



Predicting with your head, not your heart: Forecasting errors and the impact of anticipated versus experienced elements of regret on well-being

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Abstract

Research suggests that when predicting our future emotions, affective forecasting errors are frequent (Wilson and Gilbert in *Adv Exp Soc Psychol* 35:345–411, 2003), influence motivation (Wilson and Gilbert in *Curr Dir Psychol Sci* 14:131–134, 2005), and drive decisions and behaviors (Dunn and Laham *Affective forecasting: a user's guide to emotional time travel*, Psychology Press, London, 2006). Regret can fall prey to these same errors (Gilbert et al., in *Psychol Sci* 15:346–350, 2004). Recent research characterizes two distinct components of regret: an affective element and cognitive element associated with maladaptive and functional outcomes, respectively (Buchanan et al., in *Judgment and Decision Making* 11:275–286, 2006). We explored forecasting of these elements across two studies. In Study 1, we investigated how accurately individuals forecast each component of regret, and how this relates to well-being. Participants forecasted experiencing a greater amount of regret (including affective and cognitive components) than they actually experienced. Additionally, forecasted (compared to experienced) components of regret uniquely predicted well-being outcomes, suggesting that predicting more affective regret coincides with lower well-being. In Study 2, forecasting errors in overall regret were eliminated by asking participants to focus on cognitive elements of regret prior to forecasting.

Keywords Regret · Affective forecasting · Emotion · Well-being · Motivation

“One of the most difficult things to think about in life is one's regrets. Something will happen to you, and you will do the wrong thing, and for years afterward you will wish you had done something different.”—Lemony Snicket, Horseradish.

Unfortunately, Lemony Snicket's view of regret as an enduring emotion that lingers for years is commonly shared. The fear of intense and persistent regret following a poor decision can cripple peoples' decision-making skills and impact major aspects of peoples' lives, such as the decision of who to marry or what profession to enter. But what if this conventional perception of regret is actually overstated or even

incorrect? Would people live differently knowing that the regret they might experience following a negative outcome is much less overwhelming than anticipated? The current research explores the (in)accuracy with which people are able to forecast their future feelings of both affective and cognitive elements of regret, the extent to which these forecasts are related to well-being, and ways to improve forecasts of regret.

Regret

Regret is a negative emotion driven by self-focused thoughts of “what might have been” (Gilovich and Medvec 1995). That is, a person experiencing regret might think back on a past decision that led to a poor outcome and think about how things could have been better if only the person had done something differently. Although people can experience severe instances of regret, it is also a commonplace emotion experienced in everyday life. In fact, regret is one of the emotions that people report experiencing the most

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(Shimanoﬀ 1984). One key characteristic that distinguishes regret from other negative emotions such as anger, sadness, or jealousy, is the presence of self-blame (Frijda et al. 1989; Zeelenberg et al. 1998). Furthermore, research suggests people overestimate the impact of this self-blame, leading them to anticipate experiencing more regret when losing by a narrow (vs large) margin for which it is easier to blame oneself (Gilbert et al. 2004).

Regret has been associated with both positive and negative outcomes. Experiencing regret often guides our thoughts and behaviors in a productive manner (Smallman and Roese 2009; Zeelenberg and Pieters 2007) and helps individuals learn from their mistakes (Zeelenberg 1999). However, experiencing regret has also been associated with increased anxiety, depression, and distress (Roese et al., 2009). Additionally, anticipated regret can lead to decision avoidance as individuals struggle to evade potential negative outcomes (Zeelenberg and Pieters 2007). Recent research on regret delineates between two elements of regret and outlines when experiencing regret is advantageous rather than maladaptive (Buchanan et al. 2016). Definitions of regret have historically described the emotion in terms of two components: the affective experience produced by the negative outcome, and the cognitive understanding of the poor decision (Gilovich and Medvec 1995). In other words, each experience of regret can be characterized as a combination of both negative affect and counterfactual thought. The Regret Elements Scale (RES; Buchanan et al. 2016) directly assesses these components. The affective component of regret (RES-A) encapsulates the feelings associated with the experience of regret, and is associated with maladaptive affective outcomes. The cognitive component of regret (RES-C) focuses on thoughts pertaining to the decision made, and is associated with functional preparatory outcomes. Conceptualizing regret in terms of its two distinct components is necessary to independently assess the opposing antecedents and consequences of regret. Although Buchanan et al. (2016) established the predictive validity of the RES as a measure of experienced regret, much of the literature on regret has yet to be understood within the context of this new conceptualization of the emotion. This gap extends to understanding how people forecast future experiences of regret.

Affective forecasting

Affective forecasting, or predicting one’s emotional reaction to future events, is an important skill for making sound decisions. However, research has consistently shown that individuals are often unable to accurately make such forecasts. Although relatively adept at predicting the valence and emotion that will be experienced in a future situation, people seem to have trouble predicting other aspects of their

affective reactions to future events (e.g., Wilson and Gilbert 2003, 2005; Dunn et al. 2003). Specifically, forecasters often exhibit an impact bias, overestimating the intensity and duration of future affective responses (e.g., Wilson and Gilbert 2003, 2005).

One well-documented explanation for why individuals routinely overestimate the emotional impact of negative events is that they do not realize how readily their “psychological immune system” will rationalize negative outcomes (e.g., end of a relationship, failure to achieve tenure, rejection by a potential employer) once they occur (Gilbert et al. 1998). For example, once a decision is made or an event takes place, the alternative outcomes begin to appear less appealing, a process that often occurs without conscious awareness. With little knowledge of these silently operating defense mechanisms, people fail to take them into account in a process referred to as immune neglect (Wilson and Gilbert 2005). As a result, individuals overestimate the duration of emotional responses to future events, a phenomenon which has been termed the durability bias (Wilson et al. 2000).

Focalism also contributes to the durability bias, which occurs when people fail to consider the influence of other factors and events that may impact their emotional state, focusing instead on salient aspects of the negative event (Wilson et al. 2000). In fact, researchers have found that encouraging participants to consider other future life events before making forecasts leads to more accurate affective forecasts (Wilson et al. 2000). Eliminating the tendency to engage in focalism by training people to consider all aspects of a situation could potentially reduce forecasting errors and ultimately lead to better decision-making.

In addition to overestimating duration, people also fall prey to the intensity bias when assessing their emotional reactions to future events, overestimating how positive or negative they will feel. In one study, people predicted their emotional reactions to both positive and negative events (e.g. scores on an exam, Christmas day) and then reported on their affective experience following the event (Buehler and McFarland 2001). Although participants anticipated more intense reactions than they experienced, this effect was minimized when participants considered similar past experiences when making predictions (Buehler and McFarland 2001). Alternatively, recent research has begun to explore how motivation and attention to detail may contribute to such forecasting errors, specifically in the context of thinking for pleasure (Alahmadi et al. 2017).

