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Mindfulness and decision-making: Sunk-costs or escalation of commitment?

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Abstract

Mindfulness is related to a number of positive health outcomes, such as decreased stress, anxiety and improved physical functioning. Recent studies have found that mindfulness is related to a range of cognitive outcomes, including better decision-making. In one example, higher trait mindfulness and brief mindfulness inductions are associated with resistance to the influence of sunk-costs, where mindful individuals were more willing to discontinue a costly, but disadvantageous, course of action. However, some previous studies examining mindfulness and sunk-costs have methodological limitations which make it difficult to determine if mindfulness is specifically related to sensitivity to the sunk-cost bias, or rather than to a general willingness to continue an unprofitable course of action (independent of the level of prior investment). The present study extends previous work by replicating the finding that trait mindfulness is positively related to resistance to the effects of sunk-costs, and also demonstrates that mindfulness is related to reduced escalation of commitment, an individual's willingness to continue their commitment to an unprofitable course of action through the further investment of resources or time. Overall, trait mindfulness was most consistently related to reduced escalation of commitment, whereas the relationship between trait mindfulness and resistance to the effects of sunk-costs were less consistently observed.

Keywords: mindfulness, sunk-costs, decision-making, escalation

Mindfulness and decision-making: Sunk-costs or escalation of commitment?

Mindfulness, “the state of being attentive to and aware of what is taking place in the present” (Brown & Ryan, 2003, p. 822) has received increasing attention as a factor which may provide positive health benefits, and a number of studies have reported better psychological health in individuals who report high (compared to low) trait mindfulness (Arch & Craske, 2010; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Bowlin & Baer, 2012). Further, mindfulness-based stress reduction programs (which aim to increase an individual’s mindfulness) have also been found effective in improving mental and physical well-being, in both clinical and non-clinical samples (see meta-analyses by Baer, 2003; Bohlmeijer, Prenger, Taal, & Cuijpers, 2010; Grossman, Niemann, Schmidt, & Walach, 2004).

The benefits of mindfulness are presumed to be related to several separate skills that make up the construct, ranging from exposure to stress-eliciting stimuli, to the development of cognitive skills related to attention and cognitive control. As mindfulness is proposed to involve several cognitive skills, we might expect that mindfulness will have relationships to other cognitive skills beyond physical and psychological wellbeing. Supporting this view, a recent study by Anicha, Ode, Moeller, and Robinson (2012) found that the observing facet of mindfulness (assessed by the Five Facet Mindfulness Questionnaire, Baer et al., 2006) was associated with better perceptual abilities (in visual working memory and temporal judgment tasks) while the nonjudgmental facet of mindfulness was associated with better cognitive control in a Stoop task. Additionally, mindfulness has also been found to be associated with better creative problem solving (Ostafin & Kassman, 2012), more ethical decision-making (Ruedy & Schweitzer, 2010), more likely to stop a disadvantageous course of action (based on Hafenbrack, Kinias, & Barsade, 2014), and higher levels of grit (Raphiphatthana, Jose, & Salmon, 2018) among other relationships. While most of the relationships with mindfulness appear to predict beneficial outcomes, a brief mindfulness induction has also been found to increase susceptibility to false memories (Wilson, Mickes, Stolarz-Fantino, Evrard, & Fantino, 2015) and to be associated with reduced specificity in tests of autobiographical memory (Crawley, 2015). As research continues to identify how mindfulness may relate to dimensions beyond health, a precise understanding of the mechanisms by which mindfulness interacts with cognitive skills, such as decision-making, will be critical.

In one report, Hafenbrack, Kinias, and Barsade (2014) found that mindfulness was associated with improved decision-making, such that individuals with higher mindfulness (both on a trait measure of present moment awareness and following a brief mindfulness induction) were more likely to stop investing further resources or time in an unprofitable course of action. As such, the results of Hafenbrack and colleagues (2014) demonstrated that mindfulness is associated with improved decision-making, an effect which they interpreted as a reduction of the influence of sunk-costs (in which a person is more willing to continue to invest time and resources in an unprofitable course of action after significant, non-recoverable, investments of time/resources/etc., compared to situations in which individuals have not made a significant prior investment).

However, in the studies reported by Hafenbrack, Kinias, and Barsade (2014), participants' willingness to continue a course of action was measured using only situations which involved a single level of investment (of time or resources). For example, one of the measures used, the Resistance to Sunk Costs subscale of the Adult Decision Making Competence index (RSC, Bruine, Parker, & Fischhoff, 2007), presents ten scenarios in which participants imagine they have made an investment in a course of action which is no longer advantageous, and participants indicate their willingness to continue the course of action. One item from the Resistance to Sunk Costs subscale reads: *"After a large meal at a restaurant, you order a big dessert with chocolate and ice cream. After a few bites you find you are full and you would rather not eat any more of it. Would you be more likely to eat more or to stop eating it?"* Participants who indicate their willingness to continue eating are judged by this measure to be susceptible to the sunk-cost bias. However, if a person would be equally willing to continue eating even if the dessert had been free (and requiring no meaningful investment on the part of the individual), then an individual's sensitivity to sunk-costs would not be assessed by this item.

Rather than sunk-costs, responses to questions of this type are better measures of *escalation of commitment*: an individual's willingness to continue or increase their allocation of resources (e.g. funds, time) to a course of action which is no longer advantageous (Staw, 1981). Staw introduced the problem as follows: "It is commonly expected that individuals will reverse decisions or change behaviors which result in negative consequences. Yet, within investment decision contexts, negative consequences may actually cause decision makers to increase the

commitment of resources and undergo the risk of further negative consequences” (Staw, 1976, p. 27).

Escalation of commitment to a course of action has been shown to be sensitive to increased sunk-costs (Arkes & Blumer, 1985). However, other factors can also influence escalation or moderate the impact of sunk-costs on escalation (for a review, see the meta-analysis by Sleesman, Conlon, McNamara, & Miles, 2012). Some factors which impact escalation of commitment include how far a project is from completion (Boehne & Paese, 2000; Garland & Conlon, 1998), whether an individual feels personally responsible for initiating the course of action (Staw, 1976), and norms for consistency in decision-making (Staw & Ross, 1980). Research has also found that escalation of commitment in investment decisions is reduced when motivations for promotion and growth are activated (Molden & Hui, 2011) and following ego-depletion (Lee, Keil, & Wong, 2018).

