# ANXIETY AND AFFECTIVE FORECASTING

A Thesis

by

VAN DANG

Submitted to the Graduate and Professional School of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

| | |
|---|---|
| Chair of Committee, | Heather Lench |
| Committee Members, | Rebecca Brooker |
| | Jeffrey Liew |
| | Rachel Smallman |
| Head of Department, | Mindy Bergman |

August 2023

Major Subject: Clinical Psychology

ABSTRACT

Affective forecasting is critical for effective decision making as people strive to attain goals that increase positive feelings and decrease negative feelings. Despite its importance in relation to choice, research has shown that forecasts of future feelings are often biased. Individual characteristics, such as anxiety, influence people's predictions of their future emotions. However, there is scant, and often contradictory, research on affective forecasting and its pertinent mechanisms in anxious individuals. Further investigation into biased forecasts in this population is important, as highly anxious individuals exhibit cognitive biases that result in maladaptive behaviors and impair functioning. This study examined whether perceived lack of control, a vulnerability underlying the etiology of anxiety, influences forecasts of negative emotion in highly anxious individuals. Participants were told about an opportunity to participate in a paid study, in which they would be evaluated and selected based on their performance on a pre-screen task. Participants then predicted how they would feel in response to being selected or rejected. Once participants completed the pre-screen task, they were told that they were rejected from the paid study and were asked to report their emotional experiences. Findings revealed that when highly anxious individuals were in a condition with high versus low control over decisions, they demonstrated greater forecasting bias of negative emotion, predicting they would be more upset than they actually were. This suggests that increased perceived control may actually heighten highly anxious individuals' negative affect about negative outcomes, thus perpetuating biased forecasts in this population. Results did not demonstrate any meaningful relationships among affective forecasts, emotional experiences, and affective memory.

CONTRIBUTORS AND FUNDING SOURCES

## Contributors

This work was supervised by a thesis committee consisting of Professors Heather Lench, Rebecca Brooker, and Rachel Smallman of the Department of Psychological and Brain Sciences and Professor Jeffrey Liew of the Department of Educational Psychology.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

# 1. INTRODUCTION

People make choices on a daily basis, ranging from the inconsequential such as which food to eat to the utmost importance such as moving to a new state. To make choices, people rely in part on their affective forecasts: predictions about how they will feel in response to future events. Despite the importance of these forecasts for decisions, research has shown that people show consistent biases in forecasts that can result in inaccurate predictions. One source of bias is individual differences that appear to influence how people respond to events and think about future events. The focus of this investigation is on trait differences in the tendency to experience anxiety. Those with elevated anxiety symptoms have been shown to mispredict their emotional reactions, overestimating their future emotions (Arditte Hall et al., 2018; Arditte et al., 2020; Dev et al., 2022; Wenze et al., 2012). The consequences of biased affective forecasts may be particularly harmful for those suffering from anxiety because people who are anxious tend to avoid situations that they anticipate will be negative (Arnaudova et al., 2017). The current study examines whether perceived control influences affective forecasting biases in individuals with higher trait anxiety. Additionally, we also investigate whether affective forecasts predict affective memories above and beyond actual emotional experiences.

## 1.1 Anxiety and Affective Forecasting Bias

Research on affective forecasting has primarily focused on the accuracy of people's predictions about their future emotions by comparing their predictions and actual emotional experiences. A discrepancy between forecast and experience is therefore termed "affective forecasting bias." The focus on bias was due to a concern that people's ability to make informed decisions is impaired by inaccurate predictions about their future responses to outcomes. Research evidence has consistently demonstrated that people are not quite adept at predicting

how they will feel in response to future events, frequently overestimating future emotion (e.g., Wilson & Gilbert, 2005). Under different conditions and motivations, people also can be accurate or underestimate their future emotions (Dunn et al., 2007; Lench et al., 2011). While people may think that they generally make informed decisions based on objective facts, research findings have revealed that predicted emotions influence judgments and decision-making to a greater degree (Charpentier et al., 2016; DeWall et al., 2015). Thus, given that people make choices based on their anticipated emotional outcomes, biased forecasts may result in erroneous judgments and poor decisions.

A number of factors have been shown to influence affective forecasting biases, suggesting that predicting how one would feel about a future event is a complex process in which several underlying mechanisms are involved. Individual differences in anxiety-related symptoms, such as social anxiety as well as trait anxiety, have been linked to biases in affective forecasting (Arditte Hall et al., 2018; Arditte et al., 2020; Martin & Quirk, 2015; Dev et al., 2022; Wenze et al., 2012). Specifically, findings consistently suggest that people with elevated symptoms of anxiety tend to overestimate their future negative emotions (Arditte Hall et al., 2018; Arditte et al., 2020; Martin & Quirk, 2015; Dev et al., 2022; Wenze et al., 2012). In other words, these individuals exhibit the propensity to predict that future events will make them feel worse than they actually feel. Although some studies have failed to establish the relation between affective forecasting biases and symptoms of anxiety (Mathursal & Ruscio, 2020; Hughes et al. 2022), the growing evidence supporting the link between affective forecasting biases and anxiety begs the question of what potential mechanisms are driving biased forecasts in highly anxious individuals. Within this vein, researchers have proposed that affective forecasting biases may

even serve as a cognitive vulnerability factor of emotional disorders (Arditte Hall et al., 2020; Dev et al., 2022).

Affective forecasts motivate individuals to pursue decisions and goals that will bring about outcomes that result in positive emotions and avoid those that result in negative emotions. In a normal context, it makes sense that people want to avoid situations that would elicit aversive emotional reactions. However, what happens when anxious individuals persistently overestimate how badly they will feel in response to innocuous events? Based on previous work on avoidance behaviors in anxiety, problems arise when this pattern of overestimation perpetuates. Accumulating evidence suggests that anxious individuals possess the proclivity to interpret emotionally ambiguous events as threatening (e.g., Amir et al., 2005; MacLeod & Cohen, 1993). Further, they exhibit an attentional bias that favors threats or negative stimuli (Bar-Haim et al., 2007). As a result, anxious individuals typically expend a great amount of effort and resources to avoid any events that they deem as negative or threatening until their resources are depleted.

Consequently, excessive avoidance behaviors, a pivotal feature of anxiety, can impair functioning by preventing people from pursuing and achieving important life goals (Salters-Pedneault et al., 2004). Further, excessive avoidance can worsen functioning over time as it precludes adaptive learning from occurring (Hayes & Wilson, 1994). For instance, individuals with social anxiety may attempt to avoid social events at all costs so that they can spare themselves from experiencing negative emotions and the physiological reactions that are associated with anxiety. However, this pervasive avoidance pattern will further exacerbate anxiety symptoms, and prevent socially anxious individuals from disconfirming their dysfunctional cognitions and learning adaptive behaviors. Understanding the processes that contribute to bias in affective forecasting is therefore particularly important in relation to anxiety.

## 1.2 Anxiety and Perceived Control

Evidence suggests that perceived lack of control is central to the experience of negative emotion and has important implications for various emotional disorders, including anxiety (Barlow, 1991, 2000, 2004; Chorpita & Barlow, 1998). Furthermore, theorists consider low perceived control as a transdiagnostic factor across anxiety disorders (Gallagher et al., 2014), as it has been shown to predict elevated symptoms of obsessive-compulsive disorder (OCD; Brown & Naragon-Gainey, 2013; Moulding & Kyrios, 2007), posttraumatic stress disorder (PTSD; e.g., Vujanovic et al., 2010), generalized anxiety disorder (GAD; Brown & Naragon-Gainey, 2013; Stapinski et al., 2010), as well as trait anxiety (e.g., Brown et al., 2004). To further elucidate this relationship, the triple vulnerabilities model of psychopathology was proposed to explicate the interacting vulnerabilities that contribute to the development and maintenance of anxiety disorders (Barlow, 2000, 2004). In this model, Barlow (2000, 2004) suggested that a diminished perception of control over negative events and emotional experiences serves as an underlying psychological vulnerability that predisposes individuals to the experience of anxiety. According to Chorpita and colleagues (1998), early exposure to uncontrollable life factors, such as family structures and parenting styles, can result in a diminished perception of control over external environment as well as internal experiences. Specifically, this lack of perceived control gradually becomes manifested in a more external locus of control and subsequently contributes to increased negative emotions and the development of anxiety.