Research has clearly demonstrated that affective forecasting errors are both frequent and consequential (for reviews see Frederick and Loewenstein 1999; Gilbert et al. 2002; Loewenstein and Schkade 1999; Wilson and Gilbert 2003). In fact, recent research has begun to explore the impact of affective forecasts in driving decisions and behaviors that were once thought to be the product of experienced emotion.

For example, researchers have found that self-regulatory behavior in response to potential self-discrepancies (e.g., practicing after failing at an important task), is predicted by forecasted rather than currently experienced emotion (Brown and McConnell 2011). Other research has found that avoidant behavior in patients with phobias is predicted by anticipated affect in the focal situation (e.g., in crowds, when traveling, near spiders) rather than the patient's actual experience of affect in the situation (Dunn and Laham 2006). Clearly, anticipated affect has a powerful grasp on our behaviors, and anticipated regret is likely no different.

Given the breadth of research which suggests affect serves as a powerful source of motivation, influencing the construal of situations, choices, and behaviors (e.g., Baumeister et al. 2007), errors in affective forecasting may prove costly in some contexts, but provide the requisite motivation to achieve or avoid positive or negative outcomes, respectively. For better or for worse, such predictions about expected emotional responses to a future event contribute to motivation and subsequent decision making (Wilson and Gilbert 2005).

Regret and affective forecasting

Researchers have examined the impact of affective forecasting errors on a variety of emotions, including regret. Studies have shown that, similar to other emotions, people are relatively poor at predicting the intensity of the regret they might experience following a negative event (e.g., Gilbert et al. 2004). Furthermore, individuals predict that situations that exacerbate self-blame, such as missing one's flight by just a couple of minutes, coincide with stronger experiences of regret. However, research suggests that these predictions may be inaccurate. In a series of four experiments, Gilbert et al. (2004) compared individuals' forecasts and experiences of regret after losing by a narrow or a wide margin. They found that participants expected a narrow margin of loss to intensify their feelings of regret but, in reality, the impact of the loss was not as powerful as anticipated. Participants were also less likely than they anticipated to blame themselves for their negative outcomes (Gilbert et al. 2004). Overall, it appears that people have a misunderstanding of which factors influence experiences of regret, and their forecasts of this important emotion may be rife with errors as a result. These common misconceptions of regret likely have implications for everyday life (e.g., reduced risk-taking behavior, impaired decision-making).

In fact, researchers have identified several consequences of forecasting errors for regret. For example, fear of regret leads people to overpay for consumer goods (Simonson 1992), negotiate ineffectively (Larrick and Boles 1995), and overvalue the ability to change their minds at a later

point in time (Gilbert and Ebert 2002). It can also have negative social outcomes such as discouraging apologies for one's transgressions (Leunissen et al. 2014). For example, Leunissen et al. (2014) found that people overestimate the negative consequences of apologizing while underestimating the positive outcomes, which could stall or fully prevent reconciliation. This overestimation is maladaptive, given that people consistently regret not apologizing more than they regret apologizing (Exline et al. 2007). This indicates that the hesitation to apologize out of fear of adverse consequences is unwarranted.

Other research supporting the important role of anticipated regret suggests the relationship between adolescent smoking initiation and intentions is moderated by anticipated regret, with intentions predicting the onset of smoking only when anticipated regret was low or absent (Conner et al. 2006). Beyond the context of smoking, peoples' happiness might be compromised because anticipated regret prevented them from making the proper decision. A recent meta-analysis provides further support for the unique role of anticipated regret even when accounting for other variables (e.g., perceived behavioral control, past behavior), with the addition of anticipated affect significantly improving prediction of a range of behavioral intentions (Sandberg and Conner 2008).

Although previous research has explored errors in the forecasting of regret and the predictive utility of anticipated regret, no known work has examined these issues using the more nuanced view of regret identified earlier (Buchanan et al. 2016). It is important to examine the different elements of regret in this context, as this new conceptualization of regret may shed a light on what is already known about anticipated regret and affective forecasting more generally. Despite the label, much of the affective forecasting literature focuses on the prediction of emotion more generally (not just the affective portion of an emotion). By explicitly delineating between the affective and cognitive components of emotion, researchers may learn valuable information regarding when and where forecasts of emotions may exhibit errors, and the consequences of these forecasts.

The current work

In this work, we aimed to better understand affective forecasting errors within the realm of regret. Specifically, we examined these errors considering the cognitive and affective elements of regret identified in recent literature. In Study 1, we examined the level of overall, cognitive, and affective regret participants expected or actually experienced following a negative event. We explored if affective forecasting errors were present and, if so, how forecasts and experiences of these elements of regret might differentially predict well-being (e.g., self-esteem, subjective happiness). In addition to

replicating the impact bias in affective forecasts observed in Study 1, in Study 2 we examined if focusing forecasters on either cognitive or affective aspects of regret would impact their anticipation of the regret they would experience after a negative incident, subsequently impacting forecasting errors.

To systematically examine forecasts and experiences of regret, we used a controlled lab task: a rigged version of the Monty Hall task in which all participants forecasted and/or experienced the same losing outcome (similar tasks used in Granberg and Brown 1995; Petrocelli and Harris 2011). In keeping with the existing research on affective forecasting, we hypothesized that participants would expect to feel more regret than they (or others) actually experience following a negative event (Hypothesis 1A).

In addition to investigating forecasting errors in overall regret, we examined errors for each of the elements of regret separately. Using the RES (Buchanan et al. 2016), we measured forecasts and experiences of both the affective and cognitive elements of regret. Given the relative novelty of this conceptualization of regret, our hypotheses pertaining to the impact bias as it relates to affective and cognitive regret were largely exploratory. Past research on affective forecasting suggests that people tend to focus on the future emotional event without considering other relevant factors (Wilson et al. 2000). Responding to items that focus on the cognitive aspect may reduce the tendency to focus on emotional reactions to events, making it easier to place the event into context and to rationalize the negative outcome. As such, we explored whether, compared to the affective component of regret which may be more prone to forecasting errors, the cognitive component of regret might be buffered against these errors (Hypothesis 1B).