To determine if the relationship between mindfulness and reduced escalation observed in previous research is due specifically to a reduced susceptibility to sunk-costs, it is important to also compare behavior under conditions in which the level of prior investment is manipulated (to compare escalation under both low and high prior investment). While it is possible that mindfulness reduces escalation by reducing an individual’s sensitivity to sunk-costs (and thus impacting escalation specifically under conditions of high prior investment), it is equally possible that more mindful individuals are less willing to escalate in general, independent of the level of prior investment. For this reason, the present study examined the relationship of mindfulness both to escalation of commitment and to resistance to the influence of sunk-costs on escalation.

In the studies described below, I attempted to replicate the findings of Hafenbrack, Kinias, & Barsade (2014) from Study 1, which demonstrated a correlation between trait mindfulness and resistance to sunk-costs. And, I also attempted to replicate their Studies 2a, 2b and 3, which demonstrated that a 15-minute mindfulness exercise decreased participants’ susceptibility to sunk-costs, compared to a mindwandering control condition. To assess the relationships of mindfulness to both escalation of commitment and resistance to sunk-costs, I also included additional measures of escalation of commitment in which the level of prior investment was manipulated. The data presented here in Studies 1 and 2 were previously posted in an online archive of replication studies (Schmitzer-Torbert, 2014).

I hypothesized that high mindfulness (on trait measures and following a brief mindfulness induction) would be related to reduced escalation of commitment (e.g. that participants would be less willing overall to continue to commit to an unprofitable course of action) and also better resistance to the influence of sunk-costs on escalation.

Study 1

Hafenbrack, Kinias, & Barsade (Study 1, 2014) obtained a positive correlation between trait mindfulness, assessed by the Mindful Awareness Attention Scale (MAAS, which focuses on present-moment awareness, Brown & Ryan, 2003) and resistance to sunk-costs, assessed using the Resistance to Sunk Costs subscale of the Adult Decision Making Competence index (RSC, Bruine et al., 2007). Unlike some other measures of sunk-costs (e.g. Arkes & Blumer, 1985), the Resistance to Sunk Costs subscale does not directly compare a participant's continuing a course of action under conditions of low and high investment. Instead, the Resistance to Sunk Costs subscale presents ten hypothetical situations, all involving a different type of prior investment, and participants indicate how likely they are to continue a course of action that is presented to be currently disadvantageous. Participants who indicate they are likely to change their course of action are considered to demonstrate resistance to sunk-costs. However, without a comparison condition (in which situations are used that do not involve high prior investment) it is difficult to determine if the responses to the Resistance to Sunk Costs subscale specifically involve sunk-costs rather than escalation of commitment in general.

For that reason, I used in Study 1 a different self-report measure of sunk-costs developed by Strough, Schlosnagle, Karns, Lemaster, and Pichayayothin (2014), referred to in this report as the Sunk-cost Fallacy Questionnaire (SCFQ). The SCFQ presents eight scenarios, with either a no/low-investment framing (*"You have been working on a project related to one of your hobbies for hardly any time at all. Lately, you have lost interest in the project. Whenever you work on the project, you are bored and wish that you were doing something else."*) and with a high-investment framing (*"You have been working on a project related to one of your hobbies a very long time ..."*). For each scenario, participants selected one of six response options, ranging from completely discontinuing the behavior to completely continuing the behavior (e.g., for the hobby scenario, response options were: *stop working on the project immediately, wait for a couple of weeks to see if interest in the project increases, wait for a month or two to see if interest in the*

project increases, wait for six months to see if interest in the project increases, remain committed to the project). Participants complete both versions of each scenario, and those who indicate they would be more willing to continue a behavior after making a high investment (of time or resources) compared to no- or low-investment, are considered to be susceptible to the sunk-cost fallacy. Under both investment frames, the participant has an opportunity for escalation, in which they can “throw good money after bad” by continuing to invest their time in a hobby they no longer enjoy. This format allows for the separate estimation of individual differences in escalation (by comparing how likely a person is to continue a behavior independent of investment) and sensitivity to sunk-costs (by comparing the high-investment frame to the low-investment frame).

Using the SCFQ, I conducted a cross-sectional study of the relationship between trait mindfulness, escalation of commitment and sunk-cost bias. I expected that MAAS scores would be negatively related to the sunk-cost bias (based on Hafenbrack et al., 2014). Additionally, based on an examination of the items which comprise the Resistance to Sunk Costs subscale, I predicted that trait mindfulness would be negatively correlated to escalation of commitment (measured as the general willingness of the participant to continue a disadvantageous course of action in the SCFQ scenarios).

Method

Participants. A total of 150 (55 female) participants were recruited from Amazon’s mTurk service (<http://mturk.com>). The majority of participants identified themselves as White (72.5%), with 12.1% identifying as African-American/Black, 6.7% as Asian, 3.4% as Hispanic or Latino, and the remaining 5.3% selecting another option. The target sample size was based on Study 1 in Hafenbrack, Kinias and Barsade (2014). The average age reported by participants was 35.9 years ($SD = 12.3$, range = 20-71). Participants were paid \$1 USD for completing the surveys, and eligibility was limited to mTurk workers in the United States who had a previous approval rating (for mTurk assignments) of at least 95%. The study was approved by the Wabash College Institutional Research Board.

Procedure. After accepting the assignment through the mTurk website, participants were directed to an online survey (administered through SurveyMonkey, www.surveymonkey.com), where they completed the Mindful Awareness Attention Scale (MAAS), the Rosenberg self-

esteem scale (SE), and the Sunk-cost Fallacy Questionnaire (from Study 3 in Strough et al., 2014). The Sunk-cost Fallacy Questionnaire includes eight scenarios, each of which are presented twice: once under conditions of high-investment, and once under conditions of low/no-investment.

In order, participants completed the MAAS, the SCFQ scenarios (4 presented with the high-investment framing language, and 4 presented with the low/no-investment framing language), the Rosenberg self-esteem scale (SE), a filler questionnaire measuring aggressive perceptions of actions (created as part of a class activity for an undergraduate research methodology course), and then the SCFQ scenarios for a second time (with the alternate wording for each scenario), ending with demographic information (gender, age, and ethnicity).

As in Strough et al. (2014), sunk-cost fallacy scores (SCF) were calculated by scoring each scenario as a 1 if participants indicated they would continue a course of action longer under conditions of high investment (compared to low/no-investment), and as a 0 otherwise, and summing across all eight scenarios.