Furthermore, prior investigations suggest that perceived control plays an important role in emotion regulation. For example, Scott and Weems (1994) found that perceived control predicted resting vagal tone, a physiological indicator of emotion regulation that was associated with decreased anxiety. In addition, multiple experimental studies revealed that individuals who

did not have control over stressful stimuli demonstrated heightened fear responses, greater negative affect, and increased stress levels (Amat et al., 2005; Maier & Watkins, 2005; Mohr et al., 2012). Perceived control has also been shown to attenuate the impact of pain through a reappraisal process that decreased the threat levels of pain (Arntz & Schmidt, 1989; Salomons et al., 2004; Mohr et al., 2005) and activate areas in the brain that are involved in high-level appraisal processes (Kalisch et al., 2006a, 2006b; Wiech et al., 2006). In other words, perceived control operates by changing people's perception and appraisal of pain, which in turn reduces its threat levels. Based on these previous findings, perceived control may play a role in skewing anxious individuals' affective forecasts. Specifically, anxious individuals may experience heightened negative affect when they evaluate a future negative event as uncontrollable, thus leading them to predict high intensity future negative emotions. At the time of actual experience, however, people are typically able to implement coping strategies that modulate their emotions, resulting in forecasts that are more intensely negative than experience (immune neglect; Hoerger et al., 2009; Hoerger, 2012; Gilbert et al., 1998).

### 1.3 The Perpetuation of Negative Forecasts

A continuing question in the literature on forecasting biases is why people continue to misestimate their future emotion. If accurate predictions are important to choice, then why do biases exist? Because people rely on their affective memory to inform decision-making, if their memories are biased, affective forecasts will therefore be biased. Findings suggest that people are not always accurate in recalling their affective memories (e.g., Safer & Keuler, 2002; Thomas & Diener, 1990). More specifically, people tend to exaggerate the intensity of their past emotional experiences, including both positive and negative affect (e.g., Manuel & Wade, 2013; Schrader et al., 1990; Wirtz et al., 2003).

To elucidate the mechanisms that contribute to biases in emotional memories, researchers have distinguished two systems by which memories for emotions operate: implicit memory and explicit memory. Implicit memories for emotions are not readily accessible to conscious awareness and are dependent on retrieval cues, yet they still have an influence on one's thoughts, feelings, and behaviors. In contrast, explicit memories for emotions can be deliberately retrieved and are accessible across situations. Robinson and Clore (2002a, b) argued that emotions do not persist in explicit memory. Instead, when people try to remember their past emotions, they reconstruct their experiences by recalling the contexts of the emotional experiences as well as their own beliefs about emotions. One key issue is that memory for contextual details of an event becomes less accessible after some time has passed. As a result, people increasingly rely on semantic knowledge about the types of emotions they and others typically feel in similar situations. Furthermore, as a result of this reconstructive process, memories for emotions not only include cues about the event and associated feelings, but also individual differences and beliefs about emotions. For instance, highly anxious individuals were shown to overestimate previous unpleasant emotions during delayed recall (Cutler et al., 1996).

Anxiety has been shown to relate to an increase in cognitive processing of threats (Amir et al., 2005; Barlow, 2002; MacLeod & Mathews, 2012) in ways that are likely to influence memory for negative information. Individuals with elevated trait anxiety, along with clinically anxious individuals, recall more threatening information compared to controls (Coles & Heimberg, 2005; Coles et al., 2007; Herrera et al., 2017). Furthermore, anxious individuals selectively remember and process more threatening cues (Mathews et al., 1989) as a means of keeping these memories alive to prepare themselves for future dangers (cognitive-motivational model of anxiety; Mogg & Bradley, 1998). According to Mogg and Bradley's theory, anxious

individuals continuously evaluate low-level threats as dangerous and consequently allocate much of their cognitive resources to detecting threats in their surroundings. This pattern of selective encoding and retrieval of threat cues may contribute to an increase in memory bias for negative experiences.

It is evident that memories for emotions serve a crucial role in effective decision making by permitting people to forecast their emotional responses in the future. Although accumulating evidence suggests that people demonstrate small but consistent biases in their affective memories, research that concurrently explores predictions and memories within the same anxious individuals has been scant and contradictory. When evaluating memory biases within a clinical population, Mathersul and Ruscio's (2020) results revealed that adults who suffered from GAD demonstrated stronger negative memory bias compared to healthy controls. On the other hand, two other studies examined memory biases in a nonclinical population; and they failed to demonstrate an association between anxiety and memory biases (Hughes et al., 2022; Wenze et al., 2012). Given these inconsistent findings and the lack of understanding regarding the mechanisms underlying biases, it will be informative to investigate whether anxious individuals rely solely on their actual experiences to construct their memories for emotions, or if predictions also play a role in informing their emotional retrieval process. If forecasts of emotion predict memory for emotion above and beyond the experienced emotion, this provides one path through which biased forecasts could perpetuate over time. In other words, it would suggest that memories for past events are biased by what people thought would happen rather than what did happen. As people determine their future decisions and goals based on how similar events in the past had made them feel, if their memories for emotions are inaccurate, biased forecasts will consequently be perpetuated. This pattern of biases may be particularly harmful for anxious

individuals given their pervasive avoidance behaviors as it may contribute to maintenance of dysfunctional cognitions and prevention of adaptive learning.

### 1.4 The Present Study

Given the crucial role of forecasts to choice, it is imperative to determine the cognitive mechanisms that influence forecasts in anxious individuals, potentially including perceived control. As mentioned previously, perceived control modulates emotions through high-level appraisal processes (Kalisch et al., 2006a, 2006b; Wiech et al., 2006), thus aversive stimuli are perceived as less threatening when individuals appraise that they have control over them. A lack of perceived control, therefore, may influence anxious individuals' emotional predictions in response to events. More specifically, we predict that changes in perceived control is relevant to anxious individuals' predictions of negative but not positive affect. In other words, when highly anxious individuals appraise that they have control over an event, they may perceive the event as less threatening. However, if they perceive the event as out of their control, it will increase their negative emotion, thus exaggerating their negative affective forecasts. Based on previous work on immune neglect (Hoerger et al., 2009; Hoerger et al., 2012; Gilbert et al., 1998), we predict that changes in perceived control will not have an influence on anxious individuals' experienced emotions, resulting in biased affective forecasting. The present investigation additionally explores the degree to which memories for emotions are influenced by people's predictions about how they would feel as well as their actual emotions. This has the potential to elucidate processes that may be maintaining biased forecasts in anxious individuals.

# 2. METHODS

## 2.1 Participants

Participants were recruited via a psychology subject pool at Texas A&M University. Participants were compensated with course credits for their participation. A statistical power analysis was performed to estimate the sample size needed to detect a medium effect size *f* of .25 with an alpha of .05 and power of .8. We computed an a priori g*power for a 2 x 2 fixed effects ANOVA and yielded a sample size of 128. Therefore, we propose a sample of 200 to allow for nonrespondents and attrition over time. Our final sample size consisted of 76 participants (62.5% female, 35.9% male, 1.6% responding as "other") with a mean age of 18.9 years (*SD* = 1.08). Therefore, based on our final sample size and an effect size of 0.03 for the primary analysis (interaction between trait anxiety and control for affective forecasting bias of unhappiness), we had an observed power of 0.28. Out of the 76 participants that completed the Time 1 surveys, 64 participants completed the Time 2 survey that assessed affective memory. Participants identified as White (57.8%), Asian (17.2%), Hispanic (15.6%), African American (3.1%), and multiracial (6.3%).

