayothin, & Delaney, 2016).

Augmenting the scenario. Age was unrelated to augmenting the scenario, similar to prior research (Berg et al., 1999). As noted, augmenting the scenario was the most common response to the interventions. Recent experience could have facilitated augmenting scenarios

irrespective of age. Approximately 73% of “Baby Boomers”, 71% of “Generation X”, and 76% of “Millennials” reported taking at least one leisure trip in the past year (Destination Analysts, 2013). Methodological issues may have also influenced introspections. Directive questions like the ones we used (“what could be done to improve this situation?”) may diminish age differences detected with other methods (general instructions to “think aloud,” Woodhead et al., 2011).

Past loss, negative affect, and avoiding rumination. Older adults were less likely to focus on past losses and more likely to decide to cancel the failing plan, which replicated prior research using different scenarios (Bruine de Bruin et al., 2012; Strough et al., 2008; Strough et al., 2011b). However, focusing on past losses and avoiding rumination were not related to age differences in decisions, which is in contrast to prior research (Bruine de Bruin et al., 2014; Strough et al., 2011b). It has been suggested that within and between-subjects designs may elicit different decision-making processes (Kahneman, 2000; Klaczynski, 2001). Prior research using a within-subjects design found that coping through rumination avoidance statistically accounted for age differences in decisions when the irrecoverable investment was large, but not when it was small (Bruine de Bruin et al., 2014). In the between-subjects design we used, participants were not presented with a version of the scenario with a smaller loss. This could have made loss of the prior investment a less salient factor in their decision making.

Limitations and Future Directions

Our findings are based on a single scenario. Similar items correlate with other scenarios assessing sunk-cost bias and have validity, as shown in significant correlations with better life decision outcomes (Bruine de Bruin et al., 2007; Parker et al., 2015; Strough et al., 2014). Yet the scenario may have facilitated adding contextually-relevant details to support continuing with

the plan. Other scenarios, such as one describing dissatisfaction with painting a room (Bruine de Bruin et al., 2007), may not have as many ways to alter the scenario to justify continuing.

The scenario we used could have been less relevant to people who do not drive to vacation destinations. Age-related declines in health could have influenced older adults' decisions. However, other studies that used different scenarios also indicated that older adults were less biased by sunk costs (Bruine de Bruin et al., 2012; Strough et al., 2008). Studies have also shown that age-related reductions in sunk-cost bias are not due to age declines in fluid intelligence or working memory (see Del Missier, Mäntylä, & Nilsson 2015 for a review). Because we did not assess health, cognitive functioning, or the relevance of the scenario to our participants, we cannot rule out the possibility that these factors contributed to our results.⁹

In the scenario we used, information about driving “halfway” simultaneously provided information about sunk costs and progress toward project completion. Some past research indicated that augmenting and focusing on future success were tied to project completion, not sunk costs (Jensen et al., 2011). However, other research showed that sunk-cost scenarios elicited augmentations (Frisch, 1993). Although our findings are not likely to be solely

⁹ As a step toward addressing alternative explanations for our findings, we obtained data from a different study, also conducted on the American Life Panel, where a subset of our participants ($n = 41$) answered questions about their perceptions of changes in their health over the past year and how their ability to make decisions had changed over time (see Strough et al., 2016 for details). Reflecting the small sample size, none of the correlations were significant, but they were in the expected direction. Namely, older age was associated with perceiving that one's health had gotten worse over the past year ($r(41) = -.21, p = .18$) and that one's decision making ability had gotten worse over time ($r(41) = -.16, p = .37$). The magnitude and direction of the correlation between age and less sunk-cost bias ($r(41) = .14, p = .41$) was similar after controlling for perceived worsening of health over the past year ($r(41) = .13, p = .41$) and perceived declines in decision making ability over time ($r(41) = .13, p = .41$). Together, these results suggested that self-rated age-related declines in health and decision-making ability did not have an undue influence on our results. To address concerns about the perceived relevance of our scenario by age, we accessed participants responses to the question “could you tell us how interesting or uninteresting you found the questions in this interview,” which is included in every survey fielded on RAND's American Life Panel. Participants responded to the question on a scale that ranged from 1= very interesting to 5= very uninteresting. Age was not significantly correlated with participants' ratings of how interesting the questions were ($r(395) = .02, p = .66$). Thus, our findings do not appear to be due to differential interest in our measures by age.

attributable to the scenario we used, future research could use scenarios where sunk costs and project completion are distinct to address this issue.

The event that precipitated the need for a decision was feeling sick. When motivated to focus on acting to improve the situation, people augmented the scenario by taking action to treat the illness (taking medication, stopping at a motel to rest). These additions could make it reasonable to continue with the already-initiated action of going on vacation. Perhaps if participants interpreted the “main problem” (Berg et al., 1999) as having driven halfway but knowing they would feel better at home, they would have taken action to return home.