Across participants, willingness to continue a disadvantageous course of action in the SCFQ scenarios was very stable across the no/low- and high-investment framing (the correlation across participants between the averages for each frame was $r(148) = 0.84$, $p < 0.001$). Therefore, the participants' average rating across the sixteen SCFQ scenarios (including both the no/low- and high investment framing) was used as a measure of escalation of commitment.

Scale reliabilities were assessed using Cronbach's α , and were acceptably high for most measures: MAAS ($\alpha = 0.92$), SE ($\alpha = 0.94$), and SCFQ ($\alpha = 0.86$, measured across all 16 scenarios/investments).

Data used in the analyses presented here are available online at <https://osf.io/ty7rw/>.

Results and Discussion

Based on findings of Hafenbrack et al. (2014), I expected that MAAS scores would be negatively correlated with SCF scores, but this was not the case ($r(148) = -0.06$, $p = 0.46$, see Table 1). Participants did show the sunk-cost effect: average ratings for scenarios presented with a high investment framing ($M = 2.43$, $SD = 0.75$) were higher than ratings for scenarios presented with a low/no-investment framing ($M = 2.18$, $SD = 0.72$), a difference which was significant ($t(149) = 7.3$, $p < 0.001$, 95% CI for the difference = 0.18, 0.32). The average SCF

score was 1.70 (95% CI = 1.44, 1.96), indicating that participants did tend to show a sunk-cost bias (rating 1-2 of the eight scenarios on average more highly when presented in the high-investment frame). While not correlated with the SCF scores, MAAS scores did tend to be negatively correlated with the responses to the sunk-cost questionnaire ($Sunk_{average}$, $r(148) = -0.157$, $p = 0.056$). SCF scores were not correlated with any other measure, except the aggression survey included as a filler ($r(148) = -0.19$, $p = 0.023$). As expected, based on the results of Hafenbrack et al. (2014), MAAS scores were significantly correlated with SE ($r(148) = 0.45$, $p < 0.001$) and age ($r(148) = 0.26$, $p = 0.001$).

The results of Study 1 did not find a relationship between trait mindfulness and susceptibility to the sunk-cost bias, as had been expected based on the findings of Hafenbrack, Kinias & Barsade (2014). However, in Study 1, trait mindfulness tended to be negatively correlated with responses to the SCFQ scenarios (across the two levels of prior investment). These results indicate that participants who were high in trait mindfulness were somewhat more likely to resist escalation of commitment to a disadvantageous course of action.

While the results of Study 1 did not find a significant correlation between MAAS and SCF scores, it may be the case that the Resistance to Sunk Costs subscale (which assesses an individual's willingness to continue or change a behavior only under conditions of high-investment) used by Hafenbrack, Kinias and Barsade is also assessing escalation of commitment, rather than susceptibility to sunk-costs. If so, then the results of Study 1 could be interpreted as consistent with the findings presented by Hafenbrack, Kinias & Barsade (2014). However, since the Resistance to Sunk Costs subscale was not included in the present study, I was unable to test this hypothesis, and a second study was conducted to address this concern.

Study 2

To more directly replicate Study 1 of Hafenbrack, Kinias & Barsade (2014), I conducted a second cross-sectional study, using the same measures as in Study 1 and also including the Resistance to Sunk Costs subscale of the Adult Decision Making Competence index (RSC, Bruine et al., 2007). Also, items from the Sunk-cost Fallacy Questionnaire (SCFQ) were presented again in two sets, but for this experiment each set included either all of the high-investment versions, or all of the low/no-investment versions, so that participants were presented with only one level of investment in each set of scenarios. As in Study 1, I hypothesized that if

mindfulness is related to increased resistance to sunk-costs, mindfulness would be negatively related to sunk-cost fallacy scores derived from the SCFQ. Additionally, I expected that mindfulness would be related to reduced escalation of commitment on the SCFQ items. Finally, based on an examination of the items on the RSC, I expected that scores on the RSC would be better related to escalation of commitment than to the influence of sunk-costs specifically. So, I expected that score on the RSC would be more strongly correlated to average scores on the SCFQ items (under both high- and no/low-investment framing) than to sunk-cost fallacy scores.

Method

Participants. Participants were recruited from an all-male undergraduate private liberal arts college ($n = 29$) and from Amazon mTurk ($n = 173$ [66 females]). The undergraduate sample size was limited by the size of the Psychology Department participant pool. For the undergraduate sample, the average age was 19.2 years ($SD = 0.98$, range = 18-22 years), while for the mTurk participants, the average age was 33.0 years ($SD = 11.5$, range = 18-74). The majority of participants identified themselves as White (77.7%), with 6.9% identifying as African-American/Black, 4% as Asian, 6% as Mexican, Hispanic or Latino, and the remaining 5.4% selecting another option. Participants recruited from mTurk were paid \$1 USD for completing the surveys, and eligibility was limited to mTurk workers in the United States, and who had a previous approval rating (for mTurk assignments) of at least 95%, and who had not participated in Study 1. Undergraduate participants received course credit for participation, and were recruited by email advertisement to the Psychology Department participant pool.

Procedure. As in Study 1, survey measures were administered through an online survey created using SurveyMonkey. In order, participants completed the Resistance to Sunk Costs subscale of the Adult Decision Making Competence index (RSC, Bruine et al., 2007), the Mindful Awareness Attention Scale (MAAS), the eight scenarios from the Sunk-cost Fallacy Questionnaire (SCFQ, presented in no/low-investment or high-investment framing), the Rosenberg self-esteem scale (SE), the filler aggression survey used in Study 1, and the eight scenarios from the Sunk-cost Fallacy Questionnaire (presented with the alternate framing), ending with demographic information (gender, age and ethnicity).

Sunk-cost fallacy scores (SCF) and average willingness to continue a disadvantageous course of action ($Sunk_{average}$) were calculated for the SCFQ as in Study 1. Scale reliabilities in

Study 2 were: MAAS ($\alpha = 0.92$), RSC ($\alpha = 0.42$), SE ($\alpha = 0.94$), and SCFQ ($\alpha = 0.88$, measured across all 16 scenarios/investments). While the internal consistency of the RSC was low, the Cronbach's α obtained was consistent with that reported in the original study by Bruine, Parker & Fischhoff (2007) and with the results reported by Hafenbrack, Kinias and Barsade (2014).

Analysis. Simple mediation analyses were conducted in SPSS using the syntax provided by Preacher and Hayes (2004). Bootstrapped 95% confidence intervals are reported for the indirect effect, based on 5,000 resamples.

