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ORIGINAL ARTICLE

Self-affirmation reduces uncertainty aversion for potential gains

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Abstract

Decisions about one's health are often accompanied by uncertain outcomes, which may be either positively or negatively valenced. The presence of this uncertainty, which can range along a continuum from risk to ambiguity (i.e., decisions in which the outcome probabilities are known or unknown), can be perceived as threatening, and individuals tend to be averse to uncertain outcomes, attempting to avoid uncertainty when possible. We proposed that one way to reduce uncertainty aversion could be to provide opportunities to affirm one's core values, or "self-affirmation." Prior research has suggested that self-affirmation promotes health behavior by providing a buffer against potential threats to the self. However, the degree to which self-affirmation affects decision making is still unclear. Across two studies, we tested the effects of a self-affirmation manipulation on risk (Study 1) and ambiguity (Study 2) preferences for both potential gains and losses. In both studies, we found that, compared to the non-affirmed group, affirmed individuals were more accepting of uncertainty when the decision involved potential gains, but not for potential losses. Furthermore, for risky decisions, the increased acceptance of uncertainty came at the expense of making choices consistent with the expected value, such that self-affirmed individuals made more disadvantageous choices than non-affirmed individuals. Our results suggest both benefits and costs of self-affirmation in the context of risky choice, an important finding has given the many applications of self-affirmation in behavioral decision-making contexts.

1 | INTRODUCTION

Folk wisdom reminds us that "better the devil you know than the devil you don't," and "One in the hand is better than two in the bush," suggesting a general aversion to the unknown. Typically, individuals prefer concrete information when making decisions, and often may eschew potential larger gains for the safety of a more certain option (Kahneman & Tversky, 1984). The presence of uncertainty, which can range along a continuum from risk to ambiguity (i.e., decisions in which the outcome probabilities are known or unknown; Knight, 1921), can often be perceived as threatening, and especially so when it is associated with decisions involving finances, health, and interpersonal relationships. When important information is missing from a decision context that could lead an individual to a more informed choice, it is believed to become exceptionally salient (Frisch & Baron,1988). This lack of information may pose a sense of threat (Damasio, 1994; Kahn & Sarin,1988), which individuals appear motivated to reduce (e.g., Slovic et al., 1982).

More broadly, uncertainty about a potential outcome is often perceived as an obstacle, or threat, to realizing long-term goals. People appear to be motivated to make decisions that are defensible to both themselves and others (Shafir et al., 1993), to the point that,

in the absence of sufficient justification, they often change their attitudes to better match their behaviors (Cooper, 2007). Notably, perceptions of threat often are met with self-defensiveness (Cohen & Sherman, 2014). It follows that uncertainty may promote defensiveness in support of pre-existing worldviews, which may preclude the ability to consider, compare, and evaluate new information, ideas, and perspectives (Liberman & Chaiken, 1992). In contrast, minimizing self-defensiveness should also affect one's tolerance for uncertainty, such that individuals should be more tolerant of uncertainty when one's self-defensiveness is low. The current study addresses this question by leveraging insights from self-affirmation theory (Steele, 1988), and applies them to behavioral decision-making research. A robust literature has found that self-affirming core values can reduce cognitive dissonance and defensiveness (Epton et al., 2015), However, it is less clear the degree to which self-affirmations can affect uncertainty-based decision making, both in terms of risky decision making (Study 1) and decision making under ambiguity (Study 2).

1.1 | Decision making under uncertainty: Risk versus ambiguity

Knight (1921) first described differences in decision making under uncertainty, ranging along a continuum between *decisions under risk* and *decisions under ambiguity*. At one end, decisions under risk involve choices in which the outcome contingencies (i.e., probability and outcome magnitude) of choices are known explicitly. For example, the classic hypothetical risky choice paradigm offers a decision maker a choice Option A, which offers a $100 win for certain, or Option B, which offers a 50% chance to win $200, otherwise win $0. With this choice, both options are equivalent with respect to the expected value (EV), suggesting there should be indifference between options. However, individuals typically select Option A, indicating a general tendency toward risk aversion when potential gains are at stake. In contrast, when faced with an equivalent choice involving potential losses (e.g., Option A: lose $100 for certain vs. Option B: 50% to lose $200, otherwise lose $0), individuals tend to choose the risky option (Kahneman & Tversky, 1979). As the EV of the risky choice becomes more favorable relative to the certain option, greater risk-seeking would be expected, though individuals still remain less risk-seeking than what EV calculations would prescribe, expressed as the concavity (or convexity in losses) in utility curves (i.e., marginal diminishing returns; (Kahneman & Tversky, 1979; von Neumann & Morganstern, 1947).