We also sought to replicate previous findings of the RES (Buchanan et al. 2016). This included the association between subscales and important regret-related outcomes. By collecting a measure of well-being using a suite of measures outlined in previous literature (e.g., Buchanan and McConnell 2016) we explored how forecasts and experiences of the elements of regret predict a person's well-being. In line with initial research on the RES (Buchanan et al. 2016), we expected that the affective component of regret would negatively predict well-being (Hypothesis 2A). We were also able to examine novel questions focused on how individuals' forecasts and experiences of the components of regret relate to well-being. Consistent with work showing that anticipated emotions are often powerful predictors of behaviors and decisions even when controlling for experienced emotion or intentions (Dunn and Laham 2006; Sandberg and Conner 2008), we explored whether forecasts might predict well-being above and beyond the experience of regret (Hypothesis 2B).

Lastly, we attempted to remedy forecasting errors using an experimental manipulation. Work on focalism suggests

that people overestimate the emotional impact of future events, in part, because they tend to perseverate on the possible event to the exclusion of the context and other important factors that impact their emotions at any given time (e.g., Wilson et al. 2000). As such, we anticipated that a manipulation designed to focus participants on an aspect of the emotion that they might typically fail to consider would be effective in reducing or even eliminating forecasting errors for regret. Thinking about the cognitive component of regret encourages people to focus on thoughts (not affect) and to place the event into context (e.g., to know if a decision was a good one, the person must also consider the other decision options) which may ultimately lead to more accurate forecasts of regret. In other words, we expected that asking individuals to focus on the cognitive aspects of a regrettable situation (vs. affective aspects) might encourage them to consider the broader context and therefore make more accurate forecasts (Hypothesis 3).

Study 1: forecasts versus experiences of the elements of regret and their impact on well-being

The first study served to further the literature on affective forecasting by examining the impact bias as it relates to regret. Although regret is a powerful and frequently experienced emotion (Shimanoff 1984), the accuracy of regret forecasts has rarely been examined (cf. Gilbert et al. 2004). We expected to replicate the impact bias typically found in the affective forecasting literature, specifically for regret. We hypothesized that participants would expect to feel more regret after a negative outcome than they report feeling in that same situation (Hypothesis 1A).

Study 1 also examined affective forecasting of regret in a unique manner, focusing on potential differences between forecasts and experiences of the two components of regret, and how they may differentially impact well-being. Given that RES-A captures more affect, and affect is likely to be more susceptible to the impact bias (vs. cognition), we predicted that affective forecasting errors would be more likely for the RES-A and less likely for the RES-C (Hypothesis 1B).

The current study also advances the literature on regret itself by examining a relatively novel scale of regret which allows researchers to separately examine two related but independent elements of regret (i.e., affective and cognitive components of regret) which are associated with different well-being outcomes (Buchanan et al. 2016). Guided by the preliminary research on the RES suggesting that the affective element of regret, but not the cognitive element, is related to feelings of general distress (Buchanan et al.,

2016), we expected that the affective component would negatively predict overall well-being (Hypothesis 2A).

Finally, given the work showing that anticipated emotions can be powerful predictors of important outcomes independent of current emotion, attitudes, or intentions (e.g., Dunn and Laham 2006; Sandberg and Conner 2008), we conducted supplementary analyses to examine the connection between forecasts and experiences of regret and well-being. We expected forecasts to predict well-being even when controlling for the experience of regret (Hypothesis 2B).

Method

Participants

To explore forecasts and experiences of the regret elements as well as their influence on well-being, we recruited students enrolled in an undergraduate psychology course at Central Washington University for a total of 51 participants (seven males; $M_{age}=20.10$, $SD_{age}=3.78$). Participants received course credit for their participation.¹

Design

Following a description of a negative event, participants provided ratings of their anticipated regret (forecasts) if the event were to occur and then experienced the same negative event and provided ratings of their actual regret (experiences). Data from these participants allowed for within-subjects comparisons of forecasts and experiences of the elements of regret. Specifically, this design allowed us to examine if participants' forecasts of regret differ from *their own* experiences of regret.

Materials

Monty hall task Similar to other published studies, we used a controlled experimental task to elicit potential feelings of regret (see Gilbert et al. 2004 for a similar game show type task). In our study, participants completed the Monty Hall task, a popular decision-making game. In this game, three doors are displayed to the player. Behind two of the doors is a goat (i.e., a bad outcome), but behind one of the doors is a car (i.e., a good outcome). The objective is to choose the door that has the car behind it. After making their initial decision, one of the unselected doors is opened and

Table 1 Scale and subscale Cronbach's alpha values for the forecasted RES and experienced RES in study 1

RES subscales	Cronbach's alpha values
Forecasted	
RES-T	0.83
RES-C	0.79
RES-A	0.80
Experienced	
RES-T	0.90
RES-C	0.88
RES-A	0.89

the contents behind the door are revealed. Importantly, the opened door always reveals a goat. Players must then choose to either stay with their initial choice or switch to the other unopened door. After deciding, all doors are opened and the final (negative) outcome is revealed.

Regret elements scale We assessed participants' level of forecasted and experienced regret using the RES (Buchanan et al. 2016). The RES asks participants to respond to 10 items (5 affective and 5 cognitive, order randomized) considering the regrettable situation they had just imagined or experienced, using a 7-point Likert scale (1 = *Strongly Disagree*, 7 = *Strongly Agree*). Specifically, when making forecasts (RES_F), participants were instructed to read the statements and rate how much each statement describes their thoughts and feelings about the *possible* situation. When reporting their experiences (RES_E), participants rated how much each statement described the *experienced* situation.

In line with previous research (Buchanan et al. 2016), we used the RES to calculate three scores for each participant (See Table 1 for all scale and subscale Cronbach's alphas). Cognitive element of regret scores for forecasts and experiences (RES-C_F; RES-C_E) were calculated from participants' mean responses to the five thought/decision-related items (e.g., "Things would have gone better if I had chosen another option"), with larger scores reflecting more of the cognitive component. Affective element of regret scores (RES-A_F; RES-A_E) were calculated from participants' mean responses to the five feeling-related items (e.g., "I feel like kicking myself"), with larger scores reflecting more of the affective component. Overall regret scores (RES-T_F; RES-T_E) were calculated from participants' mean responses to all 10 items, with larger scores reflecting more overall regret.