Results and Discussion

Results from this survey replicated the findings reported by Hafenbrack, Kinias and Barsade (Study 1, 2014). MAAS scores were significantly correlated with RSC, SE, and age (see Table 1). Following Hafenbrack and colleagues, a linear regression was conducted, predicting RSC scores with MAAS, age, gender and self-esteem (SE) scores entered as independent predictors. The regression explained 10.5% of the variance in resistance to sunk-costs ($R^2 = 0.105$, $F(4, 201) = 5.8$, $p < 0.001$). In the regression, MAAS ($\beta = 0.246$, $p = 0.001$) and age ($\beta = 0.163$, $p = 0.029$) were both significant predictors while gender ($\beta = -0.013$, $p = 0.859$) and SE ($\beta = -0.025$, $p = 0.729$) were not, consistent with the report by Hafenbrack, Kinias and Barsade (2014).

In this sample, MAAS and SCF scores were also significantly correlated ($r(200) = -0.14$, $p = 0.042$), and MAAS scores were significantly correlated with escalation of commitment: participants with higher trait mindfulness scores were less willing to continue a course of action across the SCFQ scenarios (Sunk_{average}: $r(200) = -0.28$, $p < 0.001$). These results indicate that using a separate measure of sunk-costs, higher trait mindfulness is associated with resistance to sunk-costs (lower SCF scores) and reduced escalation of commitment (lower Sunk_{average} scores). To further assess the relationship between MAAS and SCF scores independent of escalation of commitment, a separate linear regression was conducted using SCF scores as the dependent variable, and using MAAS, age, gender, self-esteem (SE), and Sunk_{average} as predictors. The regression explained 5.1% of the variance in SCF scores ($F(5, 196) = 2.1$, $p = 0.067$), and only age ($\beta = -0.155$, $p = 0.046$) was significantly associated with weaker sunk-cost fallacy scores, while MAAS ($\beta = -0.13$, $p = 0.099$), Sunk_{average} ($\beta = 0.044$, $p = 0.56$), gender ($\beta = -0.05$, $p = 0.50$) and SE ($\beta = 0.11$, $p = 0.16$) were not. These results indicate that while there was a significant

bivariate correlation between MAAS and SCF scores, the relationship was not significant in this sample after controlling for $\text{Sunk}_{\text{average}}$ and the other predictors used in the model for RSC scores.

Interestingly, the relationship between the Resistance to Sunk Costs subscale (RSC) and sunk-cost fallacy scores (SCF) scores was also in the predicted direction (if the RSC is considered to be a measure of susceptibility to sunk-costs), but the two measures were not strongly related ($r(200) = -0.13$, $p = 0.074$), and RSC scores were better related to participants' willingness to continue a course of action ($\text{Sunk}_{\text{average}}$: $r(200) = -0.39$, $p < 0.001$). These relationships are reasonable, however, as the questions on the Resistance to Sunk Costs subscale are all framed in terms of a high prior investment, and scores likely reflect willingness to continue a course of action, more so than resistance to the effect of sunk-costs specifically. Supporting this interpretation, analysis of a simple mediation models (summarized in Figure 1) revealed that the relationship between MAAS and RSC was partially mediated by $\text{Sunk}_{\text{average}}$ (Sobel test: $z = 3.2$, $p = 0.0016$, bootstrapped 95% CI for the indirect effect = 0.028, 0.12), while a separate analysis found no evidence of an indirect effect of SCF scores in mediating the relationship between MAAS and RSC (Sobel test: $z = 1.0$, $p = 0.326$, bootstrapped 95% CI for the indirect effect = -0.0038, 0.032).

As in Study 1, participants did show a sunk-cost effect as assessed by the Sunk-cost Fallacy Questionnaire: average ratings for scenarios presented with a high prior investment frame ($M = 2.47$, $SD = 0.75$) were higher than ratings for scenarios presented with a low/no-investment frame ($M = 2.11$, $SD = 0.74$), a difference which was significant ($t(201) = 10.1$, $p < 0.001$, 95% CI for the difference = 0.29, 0.43), and the average SCF score was 2.44 (95% CI = 2.18, 2.71). These results indicate that participants did tend to show a sunk-cost bias, and on average rated 2-3 scenarios more highly when presented in the high-investment frame.

Together, these results directly replicate the findings of Study 1 of Hafenbrack, Kinias, and Barsade (2014), demonstrating a positive correlation between the Resistance to Sunk Costs subscale and trait mindfulness, and extend this work by demonstrating a correlation between mindfulness and a separate measure of sunk-costs (SCF scores, Strough et al., 2014). However, scores on the Resistance to Sunk Costs subscale may be better related to escalation of commitment to a course of action in general ($\text{Sunk}_{\text{average}}$), rather than to an individual's resistance to sunk-costs specifically (SCF scores). The results of Studies 1 and 2 indicate that trait mindfulness is related to reduced escalation of commitment (independent of the level of prior

investment), as seen in the negative correlations of trait mindfulness to $Sunk_{average}$ and to the Resistance to Sunk Costs subscale. Together, these results indicate that more mindful individuals show reduced escalation of commitment, and also resistance to the sunk-cost bias.

Study 3

Results from Study 2 replicated the finding by Hafenbrack, Kinias and Barsade (2014) demonstrating that individual differences in trait mindfulness predict tendencies to escalate commitment to a course of action, and some evidence was found that mindfulness may specifically be related to susceptibility to sunk-costs. To determine if similar relationships hold for changes in state mindfulness, I attempted in Study 3 to replicate the findings of Hafenbrack, Kinias and Barsade (see Studies 2a, 2b and 3, 2014) who reported that short-term manipulations of mindfulness also decreased susceptibility to sunk-costs. In Studies 2a and 2b, Hafenbrack and colleagues used a different measure of sunk-costs (the printing press and airplane scenarios from Arkes & Blumer, 1985), while in Study 3, Hafenbrack and colleagues used the Resisting Sunk Costs subscale.