In contrast, decisions under ambiguity involve choices in which the outcome probability of at least one option is uncertain. Ellsberg's (1961) paradox demonstrated individuals' tendencies toward ambiguity aversion as a violation of EUT. Following Ellsberg's classic demonstration, an example of decision making under ambiguity may involve a choice between a chance to win $100 if a blue ball is drawn from an urn that contains 50 blue and 50 yellow balls, or to win $100 from an urn that contains an undisclosed proportion of yellow and blue balls. Although the quantity of blue balls in the latter option ranges from 1 to 99, decision makers tend to avoid the more ambiguous option, even when the probability of the known distribution is lower than 50% (e.g., Becker & Brownson, 1964; Curley & Yates, 1985; Slovic & Tversky, 1974). They are also willing to pay more to draw from the 50/50 urn (Becker & Brownson, 1964). Notably, effects become even stronger when the probabilities are believed to be known by other people, but not the decision maker, demonstrating the importance people place on being seen as effective and competent decision makers (Curley et al., 1986). When individuals feel incompetent in a choice domain, they tend to become more averse to both risk and ambiguity (Heath & Tversky, 1991; Klein et al., 2010).

Although seeking to reduce uncertainty may be a common strategy that can be beneficial for individuals, it can lead to irrational choices based on a normative standard (Ellsberg, 1961; Kahneman & Tversky, 1984). For instance, the overweighting of small probabilities can lead individuals to find both lotteries and insurance appealing. In contrast, the underweighting of probabilities that approach certainty can lead to excessive uncertainty aversion for choices between probabilistic and certain gains, and increased risk taking for choices between a probabilistic and certain loss (Tversky & Fox, 1995; Tversky & Kahneman, 1992). Similarly, individuals tend to choose options that completely eliminate the risk of only one of two aversive outcomes, rather than an equivalently distributed reduction of both risks (i.e., 0%–20% vs. 10%–10% risk; Slovic et al., 1982). This tendency toward uncertainty aversion suggests that uncertainty poses a perceived threat.

1.2 | Self-affirmation theory

One potential reason why uncertainty is threatening is that it poses a challenge to the self-concept and the goals that it tries to achieve in multiple domains (e.g., health, achievement). Broadly, increased uncertainty about a potential outcome may be perceived as an obstacle to realizing long-term goals, and people appear to be motivated to make decisions that are defensible to both themselves and others (Shafir et al., 1993). Moreover, people also tend to see themselves in positive terms—for example, as better than others on a wide variety of dimensions (Dunning et al., 2018).

We propose that bolstering one's self-system against threat might reduce the defensiveness that might arise in the context of uncertainty, thereby decreasing uncertainty aversion. Several studies have demonstrated that the process of self-affirmation, the act of reflecting on core values, is an effective way to reduce defensiveness in a variety of threat-related domains (Epton et al., 2015; Steele, 1988; Sweeney & Moyer, 2015). Of particular practical interest, self-affirmation has been shown to counter defensiveness and encourage positive behaviors in several health and social domains such as tobacco and alcohol use, (e.g., Armitage et al., 2008, 2011; Klein et al., 2011), healthy eating and exercise (e.g., Epton & Harris, 2008), condom use (Sherman et al., 2000), environmental

behaviors (Graham-Rowe et al., 2019), and prejudice and political partisanship (e.g., Binning et al., 2010). Self-affirmation appears to encourage individuals to become more self-transcendent and take an increasingly abstract, future-oriented, and third-person view (Cohen & Sherman, 2014; Crocker et al., 2008). Additionally, research also suggests that self-affirmation reduces stress reactivity, potentially mediated by activation of a neural reward processing system (Cascio et al., 2016; Duchter et al., 2016). These products of self-affirmation processes may reduce defensiveness to self-threatening information (e.g., Klein et al., 2011). For instance, Klein and Harris (2009) found that affirming core values led to increased attentional bias to threatening health messages (also see Kessels et al., 2016), which, in turn, led to lower levels of defensive avoidance (Klein et al., 2011). Although self-affirmation can influence people's beliefs about the risk of experiencing future outcomes (Armitage et al., 2008; Harris & Napper, 2005; Klein et al., 2011; Sherman et al., 2000), it remains unclear the degree to which self-affirmation directly influences decision making in the face of uncertainty. Self-affirmation also appears to be effective under some, but not all, circumstances (Ferrer & Cohen, 2018), highlighting the importance of examining its effects in multiple domains.

