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Debiasing the Mind Through Meditation: Mindfulness and the Sunk-Cost Bias

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Abstract

In the research reported here, we investigated the debiasing effect of mindfulness meditation on the sunk-cost bias. We conducted four studies (one correlational and three experimental); the results suggest that increased mindfulness reduces the tendency to allow unrecoverable prior costs to influence current decisions. Study 1 served as an initial correlational demonstration of the positive relationship between trait mindfulness and resistance to the sunk-cost bias. Studies 2a and 2b were laboratory experiments examining the effect of a mindfulness-meditation induction on increased resistance to the sunk-cost bias. In Study 3, we examined the mediating mechanisms of temporal focus and negative affect, and we found that the sunk-cost bias was attenuated by drawing one's temporal focus away from the future and past and by reducing state negative affect, both of which were accomplished through mindfulness meditation.

Keywords

mindfulness, meditation, decision making, emotions, intervention

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Mindfulness meditation is a means of cultivating awareness of the present moment. It consists of focusing on present experience and clearing one's mind of other thoughts; this is often accomplished by focusing attention on the physical sensations of breathing (Hanh, 1999; Kabat-Zinn et al., 1992). The immediate effects of mindfulness meditation constitute a psychophysiological state; however, mindfulness has also been viewed as a trait variable (Brown & Ryan, 2003) describing the extent to which people focus on the present as part of their baseline attentional patterns.

In general, most people's thoughts tend to wander away from the present toward the past and future (Mason et al., 2007). This default internal stream of thoughts, also known as mind wandering, draws attention to "events that happened in the past, might happen in the future, or will never happen at all" (Killingsworth & Gilbert, 2010). Mind wandering can also arise during task-focused activity and, when it does, distract from the task at hand (Christoff, Gordon, Smallwood, Smith, & Schooler, 2009). Predictably, people who report higher trait mindfulness demonstrate less mind wandering (Mrazek, Smallwood, & Schooler, 2012). In addition, Mrazek, Franklin, Phillips, Baird, and

Schooler (2013) found that 2 weeks of mindfulness-meditation training decreased mind wandering and improved GRE scores. Even 8 min of a mindfulness-type focused-breathing meditation decreased mind wandering in a sustained-attention response task (Mrazek et al., 2012). By focusing attention on breathing, mindfulness meditation thus weakens the tendency to think about the future or past, which is predicted to reduce the sunk-cost bias.

The Sunk-Cost Bias: The Roles of Temporal Focus and Negative Affect

The sunk-cost bias, also known as the sunk-cost effect or sunk-cost fallacy, is the "tendency to continue an endeavor once an investment in money, effort, or time has been made" (Arkes & Blumer, 1985, p. 124). It often underlies escalation of commitment (Staw, 1976) or entrapment (Brockner & Rubin, 1985). Although disastrous military

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campaigns (Staw, 1976) and overbudget public-works projects (Ross & Staw, 1993) are publicly visible cases, the sunk-cost bias also manifests itself on a smaller scale for people during everyday life. For example, it can be surprisingly difficult to sell a stock that has fallen in value (Odean, 1998), to ignore bad advice that one has paid for (Gino, 2008), or to delete carefully written text from a manuscript. Explanations for the sunk-cost bias include loss aversion (Kahneman & Tversky, 1979), self-justification (Aronson & Mills, 1959), and the desire not to appear wasteful (Arkes & Blumer, 1985).

Among decisional biases, the sunk-cost bias may be particularly influenced by mindfulness meditation, because it can involve both emotional and temporal processes. There are several reasons why focusing on the past or on the future, rather than on the present, in sunk cost situations may lead to a greater incidence of the sunk-cost bias. Sunk costs by definition were incurred in the past. Predictably, when past costs are less cognitively salient, they weigh less heavily on current decisions, which leads to resistance to the sunk-cost bias (Strough, Schlosnagle, & DiDonato, 2011). In addition, prior research has indicated that focusing on the future can lead to an increase in the sunk-cost bias. Staw (1981) suggested that escalation of commitment reflecting the sunk-cost bias may be due as much to concerns about the future as to reactions to the past and that it can be difficult to separate whether escalation arises from focusing on the past or focusing on the future. Staw (1981) outlined several reasons why escalation can arise from a focus on the future, including concerns about the possible future need to justify poor performance, intensified importance of future returns after a loss, and reluctance to deviate from stereotypes that accentuate the benefits of steadfast behavioral consistency over time. Anticipated regret, which requires future focus, has been shown empirically to increase escalation of commitment (Wong and Kwong, 2007); the authors noted that "people in escalation situations are simultaneously influenced by the emotions they expect to experience in the future (e.g., anticipated regret) and by events that have happened in the past (e.g., responsibility for the initiating previous decision)" (p. 545).