## 2.2 Materials and Procedures

To elicit an emotional response within the lab setting, we utilized a scenario previously used in affective forecasting studies and shown to generate a large effect size (Gilbert et al., 1998: Study 6; Lench et al., 2019: Study 3, Study 4, Study 5; *g* = 1.06). Upon arrival, all participants were told that local businesses were seeking students to report their opinions on a product in a brief study for pay ($40), and they were working with the researchers to prescreen participants for that study. Participants were told that, if they were not selected, they would complete an alternative questionnaire that required more time than the paid study. An

experimenter explained that participants needed to complete a prescreen task that required them to respond to ten questions into a microphone. Their responses were evaluated by three business students located in an adjoining room to determine whether they would be selected for the paid study. Potential participants were only rejected if all three of the business students unanimously conclude that the "applicant was unfit for the job."

Participants were then given the instructions to complete the prescreen task. To manipulate perceived control, participants were randomly assigned to two conditions (low control and high control). In this experimental design, perceptions of control were manipulated through the provision of choices based on evidence that availability of options in a stressful situation could increase perceived control (Paterson & Neufeld, 1995). Furthermore, perceived control was manipulated by verbally informing participants of the levels of control they had since previous findings have demonstrated that activating thoughts about control can influence people's behaviors (e.g., Bargh & Chartrand, 1999; Rotenberg et al., 2005). Participants in the high control group were told that they "will have a lot of control over the task," while participants in the low control condition were told that they "will not have any control over the task." Participants in the high control condition were instructed as followed, "You will be able to as much time as you would like to prepare your responses to each of the questions. If you want to write down your answers on the sheet of paper, you are more than welcome to. You can choose to respond to as many questions from the list as you would like, and you can respond to them in whichever order you prefer." In contrast, participants in the low control condition were not permitted time to prepare their responses. They were told, "You must answer the questions in the order in which they appear. Your answers should be short, about two to three sentences, and you will only have three minutes to answer them."

Immediately after the instructions for the prescreen task, participants were told to complete a preliminary survey that, as part of the agreement with the local businesses, the researchers had been permitted to administer to participants. For this preliminary survey, participants forecasted how they would feel after finding out the business students' decisions; forecasts were made for being chosen for the study and for not being chosen for the study. Participants forecasted the intensity of their feelings: "Suppose you are [not] chosen for the brief study with pay. Ten minutes after finding out, how will you feel about [not] being chosen for the study?" They forecasted how happy and unhappy they would feel on scales ranging from (1) *not at all* to (9) *extremely*. Then they responded to an "ambiguous emotion" question: "Ten minutes after finding out, how will you feel in general?" using the same scales. Participants completed the State-Trait Anxiety Inventory – Trait scale (STAI; Spielberger et al., 1983). The STAI-Trait scale is a 20-item self-report assessing an individual's disposition to respond with anxiety when encountering situations perceived as threatening. Each item is rated on a 4-point scale ranging from (1) *Almost never* to (4) *Almost always*. A total score for the scale is obtained by computing a composite score, with higher scores indicating higher levels of trait anxiety.

After completing the forecasting survey, participants were instructed to begin the prescreen task and reminded that they are being evaluated by business students. The research assistant left the participants alone in the room to answer the questions into the microphone. The research assistant entered the room at the three-minute mark to stop the participants in the low control condition, whereas participants in the high control condition had an unlimited amount of time to respond to those questions. Once the participants were done with the prescreen task, the research assistant informed the participants that the evaluators' decision should be ready shortly. The research assistant left the room when an associate knocked on the door and returned with an

envelope. The research assistant handed the envelope that contained the decision to the participant. There was a letter indicating that the participant was rejected for the paid study.

The research assistant then asked the participants to complete the alternative (unpaid) survey because they were not selected to try out the products. In this survey, participants reported whether they were selected for the study with pay. They rated their general perception of control: “How much control do you think you have?” Then, participants reported their emotional reactions to not being selected, “How did you feel about not being chosen for the study with pay?” One week after completing their laboratory study, participants were reminded via email to fill out a brief online follow-up survey to recall their emotional experiences during the study, “A few minutes after finding out that you were not chosen, how did you feel about not being chosen for the study with pay?”

# 3. RESULTS

## 3.1 Preliminary Analyses

Affective forecasting biases of happiness and unhappiness were computed by subtracting participants' actual experiences from their forecasts. Positive values represent an overestimation of emotion, and negative values indicate an underestimation of emotion. Similarly, affective memory bias was computed by subtracting actual emotional experiences from affective memory ratings. A positive value represents an overestimation and a negative value represents an underestimation of emotions. In addition, STAI-Trait total scores were computed by summing participants' responses; and I categorized participants into low and high anxiety group using a clinical cut-off score of 44, which has been shown to adequately detect clinical levels of anxiety (Ercan et al., 2015). Descriptive statistics and correlations for trait anxiety, perceived control, affective forecasts of happiness and unhappiness, and affective memory of happiness and unhappiness are shown in Table 1.

Table 1. Correlations among variables

| Variable | *N* | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Trait anxiety | 70 | 40.53 | 9.59 | | | | | | | |
| 2. Perceived control | 77 | 3.06 | 0.95 | -0.38** | | | | | | |
| 3. Forecasts - Happiness | 77 | 4.23 | 1.61 | -0.11 | 0.09 | | | | | |
| 4. Forecasts - Unhappiness | 76 | 4.61 | 1.83 | 0.14 | -0.01 | -0.62** | | | | |
| 5. Experience - Happiness | 77 | 4.14 | 1.95 | -0.10 | 0.14 | 0.25* | -0.15 | | | |
| 6. Experience - Unhappiness | 77 | 4.38 | 2.82 | -0.18 | 0.1 | -0.05 | 0.22 | 0.13 | | |
| 7. Memory - Happiness | 57 | 4.65 | 1.77 | -0.03 | 0.01 | 0.11 | -0.09 | -0.01 | -0.28* | |
| 8. Memory - Unhappiness | 56 | 4.11 | 1.86 | 0.04 | 0.22 | -0.16 | 0.28* | 0.01 | 0.26 | -0.35** |

**$p < .001$, *$p < .05$

To determine whether participants demonstrated overall affective forecasting biases, I conducted one sample t-tests to compare forecasts of happiness and unhappiness against zero. Results suggested there was no overall affective forecasting bias of happiness, $t(75) = 0.32$, $p =$

0.75, *CI* 95% [-0.41, 0.57], $d = 2.16$, as well as affective forecasting bias of unhappiness, $t(74) = 0.71$, $p = 0.48$, *CI* 95% [-0.45, 0.96], $d = 3.08$. Similarly, to assess for memory biases, I conducted one-sample t-tests to compare participants' affective memory of happiness and unhappiness against zero. Findings yielded no meaningful affective memory bias of happiness, $t(63) = 1.34$, $p = 0.81$, *CI* 95% [-0.22, 1.13], $d = 2.70$, and affective memory bias of unhappiness, $t(63) = -0.07$, $p = 0.94$, *CI* 95% [-0.87, 0.81], $d = 3.41$.

Additionally, I conducted an independent samples t-test to assess whether the experimental manipulation was effective in evoking different levels of perceived control. The findings demonstrated that participants in the low control condition reported lower perception of control ($M = 2.90$, $SD = 1.02$) compared to participants in the high control condition ($M = 3.24$, $SD = 0.85$), but this difference was not significant, $t(74) = -1.59$, $p = 0.12$, *CI* 95% [-0.78, 0.09], $d = -0.37$.

### 3.2 Anxiety, Perceived Control, Affective Forecast, Actual Experience, and Affective Memory

First, to examine whether changes in trait anxiety levels and perceived control conditions influenced forecasts of emotion, I conducted a series of 2 (perceived control: low control, high control) x 2 (trait anxiety: low trait anxiety, high trait anxiety) ANOVAs. Mean differences for forecasts of happiness and unhappiness are shown in Figure 1a. There was no main effect of anxiety, $F(1, 65) = 1.41$, $p = 0.24$, $n_p^2 = 0.02$, and no main effect of perceived control, $F(1,65) = 0.58$, $p = 0.45$, $n_p^2 = 0.01$. The two-way interaction between perceived control and trait anxiety was not significant, $F(1, 65) = 0.001$, $p = 0.97$, $n_p^2 < 0.001$.