While the results reported by Hafenbrack and colleagues demonstrated a clear effect of mindfulness (comparing participants who listened to a 15-minute mindfulness induction to participants who listened to a 15-minute mindwandering control), their results again seem best interpreted as an effect of mindfulness to reduce escalation of commitment to a course of action. In those studies, participants were presented with hypothetical investment scenarios, each of which was presented to all participants under conditions of high investment (having recently spent a large amount of money on a printing press, or on a research program to develop a new airplane). Participants in the mindful condition were more likely to make optimal decisions (to purchase a superior printing press, or to stop investing research money in an airplane after learning that a competing company had already completed a similar product) compared to participants in the mindwandering condition. However, since the level of prior investment was not manipulated in the study, it is not clear if the mindfulness induction specifically decreased participants' susceptibility to sunk-costs.

To replicate the findings of Studies 2a, 2b and 3 of Hafenbrack et al. (2014), I conducted an experiment to test participants on the printing press and airplane scenarios of Arkes and Blumer (1985) after listening to a 15-minute mindfulness or mindwandering audio files (courtesy

of A. Hafenbrack). To test the effect of the mindfulness induction on sunk-costs directly, participants were then presented with either the high- or low-investment version of the two scenarios taken from the original study by Arkes and Blumer (1985). Participants also completed the measures used in Study 2 (the Resistance to Sunk Costs subscale, Mindful Awareness Attention Scale, and Sunk-cost Fallacy Questionnaire). Also, one limitation of Studies 1 and 2 (and the original study by Hafenbrack, Kinias and Barsade) is that the primary measure of trait mindfulness used (the MAAS) is primarily composed of items that assess awareness of one's experience in the present moment. To better assess mindfulness in general, participants in Study 3 also completed another measure of mindfulness, the Five Facet Mindfulness Questionnaire (FFMQ, Baer, 2003). My hypotheses were that participants in the mindful audio condition (compared to the mindwandering control) would report higher state mindfulness, make more optimal decisions for each scenario, and report less escalation of commitment (on the SCFQ and RSC). If state mindfulness successfully reduced the impact of sunk-costs, I expected that the effect of the audio condition would be significantly larger when scenarios were presented with a high-investment frame (for the printing press and airplane scenarios, and in the sunk-cost fallacy scores from the SCFQ).

In a small pilot ($n = 44$ undergraduate males, tested in person), no effect of the brief mindfulness induction was found on state mindfulness (as assessed by the manipulation check) or decision-making. However, an error in administration of one measure, the SCFQ, prevented direct comparison to Studies 1 and 2. In light of the small sample size and methodological error, I recruited a larger online sample for Study 3 from Amazon's Mechanical Turk service. Results from the Study 3 pilot are consistent with those of the mTurk sample, and are included in the Electronic Supplementary Material.

Method

Participants. A total of 197 participants were recruited from Amazon's mTurk service. Participants were paid \$3.25 USD for completing the experiment, and eligibility was limited to mTurk workers in the United States who had a previous approval rating (for mTurk assignments) of at least 95%. One participant was excluded from analyses for potentially careless responding (answering with the same response option to every item of several survey measures). The average age reported by the remaining 196 participants (95 female) was 32.9 years ($SD = 10.0$,

range = 18-68). The majority of participants identified themselves as White (77%), with 7.1 % identifying as African-American/Black, 7.1% as Asian, 7.1% as Mexican, Hispanic or Latino, and the remaining 1.7% selecting another option.

Procedure. After providing informed consent, participants were randomly assigned to an to listen to a short (15 minute) audio file, and intended to stimulate mindfulness or mindwandering. The audio files used for this brief mindfulness induction and control condition were the same as those used by Hafenbrack, Kinias and Barsade (2014), and are available online (<http://www.andyhafenbrack.com/inductions.html>). The selected audio clip was presented through a web page which was designed such that the audio file would pause if the web page lost focus (e.g. if the participant left the web page, or switched to any other program on the computer).

After the audio file completed, participants were directed automatically to the start of a set of online surveys, administered using SurveyMonkey. The surveys included several measures used in the original study by Hafenbrack, Kinias and Barsade (2014), including the Mindful Awareness Attention Scale (MAAS), Resistance to Sunk Costs subscale (RSC) and hypothetical scenarios involving sunk-costs (the printing press and airplane scenarios presented by Arkes & Blumer, 1985) and the set of manipulation check questions used by Hafenbrack, Kinias and Barsade (in Studies 2a, 2b and 3). The surveys also included the Sunk-cost Fallacy Questionnaire (SCFQ), and the Five Facet Mindfulness Questionnaire (FFMQ, Baer, 2003).

Participants first completed the two scenarios (the printing press scenario, followed by the airplane scenario) from Arkes and Blumer (1985). For each participant, one scenario was presented with the high investment frame, and one with the low investment frame (with order of investment randomized across participants). Each participant received one version of each scenario (printing press and airplane), each presented in a different investment frame (one as a high investment, one as a low investment). As the two scenarios involved a substantially different level of prior investment (printing press versus airplane), between-subject analyses of the impact of framing (high or low prior investment) and mindfulness induction were conducted separately for each scenario.

Next, participants completed the mindfulness manipulation check based on the questions from Hafenbrack, Kinias and Barsade (2014), with the instructions “At this moment, please indicate the extent to which you are ...” and four items 1) focused on your breathing, 2) focused

on the physical sensations of breathing, 3) in touch with your body, and 4) absorbed in the present moment, rated on a five point scale (1 = very slightly or not at all to 5 = extremely). Following Hafenbrack, Kinias and Barsade (2014), the first three manipulation check questions were averaged to produce a single measure, while the fourth question was examined separately as a second manipulation check measure.

The Resistance to Sunk Costs subscale (RSC) was presented next, followed by the Mindful Awareness Attention Scale (MAAS), the first part of the Sunk-cost Fallacy Questionnaire (SCFQ, with 4 items presented under no/low-investment framing, and 4 presented on a separate page using the high-investment framing, and the order of investment counterbalanced), the Five Facet Mindfulness Questionnaire (FFMQ), and then the second part of the SCFQ (with the 8 items presented with the alternate investment framing, presented on two separate pages), and ending with demographic information (gender, age and ethnicity). Scale reliabilities were acceptably high for most measures, MAAS ($\alpha = 0.91$), RSC ($\alpha = 0.55$, similar to results of Studies 2 and 3), SCFQ ($\alpha = 0.90$, measured across all 16 scenarios/investments), FFMQ ($\alpha > 0.83$ for all subscales).