In addition to temporal processes, emotional processes are expected to be involved in the influence of meditation on resistance to the sunk-cost bias. There has been extensive research examining the influence of emotions on decision making (e.g., Loewenstein & Lerner, 2002). Recent evidence indicates that negative emotions exacerbate the sunk-cost bias and escalation of commitment. In a laboratory experiment, Coleman (2010) found that anger increased the sunk-cost bias in an educational decision-making task. Moon, Hollenbeck, Humphrey, and Maue (2003) found that anxiety is associated with increased incidence of the sunk-cost bias as well. Anticipated regret also leads to increased escalation of

commitment (Wong & Kwong, 2007). These findings suggest that reducing state negative affect may reduce the sunk-cost bias (for converging antecedent support, see Zhang and Baumeister, 2006; for a counterpoint, see Wong, Yik, and Kwong, 2006).

Mindfulness meditation has repeatedly been found to reduce negative affect and to lead to greater subjective well-being (Brown & Ryan, 2003). Clinical psychologists effectively combat patients' anxiety through mindfulness-meditation training (Kabat-Zinn et al., 1992), and mindfulness meditation is associated with reduced anger (Borders, Earleywine, & Jajodia, 2010; Wright, Day, & Howells, 2009). Furthermore, people report greater happiness when they focus on the present moment than when they think about the past or the future (Killingsworth & Gilbert, 2010).

Short mindfulness-meditation inductions have been shown to be effective as well. For example, one 15-min mindfulness-meditation induction reduced negative affect in response to aversive pictures and increased participants' willingness to continue to view such pictures (Arch & Craske, 2006). A similar induction also reduced negativity bias, the overweighting of negative information relative to positive information, in attitude formation (Kiken & Shook, 2011). Thus, because mindfulness meditation draws attention away from the past and future, we predicted that it would decrease the salience of both past costs and future concerns about resolving these costs, in turn reducing negative affect and increasing resistance to the sunk-cost bias.

Overview

In four studies, we tested whether greater mindfulness leads to a greater resistance to the sunk-cost bias. Study 1 was designed as a demonstration of the positive correlational relationship between trait mindfulness and resisting the sunk-cost bias. Studies 2a and 2b were laboratory experiments examining the influence of state mindfulness (following a brief mindfulness-meditation induction) on resisting the sunk-cost bias. Study 3 examined the mediating mechanisms of temporal focus and negative affect, which were predicted to underlie the relationship between state mindfulness and resistance to the sunk-cost bias. An alpha level of .05, one-tailed, was used for all hypothesis tests.¹

Study 1

In our first study, we investigated the relationship between trait mindfulness and resistance to the sunk-cost bias, controlling for two factors previously found to predict resistance to this bias. The first control factor was age: Older adults resist the sunk-cost bias more than younger adults do (Strough, Mehta, McFall, & Schuller, 2008). The second factor was self-esteem: When made

salient, self-esteem negatively predicts escalation of commitment (Sivanathan, Molden, Galinsky, & Ku, 2008). We hypothesized that greater trait mindfulness would predict increased resistance to the sunk-cost bias when we controlled for age and trait self-esteem.

Method

One hundred seventy-eight adult participants (87 men and 91 women; mean age = 37.31 years, $SD = 13.30$, age range = 18–70) residing in the United States were recruited using Amazon's Mechanical Turk survey platform, a source of reliable data (Buhrmester, Kwang, & Gosling, 2011) outside the university context.