1.3 | The current study

Across two studies, we tested the degree to which affirming one's core values prior to a decision influenced uncertainty aversion. Specifically, we examined the degree to which a self-affirmation manipulation influences both subsequent decision making for risky (i.e., a choice between a sure thing and an option with explicit probabilistic outcomes; Study 1) and ambiguous outcomes (i.e., a choice between an option with probabilistic outcomes and an option in which an individual is unable to ascribe an outcome probability; Study 2). We hypothesized that self-affirming core values would reduce uncertainty aversion, making people less attracted to "sure thing" options and options with defined probabilities. Additionally, both studies examined decision making that involved choices to achieve gains (vs. gain nothing) or to avoid losses (vs. lose nothing). This distinction is important, as risk and ambiguity preferences long have been shown to switch as a function of the decision domain, with risk/ambiguity aversion when potential gains are at stake, and risk/ambiguity-seeking when presented with potential losses (Kahneman & Tversky, 1979; Lauriola et al., 2007). Moreover, message framing in terms of gains/losses have long been applied in health and risk communication contexts (Levin et al., 2002; Rothman & Salovey, 1997). We did not make directional hypotheses a priori regarding the degree to which self-affirmation differentially affected uncertainty decisions involving potential gains versus losses because equally compelling hypotheses could be made for no differences between domains, as well as preferential effects of self-affirmation in each domain. For instance, one might not predict differences between the domains. In their meta-analysis, Sweeney and Moyer (2015) found that the directionality of the targeted behavior (i.e., health-promoting vs. health damaging) did not moderate self-affirmation effects on behavioral intention or behavior itself. Similarly, Mays and Zhao (2016) reported no interaction with gain- versus loss-oriented framing when predicting indoor tanning intentions. With respect to a hypothesis that self-affirmation would more strongly affect potential losses, Prospect Theory would suggest that losses may be more threatening (c.f., Shen & Dillard, 2007). Subsequently, one might predict that self-affirmation would mitigate risk/uncertainty seeking behaviors in this domain because the threat is stronger. However, other research suggests that decision making to avoid losses may be more trait-like and more difficult to disrupt (Weller et al., 2015, 2017; Yechiam & Telpaz, 2013). Thus, this domain may also be less susceptible to a laboratory manipulation of self-affirmation. A directional hypothesis reasonably could be made that predicted greater self-affirmation effects in the context of potential gains. Evidence suggesting a reward processing mechanism associated with self-affirmation (Cascio et al., 2016; Duchter et al., 2016) may imply that affirming core values will reduce risk/uncertainty aversion for potential gains by making greater, but uncertain, rewards salient.

2 | STUDY 1

2.1 | Method

2.1.1 | Participants

In this study, 63 undergraduate participants (Age: *median* = 20; Female = 50, Male = 13) were recruited through an introductory psychology course and completed the study for partial course credit. Participants were also offered the opportunity to enter a drawing for a $50 gift certificate to an online retailer (see below). The study lasted approximately 30 minutes. Five participants were removed from later analysis due to evidence of severe violations of dominance (e.g., selecting a risky choice when it was highly unfavorable to do so, but avoiding a risk when it was highly favorably; individuals who made four or more disadvantageous choices, relative to advantageous ones in either domain were excluded from the analysis) on the task. A final sample of $N = 58$ (Female = 46) participants was retained for further analysis. The protocols in this study were approved by the Institutional Review Board of Idaho State University.

2.1.2 | Procedure

Participants completed the experiment in individual, private testing stations. A researcher was present in the room, but was not visible by the participants throughout the course of the study. Upon arriving, the researcher described the experiment and provided the informed consent to participants. After completing the consent form, participants were asked to complete a computerized demographic questionnaire. Next, the participants received the Student Values

Questionnaire packet (for the self-affirmation manipulation) and were asked to complete it. Following Sherman et al. (2000), all participants first were asked to review a list of 20 personal values that "other psychology students have made in prior studies" (e.g., compassion, hedonism). They then rank ordered the listed values based on how important each one was to them personally (1 = *most important* to 20 = *least important*). After the rank-ordering, participants were asked to write about either their highest- or lowest-ranked value. In the self-affirmation condition, participants were asked to write two to three paragraphs about why their highest ranked value was important to them and how it influenced their lives. In the control condition, participants wrote two to three paragraphs about why their lowest-ranked value might be important to another student and how it influenced that person's life. All participants were asked to write for 10 min to complete the essay portion of the packet. After the self-affirmation manipulation was complete, participants began the risky decision-making task.

2.1.3 | Risk taking

Participants completed the expanded Cups Task (Levin & Hart, 2003; Weller et al., 2007), a decision-making task that independently tests risky decision making to achieve gains versus to avoid losses. The Cups Task consists of 54 total trials, 27 of which were gain trials, and 27 were loss trials. Gain and loss trials were presented in blocks, and their order of presentation was counterbalanced. For each trial, participants were shown, on a computer screen, two equivalent arrays of *N* cups each (either 2, 3, or 5 cups in each array). One of these arrays offers the participant a certain, or riskless, choice of winning (or losing) $1.00 USD). Participants were instructed that, under each cup in the riskless array, was either a $1.00 USD gain or a $1.00 USD loss. The other array was considered the risky option, as the participant was offered a chance to win (lose) a larger amount (either $2, 3, or 5 USD), or win (lose) nothing. For each trial, the position of the risky array of cups was randomly presented on either the right or left of the computer screen, with the riskless option presented on the opposite side of the screen.