Because we were interested in testing interventions to improve decisions, we had participants respond to introspection prompts before making their decision. As noted by Simon and Ericsson (1980), directive task instructions such as the ones we used can change the content of thoughts. The categories of responses we obtained were similar to those found in prior research, in which people were asked post-hoc to justify or explain a decision they had already made (Frisch, 1993; Jensen et al., 2011; Strough et al., 2011b). Thus, the interventions we used may not have influenced the types of thoughts that were elicited, although they did influence the relative frequency of some thoughts.

The interventions we used were taken from van Putten et al.’s (2009) research on reducing inaction-inertia bias. We aimed to test whether these interventions effectively reduced sunk-cost bias because they changed introspection processes. Less directive instructions to “think aloud,” could be used if the aim of the study is to understand the contents of cognitive processing, untainted by directive instructions (Ericsson & Simon, 1980; Fox, Ericsson, Best, 2011). Yet even less directive instructions would be imperfect if unconscious processes influence behavior (Nisbett & Wilson, 1977; Tversky & Kahneman, 1973; Wilson & Dunn, 2004).

Methods that do not require self-report, such as measuring neural activity in brain regions associated with experience and emotion (see Haller & Schwabe, 2014) could also be used. Triangulating results from multiple methods may facilitate a more complete understanding of processes underlying decision biases. In addition, recruiting samples that have greater ethnic, racial, and cultural diversity than the U.S. sample of mostly white adults that we used would help to address concerns about the generalizability of our findings.

Conclusions

Our findings offer new information about the introspective processes associated with an intervention to reduce sunk-cost bias in a decision about project completion. Our findings caution against assuming that an intervention shown to reduce one type of decision bias (i.e., inaction inertia; van Putten et al., 2009) will necessarily generalize to a different bias. To the extent that our findings generalize to other sunk-cost scenarios, they offer insights about thought processes to target in interventions to improve decisions in people of all ages. First, people draw inferences about decision scenarios and interpret interventions in light of existing beliefs. After considering these inferences, some seemingly biased decisions may be reasonable rather than indicative of faulty logic or inappropriate application of normative principles. Second, future-oriented thoughts about how soured plans may eventually be successful can have a downside. Importantly, older age appears to bring wisdom regarding the folly of such an approach. Our findings show that interventions can be designed to promote the use of older adults' wiser decision strategies among people of all ages – bringing the promise of improving their life decision outcomes and overall well-being.

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Table 1

Sample Statistics and Intercorrelations of Study Variables

	Sample Statistics	1	2	3	4	5	6	7
1. Age	M = 47.1 yrs, SD = 14.96							
2. Willingness to cancel plan	M = 3.01, SD = 1.84	.10** ⁺						
3. Future success	32.8%	-.16*	-.34**					
4. Negative affect	18.6%	-.02	.17**	-.18				
5. Past loss	17.8%	-.13*	.08	-.001	.20**			
6. Augment scenario	45.2%	.09	-.26**	.11	-.17**	-.09		
7. Coping through rumination avoidance	M = 3.98, SD = .63	.06 ⁺	-.09 ⁺	.16**	-.13*	.01	.05	

Note. * $p < .05$, ** $p \leq .01$. ⁺ Indicates Pearson's correlation where $N=397$. All other correlations are Spearman's rho (for categorical data) where $N=258$ (because members of the control group did not provide written responses). The sum of percentages across categories exceeds 100 because the categories were not mutually exclusive, and hence a particular response could receive multiple codes.

Table 2

Predicting Willingness to Cancel a Failing Plan from Age and Intervention Group

	B	SEB	β	R ²	F	t
Step 1				.04	5.71**	
Age	.01	.01	.11			2.19*
Intervention group contrasts						
Improvement vs. thoughts & feelings, & control	-.23	.22	-.06			-1.06
Thoughts & feelings vs. improvement & control	.55	.23	.14			2.47*
Step 2				.04	3.44**	
Age X intervention group contrasts						
Age X improvement group	.01	.02	.07			.38
Age X thoughts & feelings	.01	.02	.06			.32

Note. * $p < .05$ ** $p < .01$. Willingness to cancel the failing plan was measured on a 6-point scale where higher scores indicated decisions that were less biased. When contrasting the improvement group against the thoughts and feelings and control groups, the improvement group was dummy coded 1 and the other two groups were coded zero. When contrasting the thoughts and feelings group against the improvement and control groups, the thoughts and feelings group was dummy coded 1 and the other two groups were zero.