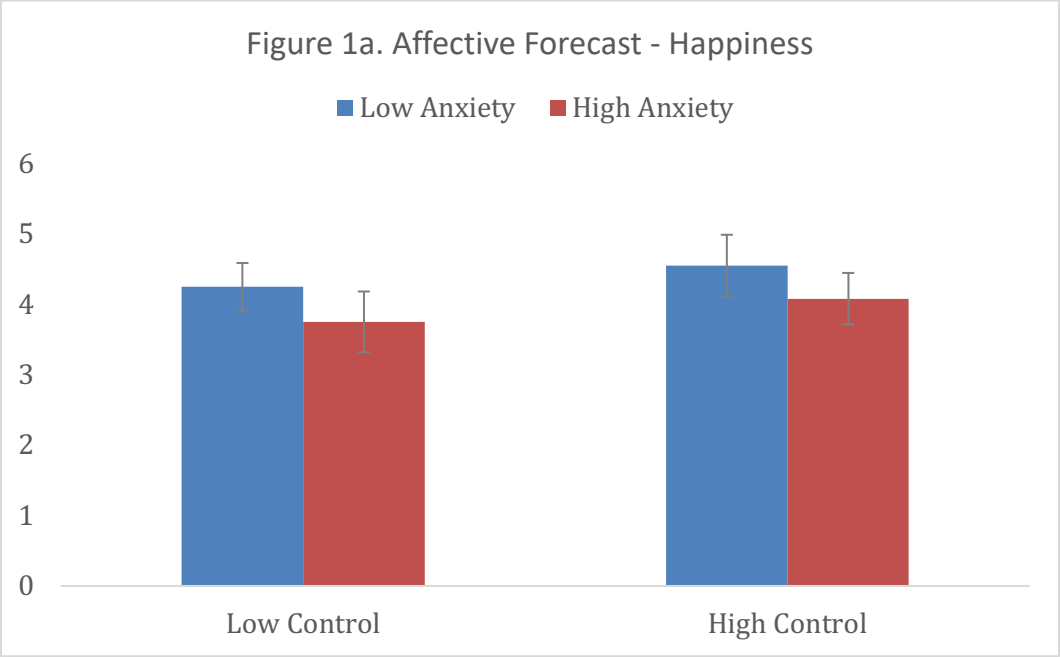


**Figure 1. Affective forecasts of happiness and unhappiness**

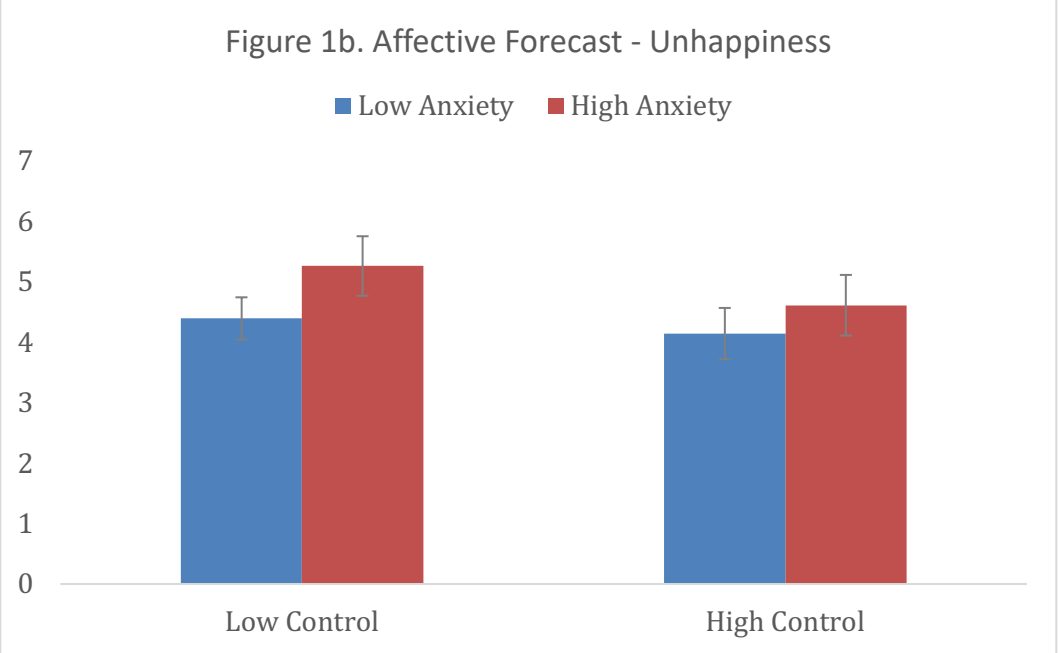


**Figure 1. Continued**

Then, to assess whether trait anxiety and perceived control influenced participants' affective forecast of unhappiness, I conducted a 2 x 2 ANOVA and found no significant main effect of trait anxiety, $F(1, 64) = 2.27$, $p = 0.14$, $n_p^2 = 0.03$, and no main effect of perceived

control, $F(1, 64) = 1.04$, $p = 0.31$, $n_p^2 = 0.02$. The overall interaction between trait anxiety and perceived control was not significant, $F(1, 64) = 0.21$, $p = 0.65$, $n_p^2 = 0.003$. Mean differences for participants' forecasts of unhappiness is shown in Figure 1b.

I conducted 2 (perceived control: low control, high control) x 2 (trait anxiety: low trait anxiety, high trait anxiety) ANOVAs to assess whether trait anxiety and perceived control had an effect on participants' emotional experiences in response to being rejected, particularly their feelings of happiness and unhappiness. The findings demonstrated that trait anxiety did not influence participants' experienced happiness, $F(1,65) = 0.03$, $p = 0.86$, $n_p^2 = 0.001$. Similarly, perceived control did not influence participants' reported happiness, $F(1,65) = 0.13$, $p = 0.72$, $n_p^2 = 0.002$. The overall interaction between trait anxiety and perceived control was not significant, $F(1,65) = 3.42$, $p = 0.07$, $n_p^2 = 0.05$. Mean differences for participants' reported happiness are shown in Figure 2a.