After clicking on the cup of their choosing, the participant received feedback regarding the outcome of the choice. For gain trials, if the participant won money, the amount won on that trial appeared in a "bank" (which was empty at the start of each trial) at the bottom of the screen in pictorial form (i.e., the number of dollar bills won), along with the message "You won × dollars." If the participants did not win any money on a trial, they saw the message, "You won 0 dollars." The loss trials were nearly identical with respect to presentation format, with one primary exception. Specifically, for each trial, the participant's bank at the bottom of the screen was filled with the number of dollars that they could possibly lose on that trial. This procedure was done to avoid the possibility of participants potentially ending up with a negative amount at the end of the task. The cumulative amount earned during all trials was tabulated throughout the task, but not presented to the participant until all trials had been completed.

Participants completed three trials for each possible Outcome ($2/3/5) × Probability level (.50, .33, or .20, represented by 2, 3, or 5 cups, respectively) combination for the risky option. This orthogonal manipulation of probability yielded trials that varied in terms of the relative EV between the risky and certain options. For the analyses in this study, we calculated the relative EV for each choice option ($EV_{risky} - EV_{certain}$) for each choice. Higher values thus indicated a greater EV for the risky option.

In order to increase personal relevance, participants were told that "At the end of the study, we will conduct actual drawings of these scenarios. Based on your choices, you will earn a score which reflects how much you gained or lost on each drawing across all twenty scenarios. The individual who wins the greatest amount will win" a $50 USD gift certificate to an online retailer. In reality, all participants were offered the same opportunity to enter the $50 gift certificate drawing. After the study, participants were debriefed about the purpose of the study and the reason for the deception about the drawing, and were thanked for their participation.

2.2 | Results

In order to test the effects of self-affirmation on risky-decision making, we conducted a generalized estimating equation (GEE; Liang & Zeger, 1986) analysis that allows for a within-subjects analysis of participants' decision behavior for each trial, rather than an aggregated response variable (see Weller et al., 2014, for use with the Cups Task). We fit a binomial response model using a logit-link function using each choice (0 = safe, 1 = risky) as the dependent measure. An exchangeable covariance matrix was used, which assumes nonzero homogeneous within-subject correlations across responses. Parameter estimates were achieved using hybrid maximum likelihood estimation. We began the analyses with a full-factorial model regressing choice on outcome domain (−1 = gain; 1 = loss), group (1 = not affirmed; 1 = affirmed), and the relative EV of the risky choice, compared to the certain option (mean-centered).

Table 1 shows the parameter estimates and standard errors for the model. Consistent with Prospect Theory (Kahneman & Tversky, 1979), we found a main effect for the domain, such that individuals made more risky choices when potential losses were at stake, compared to potential gains. Additionally, we found a main effect for EV level. However, this was qualified by a domain × EV level interaction; Individuals were more sensitive to EV level for risky gains (i.e., taking fewer risks as the EV of the risky choice became less favorable) than when risky losses were at stake. We did not find a main effect for the self-affirmation manipulation, but, more importantly, the analysis revealed a significant Group × EV level interaction, which was qualified a significant three-way Group × Domain × EV level interaction.

In order to better interpret this interaction, we conducted GEE analyses separately for the gain and loss domain. For the gain domain, we observed both a significant EV main effect ($B = .97$, $p < .001$) and a group × EV interaction ($B = -.40$, $p = .015$). For the loss domain, only EV level was significant ($B = .52$, $p < .001$), but the EV ×

TABLE 1 Effects of self-affirmation on cups task performance-GEE analyses

Parameter	self-	Std. error	95% CI Lower	95% CI Upper	Wald χ^2
Group (Not affirmed = −1; Affirmed = 1)	.08	.11	−.13	.30	.59
EV	.75	.06	.62	.87	138.93**
Domain (Gain = −1; Loss = 1)	.38	.04	.31	.46	105.42**
Domain × EV	−.22	.06	−.35	−.10	12.74**
EV × Group	−.21	.06	−.33	−.08	10.77**
Domain × Group	−.03	.04	−.10	.05	.45
Domain × EV × Group	.18	.06	.06	.31	8.63**