Results

I expected that participants presented with the mindfulness audio file would score significantly higher than the mindwandering audio file on the manipulation check, and would be more resistant to sunk-costs (as measured by the printing press and airplane scenarios) and have higher scores on the RSC scale. However, the mindfulness manipulation was unsuccessful. For the first manipulation check measure (items 1-3), the Mindful group ($M = 3.32$, $SD = 1.09$) did have higher scores than the Mindwandering group ($M = 3.07$, $SD = 1.21$) but this difference did not reach significance ($t(195) = 1.5$, $p = 0.13$, 95% CI for the difference = -0.08, 0.57). The second manipulation check measure (item 4) did also not differ between groups (Mindful: $M = 3.93$, $SD = 1.01$, Mindwandering: $M = 4.03$, $SD = 0.96$, $t(195) = -0.73$, $p = 0.46$, 95% CI for the difference = -0.38, 0.17). However, while the manipulation check failed, I did find that scores for the RSC survey were significantly higher ($t(195) = 2.59$, $p = 0.01$, $d = .36$, 95% CI for the difference = 0.06, 0.45) in the Mindful ($M = 4.42$, $SD = 0.68$) compared to the Mindwandering ($M = 4.17$, $SD = 0.70$) group.

While the brief mindfulness manipulation was not successful, an analysis was conducted to determine if choices on the scenarios presented from Arkes and Blumer (1985) were sensitive to the level of investment (to determine if participants demonstrated a sunk-cost bias) and to the mindfulness condition. As predicted, fewer participants made an optimal choice (purchasing a superior printing press, or refraining from investing company money in an inferior airplane) in the high-investment frame (Printing press: 71/96, 74%, Airplane: 34/95, 36%) compared to the low-investment frame (Printing press: 87/102, 86%, Airplane: 86/102, 84%), and these differences were significant for both scenarios (Printing press: $\chi^2(1) = 4.6$, $p = 0.03$, $\Phi = -0.21$, Airplane: $\chi^2(1) = 48.6$, $p < 0.001$, $\Phi = -0.50$).

Consistent with the failure of the audio manipulation to influence the measures of state mindfulness, no effect of audio condition was found on choices in either the printing press or airplane scenario. Examining each group separately, both groups made optimal choices at similar rates when a low investment framing was used for the printing press (Mindful: 39/46, 85%, Mindwandering: 48/55, 87%) and the airplane (Mindful: 41/46, 89%, Mindwandering: 45/56, 80%) scenarios. Similar results were found for the high-investment framing (which was the version used by Hafenbrack et al., 2014) for the printing press (Mindful: 38/49, 78%, Mindwandering: 33/47, 70%) and airplane (Mindful: 17/49, 35%, Mindwandering: 17/46, 37%) scenarios. There was no evidence that the Mindful group was more likely to make an optimal choice than the Mindwandering group for either scenario presented under high-investment (Printing press: $\chi^2(1) = 0.67$, $p = 0.41$, $\Phi = -0.08$, Airplane: $\chi^2(1) = 0.05$, $p = 0.82$, $\Phi = 0.02$).

While there was no effect of the brief mindfulness intervention on sunk-costs, this result does not necessarily contradict the theory that brief mindfulness inductions improve decision-making and reduce sunk-costs (since the intervention was not successful in increasing state mindfulness, as measured by the manipulation check). Therefore, these results were not able to test the main hypothesis for the replication (that increased mindfulness following an audio intervention would reduce sunk-costs). However, the results of Hafenbrack et al.'s (2014) Study 3 did replicate in the present study in that participants in the mindfulness condition exhibited higher scores on the Resisting Sunk Costs subscale (RSC) scale than those in the mindwandering condition.

To determine if the results from Study 3 replicated findings from Studies 1 and 2, relating trait mindfulness to escalation of commitment and resistance to sunk-costs, I next examined the

correlations between scores on measures of sunk-costs (the Resisting Sunk Cost subscale and the Sunk-cost Fallacy Questionnaire, including the average response to the items and the sunk-cost fallacy scores derived the questionnaire) and measures of mindfulness (MAAS, and FFMQ subscales). As expected, the Resisting Sunk Costs subscale (RSC) scores were significantly correlated with MAAS scores ($r(194) = 0.19, p = 0.008$) and age ($r(194) = 0.18, p = 0.011$, see Table 2). RSC scores were also significantly positively correlated with several subscales of the FFMQ (Describe: $r(194) = 0.23, p = 0.001$, Non-judgmental: $r(194) = 0.19, p = 0.006$ and Non-reactive: $r(194) = 0.24, p = 0.001$). Similar to Study 2, RSC scores were negatively correlated with the $\text{Sunk}_{\text{average}}$ ($r(194) = -0.25, p = 0.001$), but were not correlated with SCF scores ($r(194) = -0.07, p = 0.36$) in this sample. However, in this sample, MAAS scores were not correlated with either $\text{Sunk}_{\text{average}}$ nor with SCF scores (both $|rs| < 0.06$), though from the FFMQ, $\text{Sunk}_{\text{average}}$ were negatively correlated with the Non-judgmental subscale. These results are largely consistent with Studies 1 and 2, indicating that trait mindfulness is positively related to the RSC measure, but less strongly related to the sunk-cost bias (measured by SCF scores on the SCFQ).

As in Study 2, it appears that responses to the Resisting Sunk Costs subscale (RSC) relates better to escalation of commitment than resistance to sunk-costs. However, in this sample, measures of trait mindfulness appear better related to escalation of commitment ($\text{Sunk}_{\text{average}}$) than to susceptibility to the sunk-cost bias (SCF scores), as assessed by the SCFQ.

While SCF scores were not strongly related to trait mindfulness or the RSC in this sample, participants did show a sunk-cost effect on the SCFQ: average ratings for scenarios presented with high investment framing ($M = 2.41, SD = 0.76$) were higher than ratings for scenarios presented with a low/no-investment framing ($M = 2.01, SD = 0.76$), a difference which was significant ($t(195) = 10.4, p < 0.001$, 95% CI for the difference = 0.32, 0.48), and the average SCF score was 2.62 (95% CI = 2.32, 2.92). These results indicate that participants did tend to show a sunk-cost bias, and on average rated 2-3 of the eight scenarios more highly when presented in the high-investment frame.