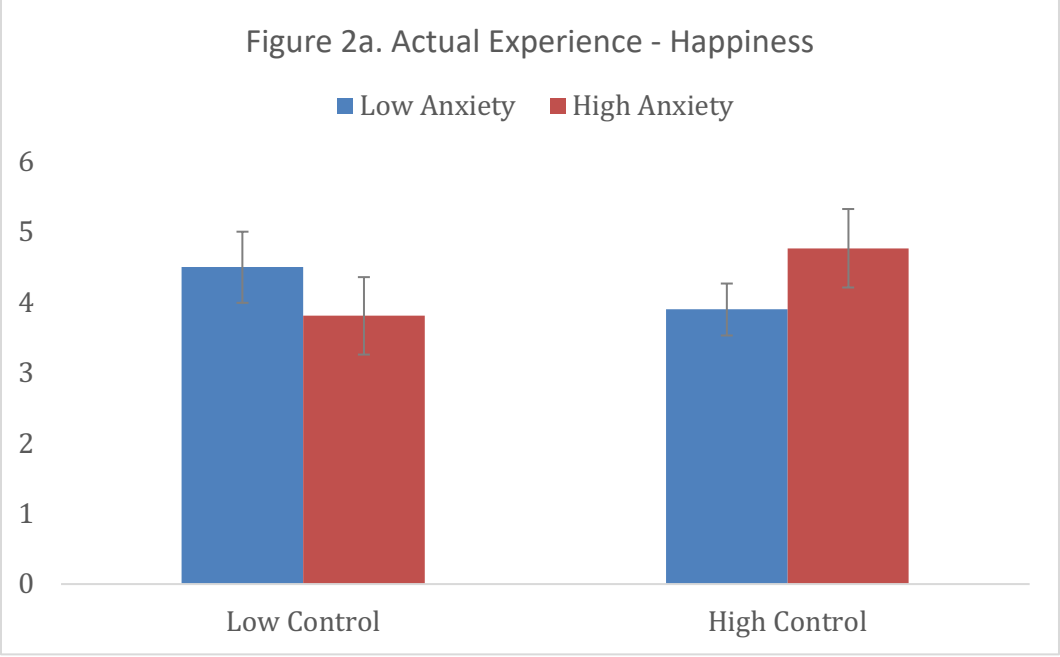


**Figure 2. Actual emotional experiences of happiness and unhappiness**

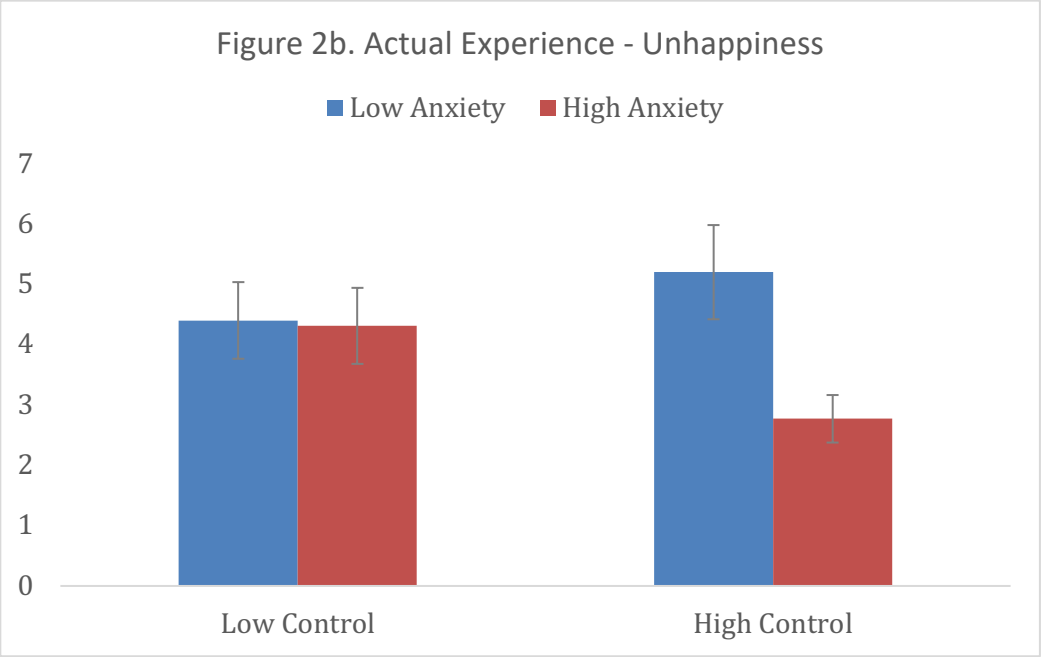


**Figure 2. Continued**

Findings also revealed no main effect of trait anxiety, $F(1, 65) = 3.42$, $p = 0.07$, $n_p^2 = 0.05$, and no main effect of perceived control, $F(1, 65) = 0.30$, $p = 0.59$, $n_p^2 = 0.01$, on participants' experience of unhappiness. The two-way interaction between trait anxiety and perceived control was not significant, $F(1, 65) = 2.96$, $p = 0.09$, $n_p^2 = 0.04$. Participants' differences for reported unhappiness are shown in Figure 2b.

Lastly, I conducted separate 2 x 2 ANOVAs to examine whether trait anxiety and perceived control influenced participants' affective memory of happiness and unhappiness. The results demonstrated no significant main effect of trait anxiety, $F(1, 54) = 0.19$, $p = 0.66$, $n_p^2 = 0.004$, and no main effect of perceived control, $F(1, 54) = 1.62$, $p = 0.21$, $n_p^2 = 0.03$, on participants' affective memory of happiness. Notably, the two-way interaction between trait anxiety and perceived control was significant, $F(1, 54) = 8.69$, $p = 0.01$, $n_p^2 = 0.14$. Specifically, those with low trait anxiety in the high control condition recalled feeling happiness ($M = 4.94$, $SD = 0.38$) to a greater degree compared to those with high trait anxiety ($M = 3.55$, $SD = 0.47$),

$n_p^2 = 0.09$. Additionally, within the high anxiety group, participants in the low control condition recalled feelings of happiness ($M = 5.29$, $SD = 0.41$) to a greater degree compared to those in the high control condition ($M = 3.55$, $SD = 0.47$), $n_p^2 = 0.13$.

In terms of affective memory of unhappiness, there was no main effect of trait anxiety, $F(1, 54) = 0.01$, $p = 0.92$, $n_p^2 < 0.01$, and perceived control, $F(1, 54) = 1.56$, $p = 0.22$, $n_p^2 = 0.03$, on affective memory of unhappiness. The overall interaction was not significant, $F(1, 54) = 0.58$, $p = 0.45$, $n_p^2 = 0.01$. Mean differences for affective memory of unhappiness are shown in Figure 3b.