**$p < .01$.

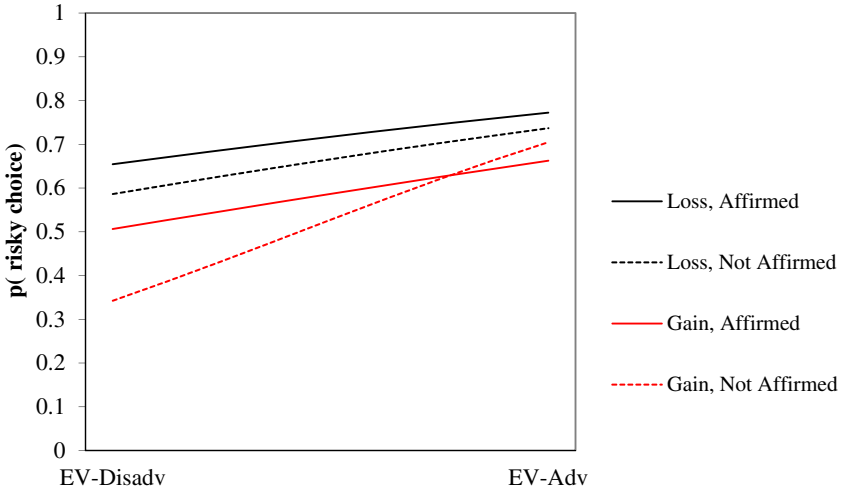

FIGURE 1 Effect of self-affirmation on risky decision making as a function of outcome valence and expected value. Because of a slight asymmetry between EV levels for the gain and loss domain, this figure is based upon an analysis that clusters decision trials by the relative favorability of the risky choice, such that a trial is either risk-advantageous (EV of the risky option > EV of the safe option; coded as −1), risk-disadvantageous (EV of the risky option < EV of the safe option; coded as +1), or is risk neutral (equal EVs for both choice options). This classification scheme is substantively identical to original studies using the cups task (Weller et al., 2007). Importantly, these analyses yielded nearly identical significant results to the analyses reported (i.e., significant main effects for domain, $B = .29$, $p < .001$, and EV level, $B = .53$, $p < .001$, and significant interactions for group × EV level, $B = -.15$, $p = .001$, domain × EV level, $B = -.14$, $p = .002$, and group × domain × EV level interaction, $B = .12$, $p = .007$)

group interaction was not significant ($B = -.02$, $p = .867$). As shown in Figure 1, individuals in the non-affirmed group were more likely to adjust their risk-taking based on the relative EV between choice options than self-affirmed participants for gain trials. In contrast, self-affirmed participants showed lower EV sensitivity and were more risk-taking for gain trials in which it was disadvantageous to take a risk.

3 | STUDY 2

Study 1 provided evidence that self-affirmation processes may affect decision making. Specifically, individuals who were self-affirmed took greater risks when achieving gains, even when it was not in their best interest to do so. These findings provide partial support for our hypothesis that self-affirmation reduces uncertainty aversion. Additionally, we found that the self-affirmed group demonstrated less sensitivity to the relative EVs between choice options. However, we did not make specific predictions regarding the observed gain–loss interaction. Thus, we aimed to conceptually replicate and extend these findings in Study 2 by testing the degree to which these effects also appear for decisions under ambiguity. Decisions under ambiguity are believed to amplify the presence of uncertainty in contrast to decisions under risk (Du & Budescu, 2005), while also demonstrating similar valence-based preference reversal effects like those observed in risky decision making (Kühberger, 1998; Lauriola et al., 2007; Levin et al., 2002).

We also examined the degree to which offering a monetary incentive affected the relationship between self-affirmation and decision making, for two reasons. First, we wanted to test the generality of possible self-affirmation effects between real and hypothetical outcomes. Second, the importance of incentivizing a financial behavioral decision task is debatable. Whereas some research has suggested that "playing with house money" changes decision behavior (Thaler & Johnson, 1990), some of the foundational research in the

uncertainty literature has found no differences between incentivized and non-incentivized participants (e.g., Tversky & Kahneman, 1992). Thus, in this study, we included reward motivation in the form of a performance-based lottery as an exploratory independent variable that may influence ambiguity preferences.

3.1 | Method

3.1.1 | Participants

Participants were 159 undergraduates who participated for partial credit in an undergraduate psychology class at a large university in Pennsylvania. Data from eight participants were removed for not following directions on the self-affirmation manipulation, and data from seven were removed for reporting that they either did not respond truthfully or carefully to either the Student Values Questionnaire or the Ambiguity-Probability Tradeoff Task. Thus, our final sample included 144 participants (106 females, 37 males, one participant did not report gender; Age: *Median* = 21 years). The protocols in this study were approved by the Institutional Review Board of University of Pittsburgh.