Participants completed the Mindful Attention Awareness Scale ($\alpha = .879$), a widely used trait-mindfulness scale (Brown & Ryan, 2003). Participants also completed the Resisting Sunk Costs subsection ($\alpha = .458$) of the Adult Decision-Making Competence Inventory (Bruine de Bruin, Parker, & Fischhoff, 2007), in which participants use 6-point scales to respond to 10 questions about sunk-cost scenarios.² To control for trait self-esteem, we asked participants to complete the Rosenberg (1979) Self-Esteem Scale ($\alpha = .925$).

Results and discussion

As predicted, trait mindfulness was positively correlated with resisting the sunk-cost bias ($r = .205$, $p = .003$).³ When trait mindfulness, self-esteem, and age were entered as independent variables in a linear regression, trait mindfulness ($\beta = 0.140$, $p = .048$) and age ($\beta = 0.322$, $p < .001$) were significant predictors of resisting the sunk-cost bias, but self-esteem was not ($\beta = -0.019$, $p = .410$). The significance pattern was unchanged when the control variables were entered individually. These results are consistent with our hypothesis that greater trait mindfulness would predict increased resistance to the sunk-cost bias after we controlled for age and trait self-esteem.

Study 2a

In this study, we tested the causal nature of the relationship between state mindfulness and the sunk-cost bias through an experimental manipulation of mindfulness meditation. We hypothesized that mindfulness meditation would increase resistance to the sunk-cost bias.

Method

Sixty-nine undergraduate students were recruited and paid through the participant pool at a large East Coast university. Five participants with asthma and 7 participants who did not listen to the full induction were removed from analyses.⁴ The remaining 57 participants (18 men and 39

women; mean age = 19.40 years, $SD = 1.10$, age range = 18–23) were included in the analyses.

Participants were greeted by an experimenter who was blind to the hypotheses and were escorted to a semi-private cubicle. Participants completed an online consent form, put on a headset, and were randomly assigned to one of two experimental conditions: mindfulness meditation or a mind-wandering control condition.

In both conditions, participants listened to a 15-min recorded induction created specifically for this research by a professional mindfulness-meditation instructor. The content of the mindfulness-meditation induction was adapted from Arch and Craske's (2006) script, which had been adapted from materials by Kabat-Zinn (1990). Participants were led through a focused-breathing meditation exercise that instructed them to focus on the physical sensations of breath entering and leaving their body and repeatedly reminded them to focus on their experience of breathing. The content of the mind-wandering induction (control condition) repeatedly instructed participants to think of whatever came to mind. This type of induction has been used as a control condition in prior mindfulness experiments (Arch & Craske, 2006; Kiken & Shook, 2011) because it replicates a waking, baseline mental state (Mason et al., 2007).

After the experimental manipulation, participants completed a decision-making task (developed by Arkes & Blumer, 1985), the outcome of which indicated whether participants had resisted the sunk-cost bias. Participants were asked to play the role of the owner of a printing company who had recently spent \$200,000 to buy a new printing press. One week later, a competitor went bankrupt and offered to sell, for \$10,000, his computerized printing press, which worked 50% faster than the new \$200,000 printing press at about half the production cost. Because the new \$200,000 printing press was custom-made for the firm's needs, it could not be sold to raise money to purchase the competitor's press. However, participants were informed that they had \$10,000 in savings that could be used to buy it. They were then asked to decide whether to buy the competitor's press. A decision to buy it was taken to indicate that the participant had resisted the sunk-cost bias.

As a manipulation check, we asked the participants to report the extent to which they were focused on their breathing, focused on the physical sensations of breathing, and in touch with their body. Responses were made on a 5-point Likert scale (1 = *very slightly or not at all*, 5 = *extremely*; $\alpha = .766$). Responses to the three questions were averaged.

Results and discussion

Participants in the mindfulness condition reported a greater focus on their breathing and body ($M = 2.65$,

$SD = 1.01$) than did participants in the control condition ($M = 2.11$, $SD = 1.11$), $t(55) = 2.032$, $p < .05$, $d = 0.51$.