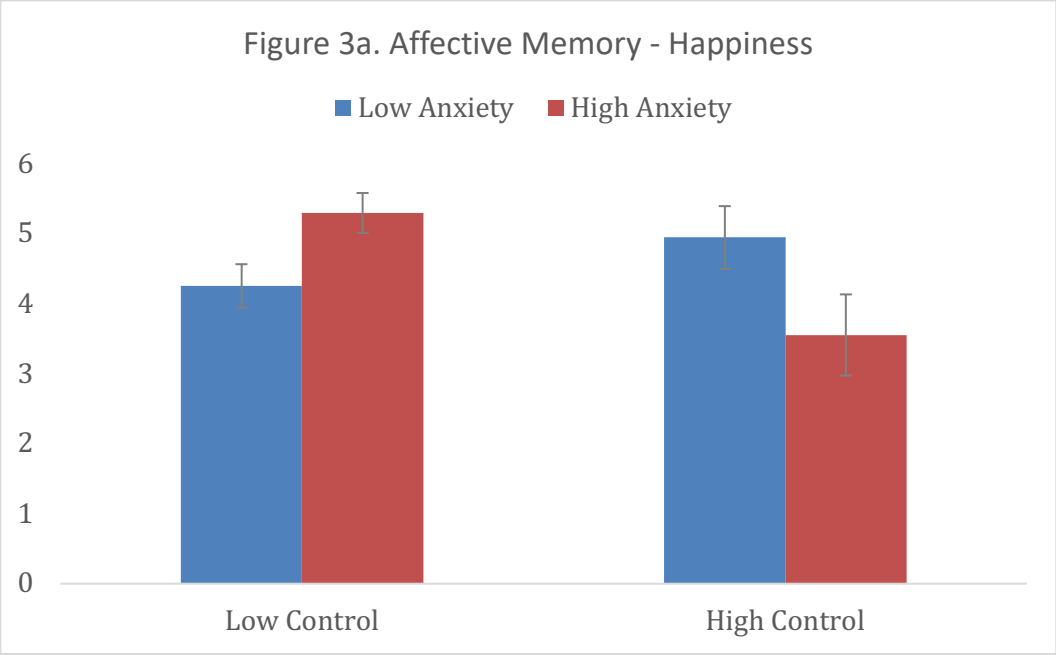


**Figure 3. Affective memories of happiness and unhappiness**

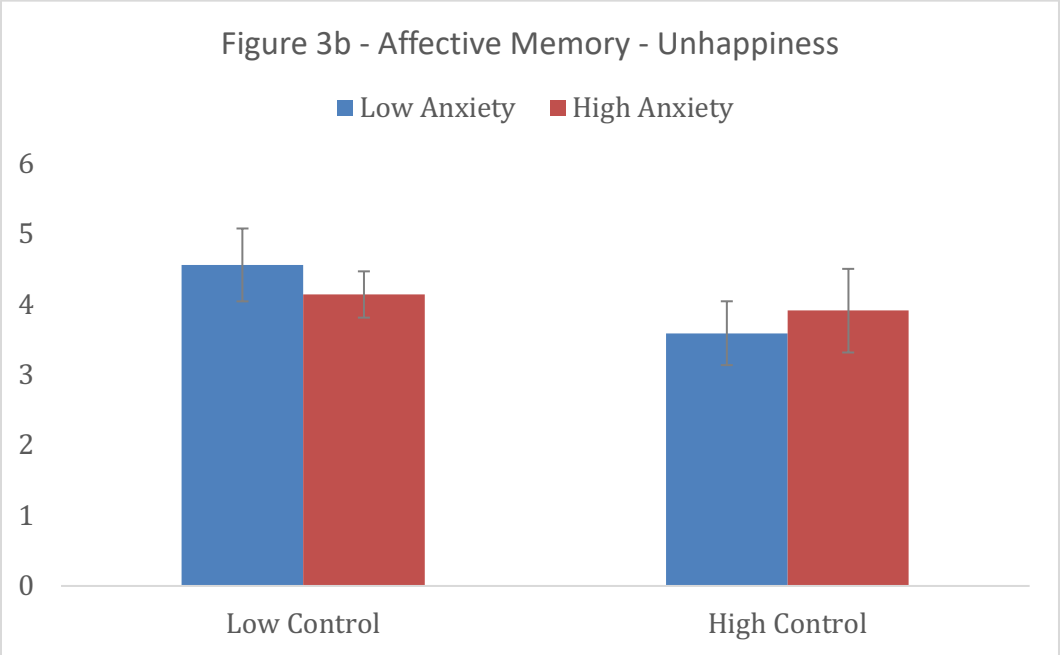


**Figure 3. Continued**

### 3.3 Anxiety, Perceived Control, and Affective Forecasting Biases

To test whether changes in levels of trait anxiety and perceived control condition influenced forecasting bias of happiness, I conducted a series of 2 (perceived control: low control, high control) x 2 (trait anxiety: low trait anxiety, high trait anxiety) ANOVAs. Results are shown in Figure 4, and did not reveal a main effect of trait anxiety, $F(1,65) = 1.12$, $p = 0.29$, $n_p^2 = 0.02$, or perceived control, $F(1,65) = 0.06$, $p = 0.81$, $n_p^2 = 0.001$, on affective forecasting bias of happiness. The two-way interaction between perceived control and trait anxiety was not significant, $F(1,65) = 1.97$, $p = 0.17$, $n_p^2 = 0.03$, thus the hypothesis was not supported. Mean differences for affective forecasting biases of happiness are shown in Figure 4a.

With respect to forecasting bias of unhappiness, results revealed a main effect of anxiety as predicted, $F(1,64) = 7.44$, $p = 0.01$, $n_p^2 = 0.10$, such that high trait anxious individuals demonstrated greater affective forecasting bias of unhappiness compared to their low trait anxious counterparts. However, there was no main effect of perceived control, $F(1,64) = 0.01$, $p$

= .92, $n_p^2$ = .00. The two-way interaction between perceived control and trait anxiety was not significant, $F(1,65) = 1.96$, $p = 0.17$, $n_p^2$ = .03. Mean differences for affective forecasting biases of unhappiness are shown in Figure 4b.

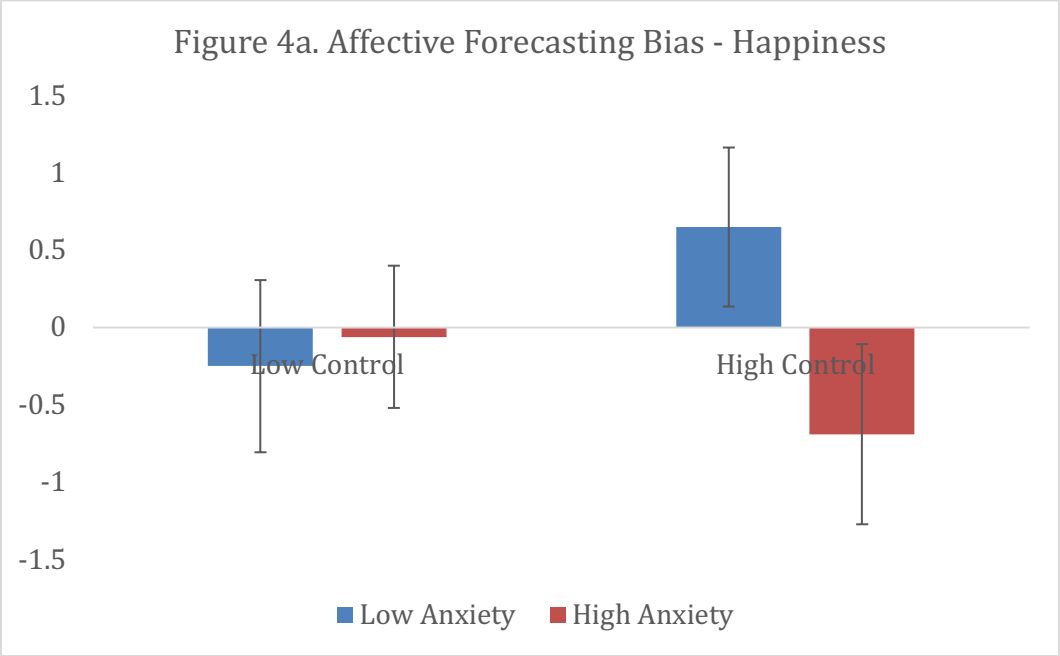


**Figure 4. Affective forecasting biases of happiness and unhappiness**

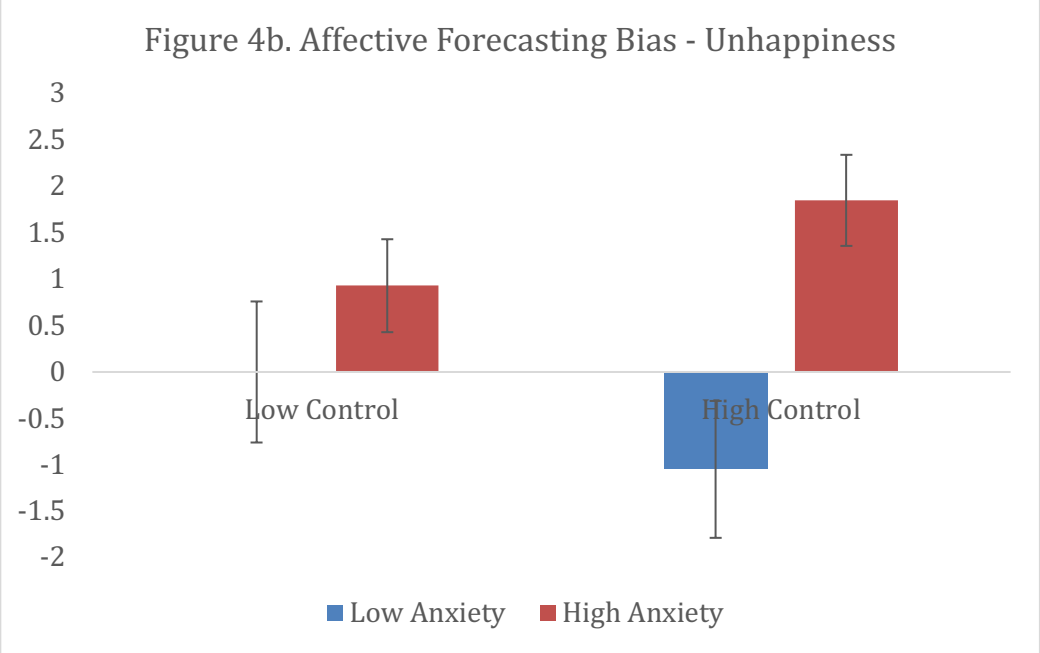


**Figure 4. Continued**

### 3.4 The Relationship Among Affective Forecast, Actual Experiences, and Affective Memory

I conducted multiple regressions to determine whether affective forecasts, actual emotional experiences, and trait anxiety (low, high) predicted affective memory. Affective forecasts, actual experiences and anxiety did not significantly predict affective memory of happiness, $b = 0.08$, $t(54) = 0.61$, $p = 0.55$, above and beyond actual experience, $b = -0.08$, $t(54) = -0.69$, $p = 0.49$, and trait anxiety, $b = -0.03$, $t(54) = -0.07$, $p = 0.95$. The overall model fit was not significant, $F(3, 54) = 0.23$, $p = 0.88$, *adjusted* $R^2 = -0.42$.