3.1.2 | Procedures and measures

Participants signed an informed consent form after being greeted by the researcher and were told that the first part of the experiment was being conducted to investigate student values. Participants were tested individually in a room with the researcher present. Participants were randomly assigned to either the self-affirmation or control condition and then given a packet of questionnaires. The first page consisted of demographic questions (e.g., age, gender). We followed the same procedure as Study 1 with respect to the self-affirmation manipulation.

Next, participants completed a modified version of the Ambiguity-Probability Tradeoff task (APT; Lauriola et al., 2007) as a measure of ambiguity preference/aversion. To manipulate the level of reward motivation, half of the participants were randomly assigned to receive either the instructions that read: "there is no right or wrong answer. We are simply interested in your preferences," or were told that their responses may potentially lead to a reward, which read:

> Your preferences are very important. At the end of the study, we will conduct actual drawings of these scenarios. Based on your choices, you will earn a score which reflects how much you gained or lost on each drawing across all twenty scenarios. The individual who wins the greatest amount will win a $50 Amazon Gift Card.

For each item of the APT, participants were asked to choose between two urns, each containing 20 balls of two different colors. They were asked to imagine, for each trial, that they would actually reach into an urn and draw a ball (e.g., Win $10 if you choose a yellow ball). On some trials, the trials involved winning money, if a ball of a particular color was selected; on other trials, the participant was told that choosing a ball of a particular color would result in a loss of money. For one urn (i.e., the "risky" urn), the participants were told the exact proportion of the two balls in the urn (e.g., 10 Yellow; 10 Brown). For the other urn (i.e., the ambiguous urn), participants were not given this information, but only the colors of the balls inside the urn (e.g. participants would see an option such as: ?? Yellow; ?? Brown). Participants were informed that the number of balls in the ambiguous urn always added to 20 balls.

The proportion of balls of the target color in the probabilistic urn was manipulated across trials, in increments of 10% from 30%, or 6 balls, to 70%, or 14 balls. Half of the trials involved potential gains, and half involved losses. Additionally, to make the task more consistent with the risk task in Study 1, we also manipulated the outcome level. Half of the trials involved winning/losing $10, and the other half involved winning/losing $50 (i.e., outcome level). Differently colored pairs were used across trials. However, it must be noted that, because the probabilities of the target color ball were unknown in the ambiguous urn, choices cannot be considered "advantageous" or "disadvantageous." Proportions, color-pairings, and positioning of urns were randomized over trials. Participants did not receive feedback for their decisions during the task. The task consisted of 20 trials total. After completing all trials, participants answered a questionnaire assessing the attention and relevance of the experimental tasks. During debriefing, it was revealed that the cover story was provided to elicit a sense of real consequences and was not true. Instead, all participants were given the chance to enter into a lottery to win a $50 gift certificate to an online retailer.

3.2 | Results

3.2.1 | Preliminary analyses

We first tested the degree to which our reward salience manipulation affected ambiguity preferences. To do so, we conducted two independent samples t-tests, with total ambiguous choices made for gain and loss decisions. These analyses revealed no differences between those in the prize condition compared to those making only hypothetical choices, t (142) = −.68, p = .49 for the gain domain, and t (142) = 1.40, p = .16 for the loss domain. In light of these results, and because this was an exploratory variable, we do not further consider the incentive variable.

3.2.2 | Data analysis

To test the effects of self-affirmation on ambiguity preference, we fit a binomial response GEE model using a logit-link function using each choice (0 = safe, 1 = ambiguous) as the dependent measure.

We followed the same procedure as Study 1 with respect to parameter estimation and the covariance matrix used in this analysis. We began the analyses with a full-factorial model regressing choice on outcome domain (−1 = gain; 1 = loss), affirmation condition (−1 = not affirmed; 1 = affirmed), outcome level ($10/$50), and the probability level of the risky option (.30/.40/.50/.60/.70).

Table 2 shows the parameter estimates and standard errors for the GEE analysis. Consistent with past research using the APT (Lauriola et al., 2007), we found main effects for domain and probability level, and also found a main effect of self-affirmation condition. There were no main effects observed for the outcome level. The results revealed a probability × domain interaction, which further demonstrates that individuals are ambiguity averse for gains and ambiguity seeking for losses, with 70% probability option of a win yielding the least ambiguity seeking and the 70% probability of loss option yielding the most ambiguity seeking.

Most important, we found a significant Domain × Probability Level × Self-Affirmation interaction. Similar to Study 1, we re-ran the GEE analyses separately for the gain and loss domain. For the gain domain, we observed both a significant probability main effect ($B = -17.68$, $p < .001$) and a group × probability interaction ($B = 2.14$, $p = .015$). For the loss domain, only the probability level was significant ($B = 14.81$, $p < .001$), but the probability × group interaction was not significant ($B = -1.00$, $p = .171$). Specifically, compared to their non-affirmed counterparts, self-affirmed individuals were more likely to choose the ambiguous option as the probability level of the risky urn increased for gain, but not loss, trials (see Figure 2).