Well-being measures In addition to regret, we also assessed a variety of well-being constructs using a suite of well-being measures similar to those found in previous published research (e.g., Buchanan and McConnell 2016; Linville 1987; McConnell et al. 2005, 2011; Woolfolk et al. 1995). Research establishing the RES (Buchanan et al. 2016)

¹ The number of participants suggested for our studies was determined by a priori power analyses (Gpower: Faul et al. 2007). Results indicated that a sample size of 52 for Study 1 and 72 for Study 2 would be sufficient to obtain a power of 0.80 and an alpha of 0.05. Sample sizes included in the analyses were near or exceeded these recommendation in the current work.

briefly examined how the scale relates to well-being via the general distress subscale of the MASQ (Watson and Clark 1991). Our research attempts to expand this knowledge in an exploratory fashion by including a battery of established well-being measures. The included measures allowed us to examine the relationship between forecasted/experienced elements of regret and overall well-being as well as specific measures related to overall well-being. All scales and items within each scale were presented to participants in a random order.

Subjective happiness Participants responded to four items assessing their subjective happiness (Lyubomirsky and Lepper 1999). For example, participants rated how happy they felt at this very moment, on a scale from 1 (*not at all happy*) to 7 (*extremely happy*), with larger scores representing greater reported subjective happiness ($\alpha=0.83$).

Self-esteem Participants also completed a frequently implemented measure of self-esteem (Rosenberg 1965). Specifically, participants were asked to rate their agreement with 10 statements such as, “All in all, I am inclined to feel like a failure” using a scale that ranged from 1 (*strongly disagree*) to 4 (*strongly agree*). Scores were computed by averaging all 10 responses (reverse coding when appropriate), with larger scores indicating greater self-esteem ($\alpha=0.89$). **Basic needs.** Participants additionally completed a 17-item measure assessing basic social needs fulfillment (Zadro et al. 2004). The basic needs scale measures sense of belonging, meaningful existence, control, and self-esteem by having participants rate their agreement with statements such as, “I feel liked,” on a scale ranging from 1 (*not at all true*) to 9 (*completely true*). In line with previous research using this measure (e.g., Bernstein et al. 2010; Buchanan and McConnell 2016; McConnell et al. 2011), we combined all 17 items (reverse coding when necessary) into a single measure of basic needs fulfillment, with larger scores indicating relatively greater fulfillment of basic needs ($\alpha=0.88$).

Flourishing Finally, we measured participants’ flourishing using Diener et al. (2010) measure. Specifically, this scale measured psychological and social prosperity. Participants signaled agreement with eight statements (e.g., “I lead a purposeful and meaningful life”) on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Scores were calculated by computing the average score for each participant, with larger scores reflecting more perceived flourishing ($\alpha=0.87$).

Overall well-being Given that all measures of well-being were positively correlated in line with expectations ($r_s=0.43$ – 0.68), we explored the possibility of simplifying our suite of measures into a single outcome measure of overall well-being using factor analysis. As such,

we followed the procedure of other published work (e.g., Buchanan and McConnell 2016) to combine all previously mentioned measures (i.e., subjective happiness, self-esteem, basic needs, flourishing) using principal components analysis. Scree plots supported a one-factor solution with a pronounced drop in the eigenvalues between the first and second factors (eigenvalues of 12.75 and 3.01, respectively). Given these results, we computed a standardized *overall well-being* score for each participant, with larger scores indicating relatively greater overall well-being.²

Procedure

Participants completed all manipulations and measures electronically via computer. After providing informed consent and viewing the online information page, participants were given a description of the Monty Hall task. Participants were informed that they were about to participate in this game, and that if they successfully choose the door with the car behind it, they would be entered into a drawing for a \$25 gift card to a restaurant of their choosing.

After reading these instructions, participants were asked to imagine and write about choosing the door with the goat behind it rather than the car. Specifically, participants were given 90s to, “Try to vividly imagine your thoughts and feelings if you really chose a goat and you missed out on earning a gift card.” They then completed a short questionnaire measuring how much of the affective and cognitive components of regret they would expect to experience if such an outcome occurred. Specifically, participants completed the RES (Buchanan et al. 2016), modified to reference the forecasted situation.

Participants then completed the Monty Hall task. However, the game was designed such that all participants experienced failure (i.e., chose the door with the goat behind it and would not be entered into the raffle; see Gilovich et al. 1995 for a similar procedure). After finishing the game, participants completed a short questionnaire measuring their experience of the affective and cognitive elements of regret. Specifically, participants completed the RES with reference to the experienced situation (Buchanan et al. 2016).

Finally, all participants completed the series of well-being measures. After completing the questionnaire, participants were thanked for their participation and debriefed. They were informed that it was impossible to have succeeded in the Monty Hall task, and they were entered into the drawing for the \$25 gift card.

² Although this overall well-being factor score serves as the primary measure of well-being, parallel analyses for each of the individual sub-measures produced similar results.

Table 2 Descriptive statistics and zero-order correlations in study 1

	Descriptives			Forecasts			Experiences		
	M	SD	WB	RES-T	RES-C	RES-A	RES-T	RES-C	RES-A
Overall Well-Being	0.00	1.00	–						
Forecasted RES-T	4.22	0.94	–0.25	–					
Forecasted RES-C	5.13	0.95	–0.02	0.79*	–				
Forecasted RES-A	3.31	1.26	–0.35*	0.89*	0.43*	–			
Experienced RES-T	4.01	1.03	–0.09	0.78*	0.64*	0.67*	–		
Experienced RES-C	5.04	1.15	–0.01	0.64*	0.75*	0.39*	0.81*	–	
Experienced RES-A	2.98	1.31	–0.14	0.66*	0.35*	0.71*	0.86*	0.39*	–

N = 100, **p* < 0.05

Results

Descriptive statistics and zero-order correlations

Table 2 presents descriptive statistics and correlations among the variables. Replicating previous research on the RES (Buchanan et al. 2016), when rating experiences of regret, the cognitive and affective regret subscales were positively correlated. Expanding upon this research to explore novel relationships for forecasted regret, we found a positive correlation between the elements of regret for forecasts as well.

Zero-order correlations involving well-being showed significantly greater well-being when people reported lower ratings of forecasted affective regret. In other words, poorer well-being (e.g., less subjective happiness, lower self-esteem) was only related to more forecasted *affective* regret specifically.

We also examined the actual behaviors of participants in the Monty Hall task (i.e., the choice to stay with the door they initially chose or to switch to the other unopened door). Overall, 85% of participants chose to stay with their initial choice. Given that the optimal strategy in this task is to switch doors, it appears that a majority of participants were not familiar with this task prior to participation, suggesting that participants were making a novel decision.³

³ In both Study 1 (85 stayed, 14 switched) and Study 2 (20 stayed, 4 switched), the decisions that participants made during the Monty Hall Game suggest that participants were not familiar with the game, given that a majority (85%) of participants used a suboptimal strategy. Furthermore, in both Study 1 and Study 2, the decision to stay or switch was unrelated to both forecasts and experiences of the elements of regret (and total regret) as measured by the RES (all *ps* > 0.13), although such null results should be interpreted with caution given the current sample sizes.