As several of the relationships between mindfulness (MAAS) and decision-making (the RSC and SCFQ measures) were observed inconsistently across the present studies, a mini meta-analysis (Goh, Hall, & Rosenthal, 2016) was conducted to estimate the size of the correlations between the primary measure of mindfulness (the MAAS) and the measures of sunk-costs (the RSC and Sunk-cost Fallacy Questionnaire) using a random-effects model (Borenstein, Hedges,

Higgins, & Rothstein, 2009), calculated using Excel. This model was used to estimate the size of the correlation between each pair of measures and also the 95% confidence interval for the correlation. For each correlation and confidence interval calculated, data was used from each of the samples tested in Studies 1 through 3, and including the Study 3 pilot (and each measure included data from 2 or 3 of the samples as not all measures were used in each experiment). Results including the SCFQ measures (SFC and $\text{Sunk}_{\text{average}}$) were not substantially changed if the Study 3 pilot was excluded.

From the random-effects model, the strongest effects were observed for the correlations between MAAS and two measures: the RSC ($r = 0.19$, 95% CI = 0.10, 0.29) and $\text{Sunk}_{\text{average}}$ ($r = -0.18$, 95% CI = -0.25, -0.10). A strong relationship was also observed between the RSC and $\text{Sunk}_{\text{average}}$ ($r = -0.27$, 95% CI = -0.36, -0.17). Weaker correlations were observed between the SCF scores and the MAAS ($r = -0.09$, 95% CI = -0.17, -0.001) and between the SCF scores and the RSC ($r = -0.07$, 95% CI = -0.17, 0.02). Overall, across the four samples tested, these results indicate that trait mindfulness is consistently related to the Resisting Sunk Costs subscale, but also to measures of escalation of commitment ($\text{Sunk}_{\text{average}}$, the average responses to the items from the Sunk-cost Fallacy Questionnaire). Relationships between trait mindfulness and a specific measure of the sensitivity of escalation of commitment to sunk-costs (SCF scores) were weaker, and less consistent, as was the relationship between the RSC and SCF scores.

General Discussion

The results of the three studies presented here largely replicate the findings of Hafenbrack, Kinias and Barsade (2014), who found a positive correlation between a trait mindfulness measure (MAAS, assessing present-moment awareness) and the Resisting Sunk Costs subscale of the Adult Decision Making Competence index (RSC, Bruine et al., 2007). Based on an examination of the items included in the RSC, and results presented here examining the relationship of mindfulness (assessed using the MAAS and the Five Facet Mindfulness Questionnaire, FFMQ, Baer, Smith, & Allen, 2004) to a separate measure of susceptibility to sunk-costs (Sunk-cost Fallacy Questionnaire, SFC, Strough et al., 2014), there appears to be a consistent relationship between higher trait mindfulness and a reduced willingness to escalate one's commitment to a disadvantageous course of action. However, the relationship between trait mindfulness and resistance to the influence of sunk-costs was weak and inconsistent across the

results of the four samples described here. Overall, these results indicate that higher trait mindfulness is associated with reduced escalation of commitment to a losing course of action, an effect which may only partially depend on a reduction in sensitivity to sunk-costs.

In the present study, I was unable to test a second set of hypotheses related to the results of Hafenbrack, Kinias and Barsade (2014), who found that state mindfulness was enhanced in participants after listening to a short (15-minute) mindfulness induction audio clip compared to a mindwandering control group, and that resistance to sunk-costs also improved significantly in their mindful participants. In two experiments (one pilot conducted in a research lab, with audio files presented using headphones, and one conducted using an online sample), I was unable to replicate the effect of the audio files on state mindfulness, using the same audio files and manipulation check measures as Hafenbrack, Kinias and Barsade (2014).

Both experiments described here using the brief mindfulness induction were limited in different ways, which may have contributed to the failure to replicate the effect of the mindfulness manipulation. Limited by our research pool, the pilot for Study 3 had a small sample size, but was conducted in a research lab where participants used headphones and researchers could verify the audio level presented to the participant. Study 3 was able to test a large sample recruited online, but while I took measures to ensure that the audio file would pause if the participant left the webpage before it completed, it may be the case that some participants muted the audio or were not attending to it during presentation. Future studies will be required to determine optimal conditions for brief interventions to manipulate state mindfulness, and to more fully determine if escalation of commitment and/or sunk-cost biases are reduced following brief mindfulness interventions. These results presented here in Study 3 do partially replicate Study 3 by Hafenbrack, Kinias and Barsade (2014), who found that RSC scores were increased in participants in the mindfulness audio condition, but given the failure of the manipulation check in the present study, this importance of this result for the replication is unclear.

As mindfulness research has expanded beyond psychological and physical health, the construct has been found to be associated with a range of other outcomes (Anicha et al., 2012; Hafenbrack et al., 2014; Ostafin & Kassman, 2012; Raphiphatthana et al., 2018; Ruedy & Schweitzer, 2010; Ruedy & Schweitzer, 2010), mostly beneficial (though see Crawley, 2015; Wilson et al., 2015). The present study adds to our understanding of the relationship between mindfulness and decision-making, and the relationship between trait mindfulness and reduced

escalation of commitment suggests that interventions targeting mindfulness for health reasons may also result in improved decision-making. Future research is required to determine the more specific mechanisms by which mindfulness impacts escalation of commitment, and the degree to which brief or long-term mindfulness interventions can also impact escalation of commitment and the influence of the sunk-cost bias in this relationship.

While the present study provides evidence that trait mindfulness is correlated with reduced escalation of commitment, the mechanisms underlying this relationship were not addressed directly in this work. However, Hafenbrack, Kinias and Barsade (2014) found that the impact of a brief mindfulness induction on the RSC was mediated by through increased focus on the present moment (rather than the future), leading to decreased negative affect, and a reduction in RSC scores. In a separate set of studies, Hafenbrack and Vohs (2018) found that mindfulness inductions reduced task motivation (without affecting performance) through decreased focus on the future, leading to decreased arousal. Similarly, Long and Christian (2015) demonstrated that both higher trait mindfulness and brief mindfulness inductions were associated with less retaliation after experiencing perceived injustice, and the effect of mindfulness was mediated through blunting of rumination and negative emotions stimulated by perceived injustice.

While negative affect was not assessed in the present study, results from Study 3 found that measures which appeared sensitive to escalation ($Sunk_{average}$ and the RSC) were both related to the Non-judging dimension of mindfulness from the Five Facet Mindfulness Questionnaire (Baer et al., 2006), which relates to not judging or criticizing feelings or thoughts, or criticizing oneself for having thoughts or feelings that might seem inappropriate or “bad”. The RSC was also correlated with the Non-reactive dimension of the FFMQ, which relates to one’s ability to be aware of emotions and feelings (especially negative, distressing ones) without reacting. Both dimensions relate to acceptance of one’s experience without judgment or automatic reactions, and these results are consistent with the work of Hafenbrack, Kinias and Barsade (2014), where the relationship between mindfulness and reduced willingness to continue a disadvantageous course of action was mediated by a reduction in negative affect.