Taken together, these findings converge with the Study 1 results in two main ways. First, self-affirmed individuals demonstrated less ambiguity aversion for potential gains than their non-affirmed counterparts. This pattern resembles that observed in Study 1, in which affirmed participants were more likely to choose a risky option when gains were at stake. Conversely, no effects were found across studies for the loss domain in either risky or ambiguous contexts. Second, the results in Study 2 also suggest that self-affirmed participants may not as strongly utilize contextual information (e.g., probability) that may otherwise guide choice preferences. Although one cannot accurately calculate the relative EV between choice options in the APT as with the Cups Task, a clear difference in choice preference emerged between the affirmed and control group as the probability levels of the risky urn shifted. Specifically, self-affirmed individuals appeared to show a more attenuated response to changes in probability level, whereas the control group demonstrated a sharper response to probability level.

4 | DISCUSSION

Across two studies we examined whether self-affirmation—a technique used in other domains to reduce defensive reactions—might affect decision-making under uncertainty. We obtained supportive findings in two studies, although only with regard to gains and not losses. Across these studies, we found that affirmed individuals were more tolerant of uncertainty, even sometimes when it was not in their best long-term interest to do so. Specifically, in contrast to some studies that have shown the positive benefits of self-affirmation on health behavior, this finding is consistent with the idea that under, some circumstances, self-affirmation opportunities can have unintended effects (Ferrer & Cohen, 2018).

Sherman and Cohen (2006) argue that "when global perceptions of self-integrity are affirmed, otherwise threatening events or information lose their self-threatening capacity because the individual can view them within a broader, larger view of the self" (p.189; c.f. Cohen & Sherman, 2014). This view is consistent with the notion that uncertainty reflects threat, which in turn might increase uncertainty-averse behaviors. Additionally, past research suggests that uncertainty-related appraisals have been associated with greater systematic processing (Tiedens & Linton, 2001; Weary & Jacobson, 1997). We speculate that any reductions in systematic processing may have especially influenced EV sensitivity, as we observed in Study 1.

TABLE 2 Effects of self-affirmation on ambiguity preference-GEE analyses

			95% CI		
Parameter	***B***	**Std. error**	**Lower**	**Upper**	**Wald χ^2**
Group (Not affirmed = −1; Affirmed = 1)	.03	.07	−.11	.17	.20
Domain (Gain = −1; Loss = 1)	.33	.06	.23	.44	36.28**
Probability level	−1.42	.57	−2.53	−.30	6.21*
Outcome level	.05	.05	−.06	.15	.71
Domain × Group	−.09	.05	−.20	.02	2.86
Probability × Group	.54	.57	−.57	1.66	.92
Outcome × Group	−.02	.05	−.13	.09	.14
Probability × Domain	16.22	.57	15.11	17.33	815.86**
Outcome × Domain	−.02	.05	−.12	.09	.10
Probability × Domain × Group	−1.55	.57	−2.66	−.44	7.44**
Outcome × Domain × Group	−.02	.05	−.12	−.09	.11

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

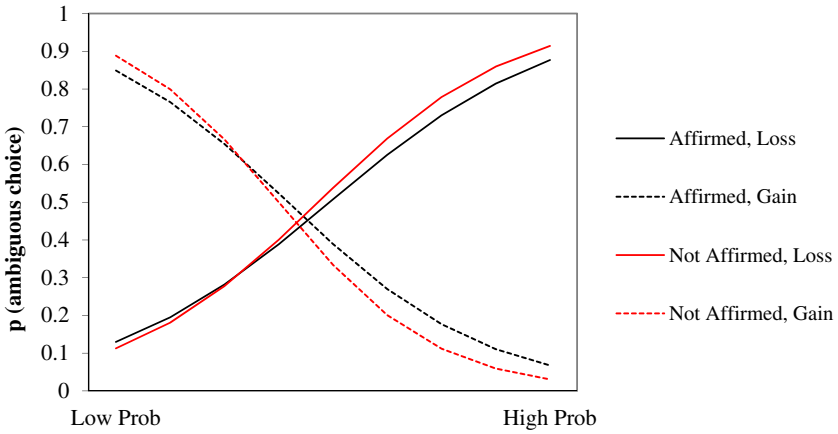

FIGURE 2 Effect of self-affirmation on ambiguity tolerance as a function of outcome valence and probability level

However, this does not fully explain the observed interactions between self-affirmation and the outcome valence of the choice, which suggest that self-affirmation may especially affect uncertainty aversion when potential gains (vs. losses) are at stake. We offer two potential explanations for these effects. First, robust evidence suggests that uncertainty-based decision making for losses appear to be more trait-like, more consistent over time, and generate greater emotional arousal (Yechiam & Hochman, 2013; Yechiam & Telpaz, 2013). Additionally, research has suggested that loss-related decision making appears to activate a more complex neural system (Levin et al., 2012). One consequence of these findings is that loss-related decision tendencies may be less malleable in response to a single intervention moment, such as a self-affirmation manipulation.