The percentage of participants in the mindfulness condition who resisted the sunk-cost bias (78%) was higher than the percentage of participants in the control condition who resisted the sunk-cost bias (44%), $\chi^2(1, N = 57) = 7.024$, $p = .004$, $\Phi = 0.35$ (Fig. 1). These findings support our prediction that state mindfulness achieved through mindfulness meditation increases resistance to the sunk-cost bias.

Study 2b

Study 2b was a follow-up study intended to replicate Study 2a with a different decision task. We again hypothesized that mindfulness meditation would increase resistance to the sunk-cost bias.

Method

One hundred thirty-three undergraduate students were recruited and compensated in the same manner as in Study 2a. Thirteen participants with asthma and 11 participants who did not listen to the full induction were removed from analyses. The remaining 109 participants (37 men, 69 women, and 3 participants who did not report their gender; mean age = 20.18 years, $SD = 1.53$, age range = 18–26) were included in analyses.

The procedure was the same as that of Study 2a except for the sunk-cost-bias measure and manipulation check. The decision task used in this study was also developed by Arkes and Blumer (1985). However, it differs from the decision task used in Study 2a in that the decision is framed as an opportunity to succumb to, rather than to

resist, the sunk-cost bias. Specifically, participants were asked to play the role of the president of an aviation company that had committed \$10 million to developing a radar-blank plane, “a plane that could not be detected by conventional radar.” After \$9 million had been spent, a rival company announced the debut of their own radar-blank plane, which had better performance and lower cost. Participants were then asked to decide whether to invest the remaining \$1 million in continued development of the company’s inferior plane. A decision to continue to fund the inferior plane was taken as an indication of having succumbed to the sunk-cost bias.

As a manipulation check, to measure the extent to which the focused-breathing induction cultivated increased awareness of the present moment in the mindfulness condition, we asked participants to report the extent to which they were “absorbed in the present moment,” using a 5-point Likert scale (1 = *very slightly or not at all*, 5 = *extremely*).

Results and discussion

Participants in the mindfulness condition reported a greater awareness of the present moment ($M = 2.89$, $SD = 1.31$) than did participants in the control condition ($M = 2.04$, $SD = 1.07$), $t(107) = 3.731$, $p < .001$, $d = 0.71$.

For clearer comparison to Study 2a, we reverse-coded the results to analyze outcomes in terms of resisting the sunk-cost bias. The percentage of participants in the mindfulness-meditation condition who resisted the sunk-cost bias (53%) was significantly higher than the percentage of participants in the control condition who resisted the sunk-cost bias (29%), $\chi^2(1, N = 109) = 6.35$, $p = .006$, $\Phi = 0.24$ (Fig. 2).

The results from Studies 2a and 2b indicated that a brief mindfulness-meditation induction increased participants’ resistance to the sunk-cost bias, regardless of how the decision was framed. The first three studies demonstrated positive relationships between resisting the sunk-cost bias and both measured trait mindfulness (Study 1) and state mindfulness experimentally manipulated through mindfulness meditation (Studies 2a and 2b).

Study 3

Study 3 examined experimentally the mechanisms underlying the influence of state mindfulness on resistance to the sunk-cost bias. We hypothesized that the increased resistance to the sunk-cost bias after mindfulness meditation would be mediated by decreased temporal focus on the future and past and by decreased state negative affect. We examined the comparative influence of these two mediators in a simultaneous test. Furthermore, because mindfulness meditation reduces focus on the future and past (Mrazek et al., 2012, 2013), which is correlated with

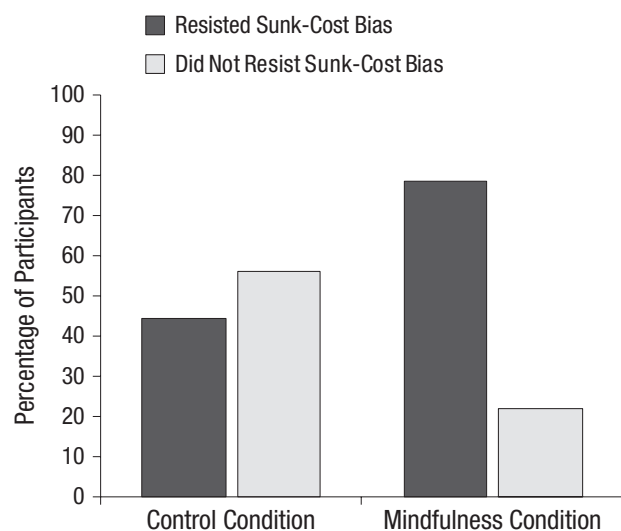


Fig. 1. Percentage of participants who did and did not resist the sunk-cost bias as a function of condition in Study 2a.