Affective forecasting errors: impact bias

The first goal of this study was to examine affective forecasting errors of regret, focusing on the two elements of regret identified in recent published work (Buchanan et al., 2016). As such, we conducted a 2 (time point: forecast vs. experience) × 2 (element: cognitive vs. affective) repeated-measures ANOVA to examine potential differences between forecasts and experiences of the different aspects of regret as measured by the RES.

We first sought to replicate previous research on forecasting of regret. We found a significant main effect of time point, in the predicted direction, $F(1,50) = 4.99, p = 0.03$. Forecasts ($M = 4.22, SD = 0.94$) of overall regret (RES-T) were reported as more intense than experiences ($M = 4.01, SD = 1.03$). Consistent with previous literature (e.g., Buehler and McFarland 2001; Gilbert et al. 2004) and Hypothesis 1A, people anticipated experiencing more regret than they themselves experienced. Considering the potential issues of a within-subjects design (e.g., possible influence of forecasting on experiences, motivations to maintain consistency across measurements), we recruited a separate group of participants ($N = 49$) to take part in only the experience portion of the study, and conducted between-groups analyses. Consistent with the within-groups analyses, we found an impact bias in forecasts of regret.⁴

⁴ Although within-subjects designs are typically more powerful than between-subjects designs, it is possible that the act of making forecasts could alter participants' experiences of regret, or that participants could remember their forecasted responses and seek to display consistency by giving similar answers when asked about their experiences. To combat these potential limitations, we also collected data from a separate group of participants ($n = 49$) that did not provide forecasts, but simply experienced the negative event and provided ratings of their current levels of regret following these experiences. This design provided us with the opportunity to examine between-group differences. Specifically, we examined whether differences exist between forecasts and experiences, without the possibility that experiences were influenced by the act of forecasting itself (see Gilbert et al. 2004, for a similar procedure). We conducted an independent samples *t*-test comparing the forecasts of our participants with the experiences of a separate group of individuals who only experienced the event. In line with the within-subjects comparison and con-

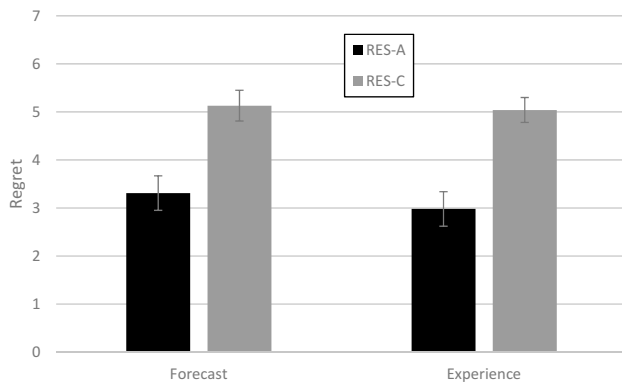


Fig. 1 Forecasts versus experiences of elements of regret (study 1)

We also found a significant main effect of regret element, $F(1,50) = 144.52, p < 0.001$. This suggests that people reported greater levels of the cognitive component of regret compared to the affective component, regardless of if they were forecasting or experiencing. Although we did not find a significant interaction, $F(1,50) = 2.08, p = .16$, analysis of the simple effects via paired samples *t*-tests supports the predicted differences between forecasts vs. experiences based on regret type. As illustrated in Fig. 1, we found a significant difference between forecasts ($M = 3.31, SD = 1.26$) and experiences ($M = 2.98, SD = 1.31$) of the affective element of regret (RES-A), $t(50) = 2.37, p = 0.02, d = 0.34, 95\% CI [0.05, 0.60]$, but, in line with our hypotheses, we did not find a meaningful difference between forecasts ($M = 5.13, SD = 0.95$) and experiences ($M = 5.04, SD = 1.15$) of the cognitive element, $t(50) = 0.84, p = 0.41, 95\% CI [-0.13, 0.31]$. Supporting Hypothesis 1B, participants expected to feel more overall and affective regret than they reported feeling. Interestingly, forecasting errors did not occur for the cognitive element of regret.

Predicting well-being: forecasts versus experiences

The second, supplementary goal of Study 1 was to examine the potential impact of forecasts and experiences of regret on well-being. Thus, we conducted a multiple regression analysis in which participants' overall well-being scores were simultaneously regressed on participants' forecasts and experiences of overall regret (RES-T). Consistent with past research illustrating the independent predictive utility of

forecasted emotions when controlling for experienced emotions (e.g., Dunn and Laham 2006), we found a unique effect of forecasted regret on well-being, $\beta = -0.44, t(48) = -2.01, p = 0.05, 95\% CI [-0.93, 0.00]$. Specifically, participants who expected to feel more regret (RES-T_F) reported lower well-being. Forecasted regret negatively predicted well-being above and beyond actual experiences of regret (RES-T_E, $p > 0.26$).

We also explored the potentially unique links between the two elements of regret and well-being. As such, we conducted a multiple regression analysis in which participants' overall well-being scores were simultaneously regressed on participants' forecasts and experiences of the cognitive element (RES-C) and forecasts and experiences of the affective element (RES-A). Interestingly, when all four variables (i.e., RES-C_F, RES-C_E, RES-A_F, RES-A_E) were simultaneously entered into the model, forecasts of the affective element (RES-A_F) were the only significant unique predictor of well-being, $\beta = -0.551, t(46) = -2.78, p < 0.01, 95\% CI [-0.75, -0.12]$ (all other *p*'s > 0.32). Specifically, participants who expected to feel more of the affective element exhibited lower levels of well-being. This effect emerged even when controlling for forecasts of the cognitive element, and experiences of both elements of regret. It appears that greater anticipated feelings of regret, especially the affective component of regret, is a better unique predictor of well-being than actual experiences of these elements.

Discussion

Study 1 examined affective forecasting errors in regret and is the first study to examine these errors as they relate to the elements of regret. In line with previous research on the impact bias, participants anticipated experiencing more overall regret (RES-T) than they themselves actually reported experiencing following the negative event, offering support for Hypothesis 1A. Examining the two components of regret individually offered a novel approach for testing this hypothesis. In line with Hypothesis 1B, when comparing forecasts to experiences, significant forecasting errors arose only for the affective element of regret.