A second, complementary, explanation for our observed effects is that self-affirmation processes activate reward processing systems (Cascio et al., 2016; Duchter et al., 2016). Dutcher et al. (2016) found that preferences for one's own core values were associated with increased activity in the ventral striatum, a neural region implied in reward processing and risky decision making (see also Cascio et al., 2016). Dutcher et al. (2016) also argued that increases in reward processing due to self-affirmation may reduce stress reactivity and threat (Cohen & Sherman, 2014), leading to greater resilience. This increased reward activation, coupled with a presumed lower degree of felt threat may have led affirmed individuals to embrace the unknown more frequently. However, it is important to note that self-affirmed participants were not risk-seeking in Study 1, but instead were more risk-neutral on risk-disadvantageous trials (i.e., $EV_{\text{risky option}} < EV_{\text{safe option}}$) than non-affirmed participants (who showed risk aversion). Though risk-neutrality for these trials is still considered disadvantageous, this pattern of results should not be equated with the excessive risk-seeking tendencies observed using the Cups Task in at-risk samples, such as problem gamblers (Buchanan et al., 2020). While these explanations are speculative, future research is needed to better elucidate the gain-loss asymmetry effects observed in both studies.

Additionally, we acknowledge several other questions for future research. Unlike previous self-affirmation research, the current study tested the effects of self-affirmation on choice using controlled behavioral tasks. This approach was selected in order to isolate uncertainty-based decision making for gains and losses separately, compared to behaviors that involve tradeoffs between both potential gains and losses, and are therefore difficult to isolate in practice. We find this distinction to be interesting and encourage future research to clarify the differences of the effects of self-affirmation between choice and judgment paradigms. We also encourage research on the effects of self-affirmation in other decision-making contexts, particularly those that may involve some threat to the self-concept (which self-affirmation can help abate). Research and theory demonstrate the effects of self-affirmation manipulations across a large range of different behaviors and outcomes, from multi-determined health behavior change at the broad end, to behavioral startle responses at a microlevel of analysis (Crowell et al., 2015; Epton et al., 2015).

Meta-analytic studies have found robust aggregate effects of self-affirmation on message acceptance, behavioral intention, and behavior change (Epton et al., 2015; Sweeney & Moyer, 2015). However, the manner in which the message is framed also determines its acceptance, subsequent behavioral intentions, and ultimately, behavior (Rothman & Salovey, 1997). Our study suggests that self-affirmation manipulations may lead to lower defensiveness with gain-framed choices, evidenced by an increase in uncertainty tolerance, but not with respect to loss-framed choices. Taking this information into account, along with characteristics such as the function of the target behavior (e.g., health maintenance vs. recovery), and an individual's experience and knowledge with the behavior (Mays & Zhao, 2016; Rothman & Salovey, 1997), future research may be able to discern the conditions in which self-affirmation may affect optimally one's choices about health.

In summary, when people face uncertainty and ambiguity in choice contexts, they may feel a threat to the self, given the possibility of making decisions with poor outcomes that will in turn reflect negatively on the self. Making cherished values salient—the technique of self-affirmation—provides a buffer that can help to mitigate such threats to the self. We found here that self-affirmation might reduce both uncertainty aversion and ambiguity aversion and may even do so in ways that promote poorer decision making. These are important findings given the increased use of self-affirmation interventions in a variety of applied domains such as prejudice reduction, political partisanship, and health behavior

(e.g., Epton & Harris, 2008; Harris et al., 2014; Klein et al., 2011). These findings illustrate the promise of leveraging social psychological theories to optimally understand decision making under uncertainty, and also should motivate further research on self-affirmation theory that explores the circumstances under which it is most beneficial.

CONFLICT OF INTEREST

The authors have no conflicts of interests/competing interests to declare. This work does not necessarily represent the opinion of policy of the National Cancer Institute or National Institutes of Health.

CONSENT TO PARTICIPATE

Informed consent to participate was obtained from participants in the current study.

AUTHOR CONTRIBUTIONS

Joshua Weller and William Klein contributed to the study conception and design. Material preparation, data collection, and analysis were performed by all authors. The first draft of the manuscript was written by Joshua Weller and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in Research Data Leeds Repository at https://archive.researchdata.leeds.ac.uk. Code availability: SPSS Syntax files for the reported analyses will be made available upon request.

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