Escalation of commitment is influenced by a range of factors (Sleesman et al., 2012), and the negative correlations with mindfulness presented here are likely to apply to situations in which escalation is enhanced when individuals experience negative affect. It is conceivable, however, that there are other situations in which mindfulness may not be related to escalation (if

negative affect is not involved), or where mindfulness could in fact produce an increase in escalation. For instance, Wong, Yik and Kwong (2006) demonstrated that escalation of commitment was negatively related to negative affect (state and trait), but only under conditions where participants were responsible for a prior decision. Trait negative affect was assessed using a neuroticism scale and as mindfulness is negatively correlated with trait neuroticism (Giluk, 2009). And, we might also expect that mindfulness would be negatively related to state negative affect in these tasks, we would predict that mindfulness would be positively related to escalation under conditions of high personal responsibility. This and similar studies would be beneficial in clarifying the mechanisms that relate mindfulness to decision-making in general, and identify under what conditions mindfulness could be associated with better or worse decisions, complementing the large body of work on the relationships between mindfulness and health.

Table 1

Correlations between survey measures in Studies 1 and 2.

Variables	1.	2.	3.	4.	5.	6.	7.
1. MAAS							
2. RSC							
Study 1	–						
Study 2	0.28**						
3. SCF							
Study 1	-0.06	–					
Study 2	-0.14*	-0.126					
4. Sunk _{average}							
Study 1	-0.16	–	0.12				
Study 2	-0.28**	-0.36**	-0.20**				
5. SE							
Study 1	0.45**	–	-0.06	0.06			
Study 2	0.39**	0.09	0.02	-0.16*			
6. Age							
Study 1	0.26**	–	-0.06	-0.13	0.10		
Study 2	0.27**	0.23**	-0.17*	-0.23**	0.13		
7. Gender							
Study 1	-0.03	–	-0.02	0.05	-0.02	-0.30**	
Study 2	-0.03	-0.07	0.017	0.16*	0.08	-0.31**	
8. Aggression							
Study 1	0.05	–	-0.19*	-0.10	0.04	0.12	-0.04
Study 2	-0.17*	-0.02	0.016	0.03	-0.01	0.13	-0.13

Measures in Study 1 were administered to 150 mTurk participants, and did not include the RSC. Measures in Study 2 were administered to 29 undergraduate males and 173 mTurk participants. MAAS = Mindful Awareness Attention Scale, RSC = Resisting Sunk Costs subscale, SCFQ = Sunk Cost Fallacy scores, Sunk_{average} = Average response to the Sunk-cost Fallacy Questionnaire scenarios, SE = Rosenberg Self-esteem Scale, Gender (coded as 1 = female, 2 = male), Aggression = filler questionnaire assessing attitudes toward aggression. * $p < 0.05$, ** $p < 0.01$

Table 2

Correlations between survey measures in Study 3.

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. MAAS											
2. RSC	0.19**										
3. SCF	-0.05	-0.07									
4. Sunk _{average}	-0.04	-0.25**	-0.01								
5. Observe	0.36**	0.09	0.07	0.01							
6. Describe	0.51**	0.23**	-0.07	-0.10	0.44**						
7. Act Aware	0.77**	0.13	-0.04	-0.07	0.29**	0.51**					
8. Non-judgmental	0.49**	0.19**	-0.02	-0.22**	0.05	0.41**	0.50**				
9. Non-reactive	0.38**	0.24**	0.02	0.00	0.45**	0.39**	0.28**	0.25**			
10. Audio	-0.10	0.19**	-0.01	0.03	-0.01	0.05	-0.16*	-0.09	-0.07		
11. Gender	-0.10	-0.04	0.04	0.05	-0.11	-0.14	-0.04	-0.10	0.05	-0.04	
12. Age	0.27**	0.18*	-0.19**	-0.09	0.11	0.32**	0.27**	0.21**	0.37**	-0.01	-0.20**

Measures in Study 3 were administered 196 mTurk participants. MAAS = Mindful Awareness Attention Scale, RSC = Resisting Sunk Costs subscale, SCFQ = Sunk-cost Fallacy scores, Sunk_{average} = Average response to the Sunk-cost Fallacy Questionnaire scenarios, Audio (coded as 0 = mindwandering, 1 = mindful), Gender (coded as 1 = female, 2 = male). Observe, Describe, Act Aware, Non-judgmental, Non-reactive = subscales of the Five Facet Mindfulness Questionnaire. * $p < 0.05$, ** $p < 0.01$

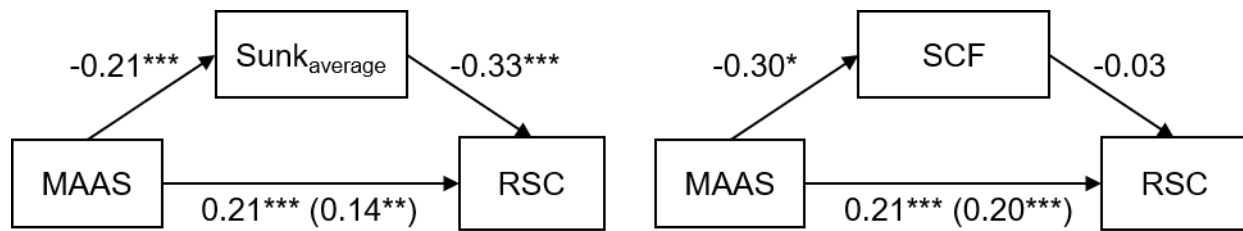


Figure 1. Standardized regression coefficients for the relationship between mindfulness (MAAS) and the Resistance to Sunk Costs subscale (RSC) as mediated by Sunk_{average} (left) and SCF (right) scores in Study 2. Standardized coefficients in parentheses indicate the relationship between MAAS and RSC after controlling for Sunk_{average} or SCF scores. Sobel tests indicated that the relationship between MAAS and RSC was partially mediated by Sunk_{average}, but not by SCF scores. *** $p \leq 0.001$, ** $p < 0.01$, * $p < 0.05$

Compliance with Ethical Standards

Funding: This study was funded by Wabash College.

Conflict of Interest: Neil Schmitzer-Torbert declares that he has no conflict of interest.

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants included in the study.

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