We also conducted supplementary analyses to examine the effect of forecasted and experienced regret on well-being. As predicted by Hypothesis 2A, the affective component of regret was a negative predictor of well-being. Interesting however, it was the forecasts, rather than the experiences of affective regret that predicted well-being. Additionally, when considering forecasts and experiences simultaneously, forecasted overall regret was the only significant predictor of well-being, with higher levels of anticipated regret associated with lower well-being. When considering the elements of regret, the affective component of regret alone was a significant negative predictor of well-being, but only for

Footnote 4 (continued)

sistent with Hypothesis 1A, we again found evidence for the impact bias, with forecasts ($M = 4.22, SD = 0.94$) of overall regret (RES-T) being rated as significantly more intense than experiences ($M = 3.52, SD = 1.44$), $t(98) = 2.88, p = 0.005, d = 0.58, 95\% CI [0.21, 1.18]$. That is, forecasters *expected* to feel more regret than a different group of experiencers *reported* feeling.

forecasts of the element. In line with past research linking affective regret to emotional distress, the affective component coincided with lower well-being whereas neither forecasts nor experiences of the cognitive component showed a significant effect (Buchanan et al. 2016). Our finding that forecasted regret significantly predicted well-being while experienced regret did not emerge as a significant predictor is in agreement with Hypothesis 2B, as well as past research showing that anticipated emotions can be independent predictors of behavior, even when accounting for experienced emotions (e.g., Dunn and Laham 2006).

The current evidence suggests that expectations of regret are associated with lower well-being, and that these forecasts are exaggerated. These results combined with the previous research that anticipated regret can drive both judgments and behavior (e.g., Zeelenberg and Pieters 2007) suggests that interventions designed to reduce forecasting errors in regret may have important implications for everyday life. We designed Study 2 to experimentally examine a method of reducing regret forecasting errors by leveraging the elements of regret.

Study 2: manipulating forecasts: focus on elements of regret

Study 1 provided initial evidence supporting the presence of forecasting errors in anticipated regret and the importance of examining the two elements of regret separately in the context of these errors. Results of Study 1 also revealed the unique impact of forecasted regret (especially the affective component) on well-being. In Study 2, we sought to replicate these findings while also attempting to reduce the type of forecasting errors typically found in research on regret (Gilbert et al. 2004) by manipulating forecasters' focus on either the affective or cognitive element of regret. As in Study 1, some participants (i.e., Forecasters) made forecasts about a possible negative outcome. However, unlike Study 1, the Forecasters were randomly assigned to focus on either the affective or cognitive aspects of the regrettable situation prior to forecasting regret. Unlike Study 1, Forecasters in the current study did not subsequently experience the negative event. Instead, a separate group of participants (i.e., Experiencers) experienced the negative outcome. All participants then provided ratings of either forecasted (Forecasters) or experienced (Experiencers) regret.

In addition to replicating the impact bias found in Study 1, we also examined if focusing on a specific element of regret could directly influence said impact bias. Research on focalism suggests that people might overestimate the emotional impact of future events because they focus on the event in question and neglect more persistent aspects of their lives and the context that are less focal (e.g., Wilson

et al. 2000). Given this research, we reasoned that forecasting errors of overall regret could be reduced or even eliminated by having participants focus on the cognitive aspects of the regrettable situation rather than the affective aspects (Hypothesis 3). Asking individuals to focus on the cognitive aspects of a regrettable situation might encourage them to consider the broader context and therefore make more accurate forecasts. Consequently, we predicted that we would replicate the impact bias for participants in the Affective Focus condition, but would not observe forecasting errors for participants in the Cognitive Focus condition. This approach would allow us to directly address the classic forecasting bias seen in past work (e.g., Gilbert et al. 2004).

Method

Participants

We collected data from 76 undergraduate students enrolled in an undergraduate psychology course (20 males; $M_{age} = 20.97$, $SD_{age} = 3.08$). Participants received course credit for their participation.

Materials

Monty hall task As in Study 1, we used the Monty Hall task to create a regrettable situation for our participants, and the game was again rigged such that all participants either imagined or experienced failure (i.e., they chose the wrong door and would not be entered into the raffle to win the gift certificate).

Forecast focus manipulation Forecasters followed the same initial format as in Study 1, but were randomly assigned to receive modified instructions that would focus them on either affective ($n = 27$) or cognitive elements ($n = 26$) of the regrettable situation. Specifically, participants in the **Affective Focus condition** (in bold) and *Cognitive Focus condition* (in italics) read the following:

Please take a few moments to imagine this situation. Try to vividly imagine your [**feelings/thoughts**] if you really chose a goat and you missed out on earning a gift card.

In the space below, please describe these feelings (e.g., [**experiencing self-blame, feeling sorry or guilty/wishing you had decided differently, thinking of how things would have gone better if you had chosen another option**]) so that someone else would experience the feelings you are imagining.

Regret elements scale We again assessed participants' levels of forecasted or experienced regret using the RES

Table 3 Scale AND Subscale Cronbach's alpha values for the forecasted RES and experienced RES in study 2

RES subscales	Cronbach's alpha values
Forecasted	
RES-T	0.91
RES-C	0.90
RES-A	0.88
Experienced	
RES-T	0.86
RES-C	0.85
RES-A	0.87

(Buchanan et al. 2016). Participants in both forecasting conditions (i.e., Cognitive Focus, Affective Focus) were instructed to read the statements and respond to them referencing the *possible* situation (RES_F). Participants in the Experience condition (n = 24) responded to the same statements with respect to the *experienced* situation (RES_E).

We again calculated three scores from each version of the scale completed by participants: overall regret (RES-T_F, RES-T_E), cognitive element (RES-C_F, RES-C_E), and affective element (RES-A_F, RES-A_E). See Table 3 for all scale and subscale Cronbach's alphas.

Procedure

Participants completed all manipulations and measures electronically via computer. After providing informed consent, all participants were given a description of the Monty Hall task and were told that if they successfully chose the correct door, they would be entered into a drawing for a \$25 gift card to a restaurant of their choosing.

After reading these instructions, participants were randomly assigned to one of three conditions. Participants in the two Forecasting conditions (i.e., Affective Focus, Cognitive Focus) imagined choosing the wrong door and to spend a few minutes thinking and writing about the situation. As outlined above, we modified the instructions to focus participants on either the affective or the cognitive aspects of the regrettable situation. They then completed the RES to measure how much of the affective and cognitive components of regret they would expect to feel if such an outcome occurred. Unlike Study 1, these participants did not participate in the actual Monty Hall task and were taken to the end of the study. Participants in the Experience condition proceeded directly to the game where they all experienced failure (i.e., learned that they had chosen the incorrect door). After participating in the game, participants completed the RES measuring their experiences of the affective and cognitive components of regret.