Table 3

Introspective Processes by Intervention Group

Response	Thoughts and Feelings	Improvement	Control	Significance
Augment scenario	24.2	64.4	--	$\chi^2 = 42.28^{**}$
Past loss	26.6	9.7	--	$\chi^2 = 12.57^{**}$
Future success	25.8	39.3	--	$\chi^2 = 5.04^*$
Negative affect	35.5	3.0	--	$\chi^2 = 44.92^{**}$
Coping through rumination avoidance	3.98 (.65)	4.03 (.59)	3.93 (.63)	F = .78

Note. * $p < .05$, ** $p < .01$. Percentage of responses within each intervention group are shown, except for coping through rumination avoidance where the mean score and (standard deviation) on the 6-point scale is shown, with higher scores indicating greater avoidance of rumination. The sum of percentages within the intervention groups exceeds 100 because the categories were not mutually exclusive, and a response could receive multiple codes. The control group did not provide written responses, so there were no introspective text-box responses to assess.

Table 4

Indirect Effects of Intervention Group on Willingness to Cancel a Failing Plan Through Mediating Variables

Mediating Variable	Bootstrapped Estimate	SE	95% Bias Corrected Confidence Interval	
Augment scenario	.35	.10	.18	.59*
Past loss	.04	.05	-.05	.15
Future success	.17	.07	.05	.33*
Negative affect	.07	.10	-.13	.28
Coping through rumination avoidance	.01	.02	-.01	.09

Note. N=258. * $p < .05$

Table 5

Correlations and Partial Correlations among Study Variables

Variable	Correlation between variable and age	Partial correlation between variable and willingness to cancel, controlling for age
1. Willingness to cancel plan	.10†	
2. Future success	-.16*	-.33**
3. Negative affect	-.02	.17**
4. Past loss	-.13*	.04
5. Augment scenario	.09	-.30**
6. Coping through rumination avoidance	.05	-.10

Note. † $p < .10$, * $p < .05$, ** $p < .01$. $N = 258$.

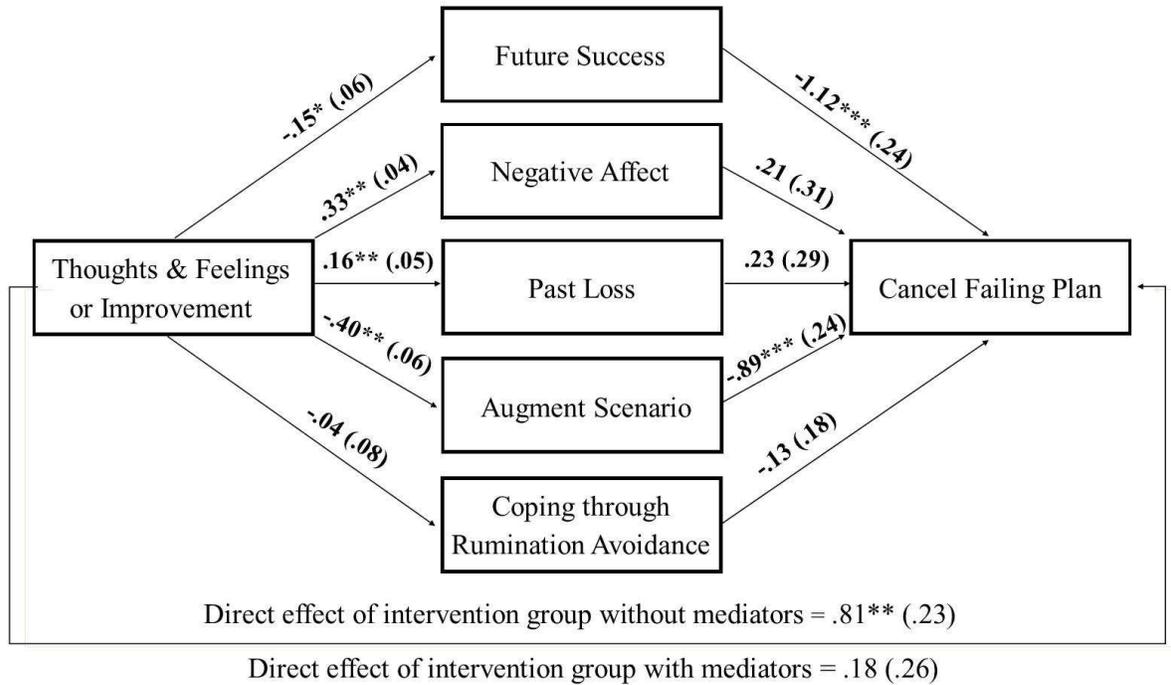


Figure 1. Multiple mediation model of decisions to cancel the failing plan by intervention group. For the mediators, the unstandardized coefficients are for their direct effects on decisions, controlling for intervention group. Standard errors are shown in parentheses. Unstandardized coefficients for the indirect effects of the intervention group on decisions through the mediators are shown in Table 4.

N = 258, * $p < .05$, ** $p < .01$, *** $p < .001$