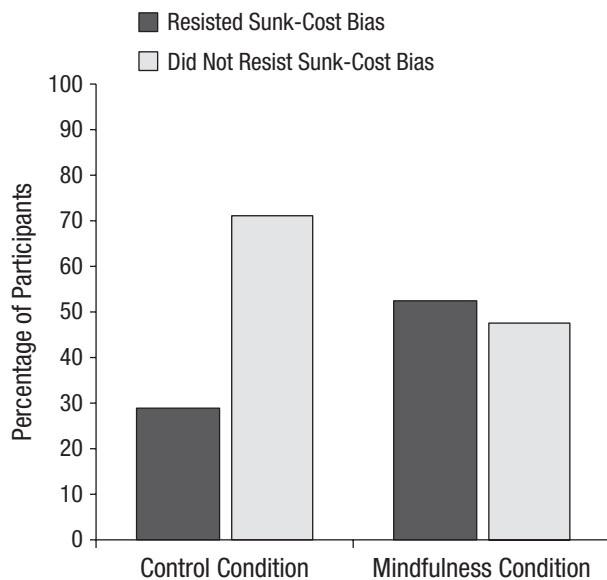


Fig. 2. Percentages of participants who did and did not resist the sunk-cost bias as a function of condition in Study 2b.

more-negative affective states (Killingsworth & Gilbert, 2010), and negative affect is positively associated with the sunk-cost bias (Coleman, 2010; Moon et al., 2003), we also tested for two-step mediation through temporal focus and then negative affect, in that order.

Method

One hundred sixty-five participants who resided in the United States were recruited on Amazon's Mechanical Turk survey platform. Nine participants with asthma were removed from analyses. The remaining 156 participants (71 men and 85 women; mean age = 35.25 years, $SD = 12.05$, age range = 18–65) were included in analyses.

The procedure was similar to that in Studies 2a and 2b; the experimental manipulation was the same as in Studies 2a and 2b. Because this was an online survey, and to increase the likelihood that participants actually listened to the recorded inductions, the survey software did not allow the participants to navigate away from the induction page of the online survey for the duration of the recording.

To measure resistance to the sunk-cost bias, as in Study 1, we asked participants to complete the 10-item Resisting Sunk Costs scale ($\alpha = .570$) of the Adult Decision-Making Competence Inventory (Bruine de Bruin et al., 2007).

To measure focus on the future or past (temporal focus), we asked participants to answer a three-item survey ($\alpha = .940$) measuring the degree to which their thoughts were focused on the future or past at the end of the recorded induction. Specifically, participants rated the degree to which their "thoughts were focused on," they

were "absorbed in," and they were "mostly thinking about" the future or past (1 = *very slightly or not at all*, 5 = *extremely*). Our hypothesis was limited to negative affective mood, but to be conservative, we also tested positive affective mood as a potential mediator.⁵ Therefore, participants completed the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), for which answers were provided by using a 5-point Likert scale (1 = *not at all*, 5 = *very much*; positive affect: $\alpha = .804$; negative affect: $\alpha = .935$). Participants responded to the PANAS questions by indicating how they felt at the end of the recorded induction.

As a manipulation check, we asked participants to answer the same present-moment-awareness question that was used in Study 2b.

Results and discussion

Participants in the mindfulness condition reported a greater awareness of the present moment ($M = 3.26$, $SD = 1.14$) than did participants in the control condition ($M = 2.65$, $SD = 1.26$), $t(153) = 3.142$, $p < .01$, $d = 0.51$.

A one-way analysis of variance revealed that participants in the mindfulness condition demonstrated a greater resistance to the sunk-cost bias ($M = 4.53$, $SD = 0.72$) than did participants in the control condition ($M = 4.31$, $SD = 0.67$), $t(154) = 1.980$, $p = .025$, $d = 0.32$.