After completing the questionnaire, participants were thanked for their time and debriefed. They were informed

that there was no way they could have succeeded in the Monty Hall task, and that they would be entered into the drawing for the \$25 gift card.

Results

Manipulation check

As a manipulation check, researcher assistants familiar with the distinction between the elements of regret but unaware of the study conditions read through participants' written responses, coding for the absence or presence of affect and cognition. Independent samples *t*-tests suggest that participants wrote about feelings significantly more in the Affective Focus condition ($M = 0.93$, $SD = 0.26$) compared to the Cognitive Focus condition ($M = 0.33$, $SD = 0.48$), $t(51) = 5.77$, $p < 0.001$, 95% CI [0.39, 0.86]. In contrast, participants wrote significantly more about thoughts in the Cognitive Focus condition ($M = 0.58$, $SD = 0.50$) compared to the Affective Focus condition ($M = .31$, $SD = 0.47$), $t(47.76) = -2.02$, $p < 0.05$, 95% CI [-0.54, -0.004]. This suggests that our manipulation had the intended effect of focusing participants on either the affective or cognitive aspects of the situation.

Forecasting errors—forecasts versus experiences

We first examined possible forecasting errors for overall regret and each element of regret separately (Buchanan et al., 2016). One-way ANOVAs revealed significant differences among conditions for overall regret (RES-T: $F(2,74) = 9.57$, $p < 0.001$), the affective element (RES-A: $F(2,74) = 11.10$, $p < 0.001$), and the cognitive element (RES-C: $F(2,74) = 4.73$, $p = 0.012$). We conducted planned comparisons to examine potential differences between forecasts (i.e., combining Affective Focus and Cognitive Focus conditions) and experiences of regret as measured by the RES (i.e., RES-T, RES-C, RES-A). In line with previous work, we found evidence for the impact bias (see Table 4 for means and standard deviations). Supporting the within-groups analyses from Study 1, between-groups analyses suggested that Forecasters *expected* to feel more overall regret (RES-T) than Experiencers *reported* feeling, $t(74) = -3.33$, $p = 0.001$, $d = 0.87$.

As in Study 1, we also conducted a 2 (time point: forecast vs. experience) \times 2 (element: cognitive vs. affective) mixed-measures ANOVA to examine the possible impact bias effect for the affective and cognitive components of regret. Consistent with Study 1, we found significant main effects for both time point, $F(1,75) = 6.07$, $p < 0.02$, and element, $F(1,75) = 131.46$, $p < 0.001$. However, unlike Study 1, there was a significant interaction, $F(1,75) = 5.91$, $p < 0.02$. Examination of the simple effects via independent-samples

Table 4 Descriptive statistics in study 2

	M	SD
Cognitive Focus Cond RES-T	3.82	0.99
Affective Focus Cond RES-T	4.66	1.31
Combined Forecasted RES-T	4.25	1.23
Combined Forecasted RES-C	4.94	1.32
Combined Forecasted RES-A	3.55	1.44
Experienced RES-T	3.34	0.94
Experienced RES-C	4.41	1.28
Experienced RES-A	2.27	0.95

N = 76

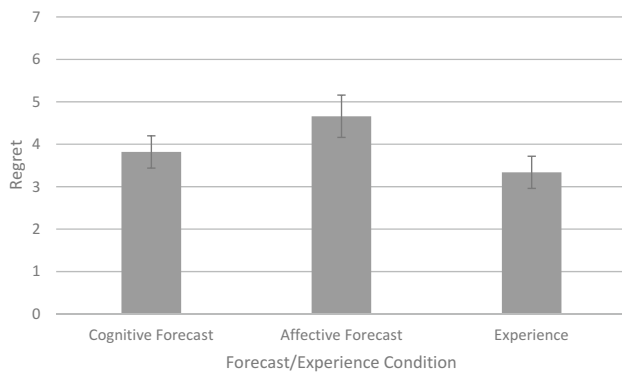


Fig. 2 Forecasts versus experiences of overall regret (study 2)

t-tests uncovered a similar pattern to that of Study 1. That is, Forecasters expected to experience more regret-related affect than Experiencers actually reported feeling, $t(74) = -4.08$, $p < 0.001$, $d = 1.07$, whereas the parallel effect for the cognitive component of regret (RES-C) was not significant, $t(74) = -1.69$, $p > 0.05$. In other words, people expected to experience more regret-related affect, but not more regret-related thoughts, than others actually experienced.

Impact of focus manipulation on forecasting errors

To examine the impact of our manipulation on forecasting errors, we compared ratings of overall regret of the Experiencers to those in the Affective Focus condition and Cognitive Focus condition separately (Fig. 2). This set of analyses allowed us to examine whether forecasting errors might be reduced or even eliminated when people focus on their thoughts or the cognitive aspects of a regrettable situation prior to making their forecasts.

For participants in the Affective Focus condition, we found evidence of the impact bias. Specifically, participants in the Affective Focus condition expected to experience more overall regret (RES-T), $t(74) = -4.29$, $p < 0.001$, $d = 1.16$, than those in the Experience Condition reported

experiencing. Overall, we replicate the impact bias found in Study 1 and previous literature on affective forecasting and show that, when focused on the affect related to the negative experience, people expect to feel more regret than they might actually experience.

For those in the Cognitive Focus condition, however, we found no evidence of forecasting errors in overall regret, $t(74) = -1.53$, $p > 0.05$. Specifically, there were no differences between the forecasts of participants in this condition and actual ratings of experiences for overall regret (RES-T). In other words, we found evidence for the elimination of the impact bias for overall regret when participants focused on the cognitive aspects of the emotion and experience prior to making their forecasts.

Discussion

In Study 2, we asked forecasters to focus on either cognitive or affective aspects of regrettable situations with the enduring goal of examining forecasting errors as they relate to regret. Consistent with the results of Study 1 and previous research (e.g., Wilson and Gilbert 2005), Forecasters predicted more regret overall than Experiencers actually experienced. This finding offers support for Hypothesis 1A and provides further evidence for the impact bias. Interestingly, we found that Forecasters (i.e., Cognitive Focus + Affective Focus conditions combined) predicted more of the affective regret element but not the cognitive regret element compared to what experiencers reported when examining the two elements of regret separately. This finding mimics our results from Study 1, where significant differences arose for the affective element of regret but not the cognitive element. These findings may indicate that regret-related thought is simply easier to accurately predict than the feelings that accompany regret. One possible explanation for this is that individuals are simply less likely to fall victim to focalism when forecasting thoughts rather than feelings.