Similarly, affective forecast, did not predict affective memory of unhappiness, $b = 0.08$, $t(53) = 0.52$, $p = 0.61$, above and beyond actual emotional experiences, $b = -0.06$, $t(53) = -0.68$, $p = 0.50$, and trait anxiety, $b = -0.10$, $t(53) = -0.20$, $p = 0.84$. The overall model fit was not significant, $F(3, 53) = 1.19$, $p = 0.10$, *adjusted* $R^2 = -0.46$. The hypotheses, therefore, were not supported.

### 3.5 Exploratory Analyses

Although the primary analysis did not reveal a main effect of perceived control as hypothesized, I conducted a series of exploratory ANOVAs to assess whether low and high anxiety groups differed in their forecasting biases within each control condition. Within the low control condition, there was no significant difference in the degree of bias in forecasts of happiness between low and high anxiety groups, $F(1,34) = 0.06$, $p = .80$, $n_p^2 = .002$. There was also no significant difference in the degree of bias in forecast of unhappiness between the two anxiety groups in the low control condition, $F(1,34) = 0.90$, $p = .35$, $n_p^2 = .03$. Degrees of biased forecasts are shown in Figure 5a.

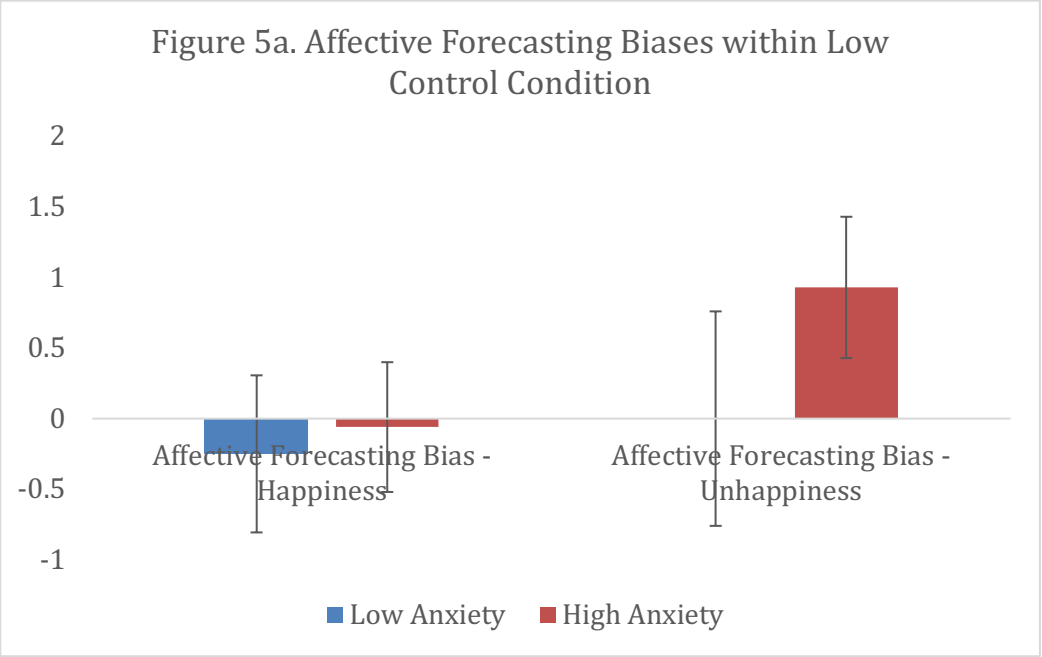


**Figure 5. Independent analyses of affective forecasting biases within each separate condition**

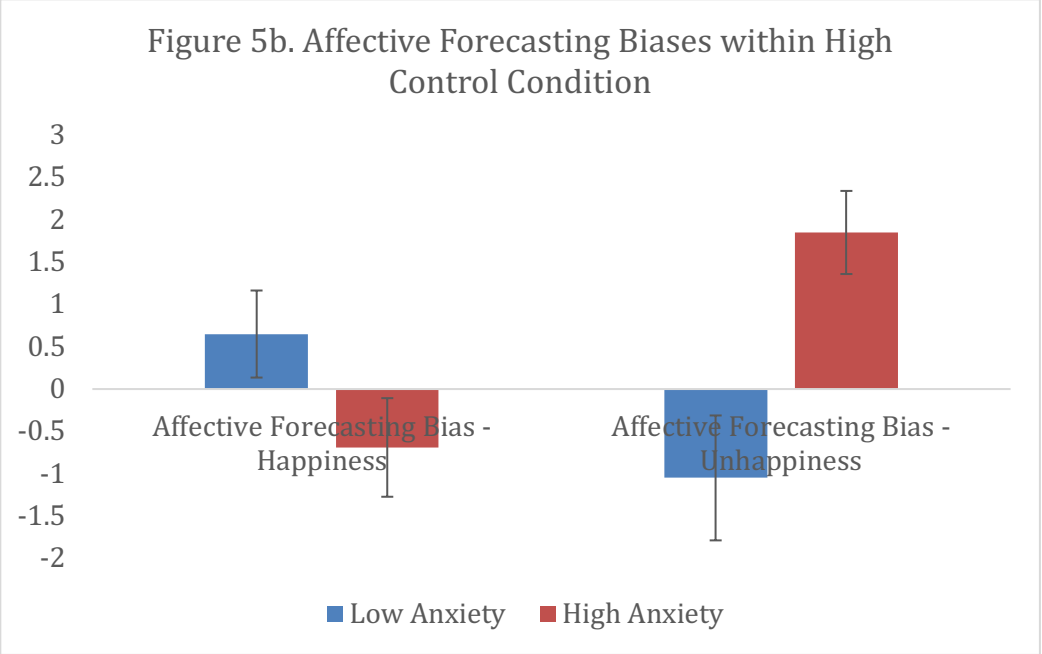


**Figure 5. Continued**

Within the high control condition, the findings similarly revealed that low and high anxiety groups did not significantly differ in the degree of bias in forecasts of happiness, $F(1,31)$

= 2.87, $p$ = 0.10, $n_p^2$ = 0.09. However, there was a difference in the degree of bias in forecasts of unhappiness between low anxiety and high anxiety groups, $F(1,31) = 8.37$, $p$ = 0.01, $n_p^2$ = 0.21, such that the high anxiety group overestimated how unhappy they would feel to a greater degree compared to the low anxiety group (Figure 5b).

To determine whether individuals with low and high levels of trait anxiety were accurate or inaccurate in their affective forecast of unhappiness, I conducted a one-sample t-test to compare the degree of bias for unhappiness against zero. The findings revealed that high trait anxiety individuals overestimated how unhappy they would feel in response to being rejected ($M$ = 1.36, $SD$ = 1.89), $t(27) = 3.80$, $p < .001$, $CI$ 95% [0.62, 2.09], $d$ = 1.89. Individuals with lower levels of anxiety, on the other hand, were accurate in their forecast of unhappiness in response to being rejected ($M$ = -0.53, $SD$ = 3.35), $t(39) = -0.99$, $p$ = .33, $CI$ 95% [-1.60, 0.55], $d$ = 3.35.

Given the significant influence of perceived control and trait anxiety on affective memory of happiness, I conducted a series of 2 x 2 ANOVAs to determine whether perceived control and trait anxiety would exert the same influence on affective memory biases. With respect to affective memory bias of happiness, there was no main effect of trait anxiety, $F(1,54) = 0.42$, $p$ = 0.52, $n_p^2$ = 0.01, and perceived control, $F(1,54) = 0.41$, $p$ = 0.53, $n_p^2$ = 0.01. The two-way interaction between trait anxiety and perceived control was significant, $F(1,54) = 9.19$, $p$ = 0.004, $n_p^2$ = 0.15. Findings further revealed that there was no main effect of trait anxiety, $F(1,54)$ = 0.41, $p$ = 0.53, $n_p^2$ = 0.01, and perceived control, $F(1,54) = 0.41$, $p$ = 0.53, $n_p^2$ = 0.01, on participants' affective memory bias of unhappiness. The two-way interaction between trait anxiety and perceived control is not significant, $F(1,54) = 0.41$, $p$ = 0.53, $n_p^2$ = 0.01. Mean differences in affective memory biases are shown in Figure 6.