When entered individually into three separate bootstrapping mediation tests (Preacher & Hayes, 2008), both temporal focus (estimate = -0.097 , bias-corrected 95% confidence interval = $[-0.201, -0.010]$) and negative affect (estimate = -0.031 , bias-corrected 95% confidence interval = $[-0.088, -0.003]$) were significant mediators of the effect of mindfulness meditation on resisting the sunk-cost bias. However, positive affect was not a significant mediator (estimate = -0.004 , bias-corrected 95% confidence interval = $[-0.031, 0.095]$).⁶ When entered together into a simultaneous bootstrapping mediation test (Preacher & Hayes, 2008), negative affect (estimate = -0.047 , bias-corrected 95% confidence interval = $[-0.112, -0.011]$) remained a significant mediator, whereas the effect of temporal focus fell to marginal significance (estimate = -0.079 , bias-corrected 95% confidence interval = $[-0.194, 0.004]$, Sobel test, $p = .067$; see Fig. 3).

A two-step bootstrapping mediation test (Hayes, Preacher, & Myers, 2011) supported a sequential model of mindfulness meditation \rightarrow decreased past and future temporal focus \rightarrow decreased negative affect \rightarrow increased resistance to the sunk-cost bias (estimate = -0.026 , bias-corrected 95% confidence interval = $[-0.064, -0.003]$; see Fig. 4). The unique indirect effect of temporal focus (estimate = -0.079 , bias-corrected 95% confidence interval = $[-0.186, 0.012]$) and the unique indirect effect of negative affect (estimate = -0.021 , bias-corrected 95% confidence

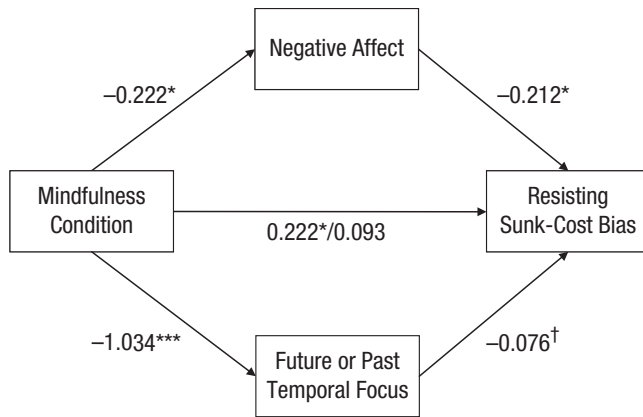


Fig. 3. Model showing the effect of mindfulness meditation on the sunk-cost bias as mediated simultaneously by temporal focus and negative affect in Study 3. The first coefficient on the path from mindfulness condition to resisting sunk costs represents the direct effect with no mediators in the model; the second coefficient on this path represents the direct effect when the mediators are included in the model. The figure shows unstandardized regression coefficients ($^{\dagger}p < .10$, $*p < .05$, $***p < .001$).

interval = $[-0.063, 0.032]$) were not significant in this multistep mediation test.

Study 3 replicated the experimental finding that mindfulness meditation significantly increases resistance to the sunk-cost bias. Furthermore, we predicted and found that decreased focus on the future and past and decreased state negative affect mediated the influence of mindfulness meditation on resistance to the sunk-cost bias. This study also supported the hypothesis of a causal progression from mindfulness meditation to decreased focus on the future and past, to decreased negative affect, and finally to increased resistance to the sunk-cost bias.

General Discussion

Answering a call for more research about how to improve decision making and reduce biases (Milkman, Chugh, & Bazerman, 2009), we investigated the relationship between mindfulness and resistance to the sunk-cost bias through one correlational and three experimental studies. In Study 1, a correlational study, we demonstrated a significant positive relationship between trait mindfulness and resistance to the sunk-cost bias. In Studies 2a and 2b, both experiments, we found that a 15-min mindfulness-meditation induction significantly increased resistance to the sunk-cost bias relative to a control induction (the mind-wandering condition). In Study 3, also an experiment, we found that the influence of mindfulness meditation on resistance to the sunk-cost bias was mediated by decreased temporal focus on the future and past and by decreased state negative affect. More specifically, Study 3 found that mindfulness meditation decreased temporal focus on the future and past, which then reduced negative affect, which in turn led to greater resistance to the sunk-cost bias. These findings should encourage researchers to further investigate the role of emotions and temporal focus in resistance to the sunk-cost bias.