Building off of past research on focalism that suggests people overestimate the emotional impact of future events by focusing exclusively on the event and how it will impact their emotions (e.g., Wilson et al. 2000), we predicted that priming participants to focus on the cognitive aspects of the negative event would reduce forecasting errors. In line with Hypothesis 3, we found that although those in the Affective Focus condition demonstrated forecasting errors for regret as measured by the RES, those in the Cognitive Focus condition did not. Overall, these findings suggest that if individuals were to focus on the thought-related aspects of a potentially regrettable future event, they would make fewer or less severe forecasting errors and therefore be equipped with the ability to make the best possible decision without as much fear of emotional consequences.

General discussion

Previous research on regret and forecasting shows that regret, similar to other emotions, often falls prey to the impact and durability biases, which result in forecasting errors (Gilbert et al. 1998; Wilson et al. 2000; Wilson and Gilbert 2003, 2005). People often predict both longer-lasting and more intense feelings of regret than they actually experience. These errors in the prediction of future emotion can have a profound impact on motivation, decision-making, and behavior (e.g., Dunn and Laham 2006; Wilson and Gilbert 2005). The present work adopts the recent, empirically supported conceptualization of regret as being comprised of two distinct components (Buchanan et al. 2016) and examined affective forecasting errors within that framework. Specifically, we investigated how accurately individuals are able to predict the components of regret, offered insight into the relationship between regret ratings and well-being, and explored a method of reducing forecasting errors of regret.

Across two studies, we report consistent evidence that affective forecasting errors are common when making predictions about future regret. Furthermore, we demonstrate that the two elements of regret produce different results when examining their influences on well-being, the likelihood of committing forecasting errors, and eliminating such errors. The reliability of our findings is strengthened by our multiple study format and ability to replicate previous research, as well as our own findings across our two studies. In Study 1, participants anticipated feeling more regret compared to what they themselves reported experiencing. Although this effect emerged for overall regret as well as the affective component of regret, forecasters did not anticipate significantly more of the cognitive component than they experienced. In addition, we found evidence that forecasted regret was a significant and independent predictor of well-being outcomes, even when accounting for experienced regret, and these effects were particularly pronounced for the affective component. In Study 2, we manipulated focus on the components of regret and found that individuals who were asked to focus on cognitive (vs. affective) aspects of regret no longer exhibited forecasting errors.

Across two studies, utilizing both between- and within-subjects procedures, this work extends research on regret and affective forecasting in a number of ways. The current work examines forecasting errors in connection with regret, a subject rarely documented in the literature (cf. Gilbert, et al. 2004). This study also utilizes a recently developed scale that defines regret in relatively novel terms: consisting of related but distinct elements, specifically affective and cognitive components (Buchanan et al.

2016). Lastly, the present research uniquely merges the standing knowledge on these elements of regret and on affective forecasting to examine differences between forecasts and experiences of these elements and their ability to predict well-being outcomes above and beyond experienced emotion.

Past research has focused on a possible procedural artifact that calls into question much of the affective forecasting literature. Levine et al. (2012) claimed that many forecasting errors were likely a result of researchers referencing the event in the forecast condition but asking participants to report on their feelings in general in the experience condition. Whereas participants interpret the wording in the forecasting condition to mean that they should only predict their response in reference to the specific event mentioned, many other factors likely influence general responses in the experience condition. To remedy this possible alternative explanation of results, we maintained consistency by prompting participants to report their feelings (forecasted or experienced) “about this situation” rather than in general. By referencing the event in both the forecast and experience portions of the study, we avoid this potential methodological issue.

Despite these strengths, this research was not immune to limitations. For example, although using the Monty Hall task allowed for control, as all participants imagine and/or experience the same event and outcome, this task may exhibit low generalizability to real-world experiences. Future research could examine the interface between affective forecasting and the components of regret using recalled or social experiences as the method of priming regret. Doing so would increase confidence that these findings have significant and meaningful implications for everyday life. Specifically, regret elicited from failure on the Monty Hall task is unlike regret arising from more emotional or high-stakes real-world circumstances. For example, Morrison et al. (2012) found that feelings of regret are more intense when a poor decision affects one’s sense of social belonging. Furthermore, regret may be heightened when one’s personal stake in the decision is greater than merely a missed opportunity to win a gift card. As such, whether greater amounts of regret would change the current set of findings remains an empirical question.

Additionally, as with any prospective thought process, the event or outcome imagined may well be different than the actual event or outcome, contributing to errors in predicting emotional responses to the event. In our study, the description of the Monty Hall problem and participants’ subsequent imagination of the scenario involving their performance were not equivalent to the experience of the problem itself. For example, the description and subsequent imagination may have led some participants to think that they ought to be able to solve the problem readily, but once they experienced it, they might have realized that the problem was

much harder than they expected, and therefore not a problem they should regret not being able to solve. However, it seems just as likely that some participants read the description, focused on the task complexity when imagining their performance, and, in contrast, found the task to be a simple one, producing more regret for making the wrong choice than they had anticipated. Rather than a confound, the differences in the event that emerge when imagining the event vs. actually experiencing the event are at the heart of many theories related to affective forecasting error (e.g., Wilson and Gilbert 2003; Woodzicka and LaFrance 2001) and likely contribute to many of the forecasting errors we see in the literature and in the current study.

The notion that we expect to feel more regret following a negative event than we actually experience, and the knowledge that these expectations may be associated with lower well-being, has implications for daily decision-making. For example, people may make suboptimal decisions out of fear for the negative emotional experience they expect to occur, when in reality they will likely adapt to the negative event much quicker than anticipated. This scenario applies to a wide range of decisions, such as whether or not to end a bad relationship or whether or not to undergo a necessary medical procedure with possible adverse effects. Being able to accurately predict one's future reactions to negative events might ultimately lead to better decision-making.

Conclusions

Previous research has established that affective forecasting errors are common and impactful, yet the severity and consequences of these forecasts as they relate to regret and its components have received little attention. Like other emotions, regret appears to fall prey to the impact bias in forecasting. The current research outlines a more nuanced approach to studying forecasting errors in regret. Results suggest that forecasting errors in regret are common, are consequential for well-being, and differ based on the specific component of regret under investigation. Further, this research identifies a possible method for reducing such errors, by focusing forecasters on the cognitive element of regret. The findings suggest several avenues for future research in the important, yet largely unexplored area of regret forecasting.

Compliance with ethical standards

Conflicts of interest Tonya M. Buchanan declares that she has no conflict of interest. Joshua Buchanan declares that he has no conflict of interest. Kylie Kadey declares that she 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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