It is particularly notable in this set of studies that increased resistance to the sunk-cost bias occurred after only a brief recorded mindfulness-meditation induction. Many prior mindfulness-meditation interventions have involved 8 weeks of face-to-face training (Brown & Ryan, 2003); by comparison, our 15-min recorded manipulation is substantially more practical. Nonetheless, we encourage future research investigating the effects of long-term mindfulness training on resistance to the sunk-cost bias. We also encourage research investigating how

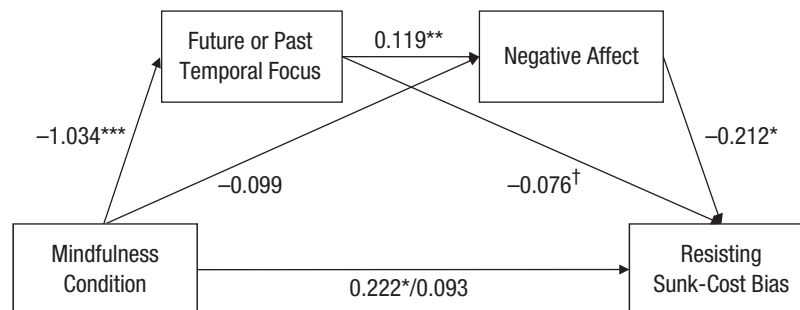


Fig. 4. Two-step sequential model showing the effect of mindfulness meditation on resisting the sunk-cost bias, as mediated by temporal focus and negative affect in Study 4. The first coefficient on the path from mindfulness condition to resisting sunk costs represents the direct effect with no mediators in the model; the second coefficient on this path represents the direct effect when the mediators are included in the model. The figure shows unstandardized regression coefficients ($^{\dagger}p < .10$, $*p < .05$, $**p < .01$, $***p < .001$).

mindfulness practice might improve other decision-making processes and outcomes.

In sum, our studies show that in addition to having the previously documented benefits on subjective well-being, mindfulness improves decision making through increasing resistance to the sunk-cost bias.

Author Contributions

A. C. Hafenbrack developed the study concept under the guidance of Z. Kinias and S. G. Barsade. A. C. Hafenbrack and Z. Kinias performed data analysis and interpretation. A. C. Hafenbrack and S. G. Barsade drafted the manuscript, and Z. Kinias provided critical revisions. All authors were involved in study design and data collection and approved the final version of the manuscript for submission.

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Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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Notes

1. Except bootstrapping mediation tests in Study 3, which used two-tailed 95% confidence intervals. This more conservative test was preferable because we were testing competing causal models.
2. The reliability observed in this study is comparable to that reported by Bruine de Bruin et al. (2007) in their validation study ($\alpha = .540$).
3. This relationship was replicated in a separate online survey we conducted with a Mechanical Turk sample ($N = 130$, 58 men and 72 women; mean age = 33.44 years, $SD = 12.59$, age range = 18–65). This survey found a positive association between trait mindfulness ($\alpha = .887$) and resistance to the sunk-cost bias ($\alpha = .506$) that was of similar magnitude, $r = .193$, $p = .015$.
4. As did Arch and Craske (2006), we removed participants with asthma from analyses in our experiments because of the breathing issues related to asthma.

5. We focused on negative as opposed to positive affect because trait mindfulness is more strongly correlated with negative affect than positive affect (Brown & Ryan, 2003, Study 4). This may be the case because positive affect is more related to social factors, whereas negative affect is more consistently related to intrapsychic processes (e.g., stress; McIntyre, Watson, Clark, & Cross, 1991; Watson, Clark, McIntyre, & Hamaker, 1992), which could be more readily influenced by mindfulness meditation.
6. All bootstrapping mediation tests used 5,000 resamples.

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