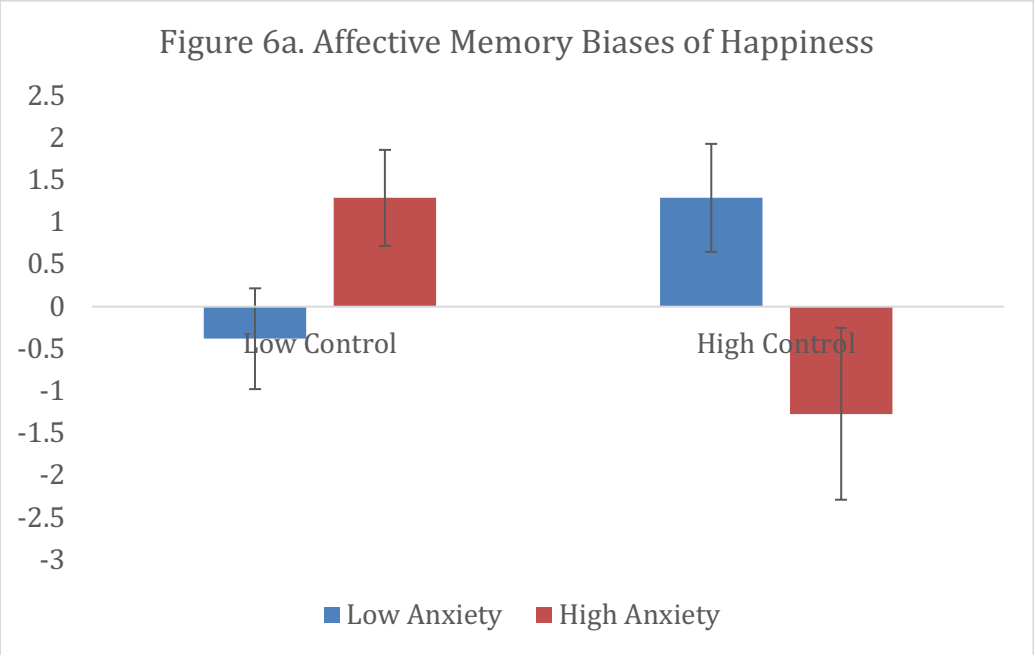


**Figure 6. Affective Memory Biases of Happiness and Unhappiness**

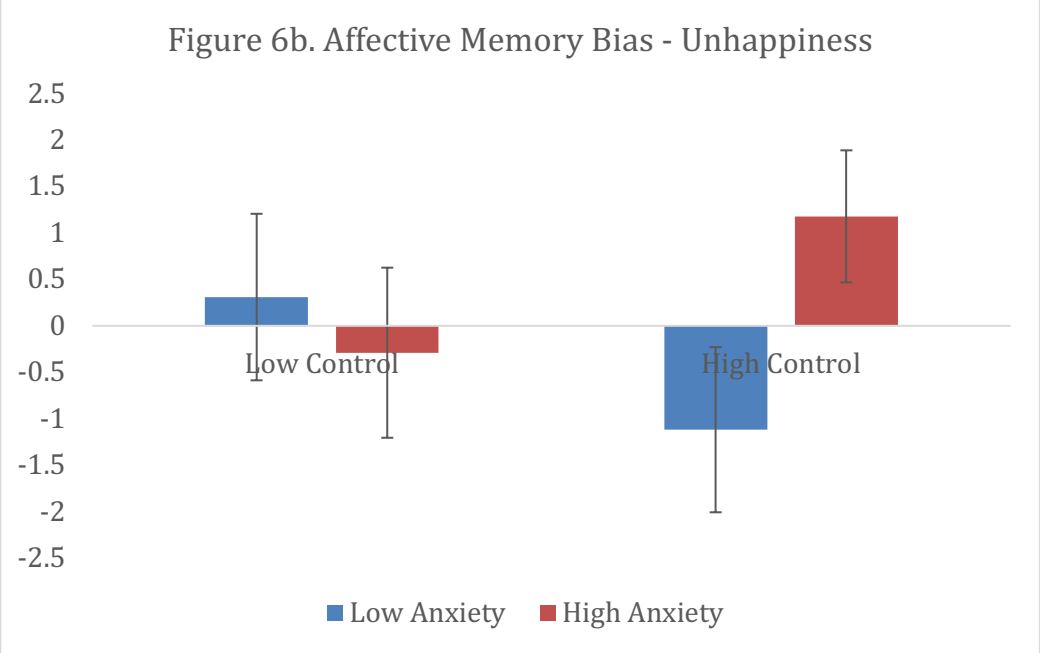


**Figure 6. Continued**

To probe the interaction effect between trait anxiety and control on participants' affective memory bias of happiness, I conducted follow-up analyses to determine whether individuals with low and high trait anxiety significantly differed in their affective memory bias of happiness by

first separating the dataset by conditions (low control versus high control). Within the high control condition, there was a significant difference between affective memory bias of happiness, $F(1,26) = 5.07$, $p = 0.03$, $n_p^2 = 0.16$, such that individuals with low trait anxiety ($M = 1.29$, $SD = 2.64$) overestimated how happy they felt to a greater degree compared to individuals with high trait anxiety ($M = -1.27$, $SD = 3.38$). There was no significant difference in affective memory bias of happiness between low and high anxiety groups within the low control condition.

Then, I separated the dataset by anxiety groups (low versus high anxiety) and conducted a one-way ANOVA to assess whether changes in control influenced affective memory bias of happiness within low versus high anxiety groups. Results revealed that, within the high anxiety group, there was a significant difference between low and high control groups in their affective memory bias of happiness, $F(1,23) = 5.36$, $p = 0.03$, $n_p^2 = 0.19$. Specifically, highly anxious individuals in the low control condition ($M = 1.29$, $SD = 2.13$) overestimated how happy they had felt in response to the rejection to a greater degree compared to those in the high control condition ($M = -1.27$, $SD = 3.38$). Among those with low trait anxiety, there was no significant difference in affective memory bias of happiness between low and high perceived control groups, $F(1,31) = 3.61$, $p = 0.07$, $n_p^2 = 0.10$.

Lastly, to determine whether individuals with low and high levels of trait anxiety were accurate or inaccurate in their affective memory of happiness, I conducted a one-sample t-test to compare the degree of bias for happiness against zero. The findings revealed that high trait anxiety individuals were accurate in recalling how happy they had felt in response to being rejected ($M = 0.16$, $SD = 2.98$), $t(24) = 0.27$, $p = 0.79$, $CI$ 95% [-1.07, 1.39], $d = 2.98$. Individuals with lower levels of anxiety were also accurate in their forecast of unhappiness in

response to being rejected ($M$ = 0.16, $SD$ =2.62), $t(32) = 1.06$, $p = 0.30$, $CI$ 95% [-0.45, 1.42], $d$ = 2.62.

### 3.6 Exploratory Analyses to Examine the Relationships Between Trait Anxiety, Participants' Reported Perceived Control, and Affective Forecasting Bias

Because the primary constructs of interest include perceived control, I conducted multiple regressions to explore whether the same pattern of results would be observed. Specifically, I wanted to see whether trait anxiety and participants' reported control predicted affective forecasting biases. As shown in Table 2, trait anxiety and reported perceived control did not significantly predict affective forecast of happiness. The overall model fit was not significant, $F(2, 66) = 0.74$, $p = 0.48$, *adjusted* $R^2 = -0.01$.

Table 2. Regression analysis statistics for affective forecasting bias - happiness

| Predictor | *B* | *SE* | *β* | *t* | *p* |
|---|---|---|---|---|---|
| Trait anxiety (low, high) | -0.64 | 0.56 | -0.14 | -1.13 | 0.26 |
| Perceived control | -0.20 | 0.29 | -0.09 | -0.70 | 0.49 |

Consistent with the results noted above, as shown in Table 3, trait anxiety significantly predicted affective forecast of unhappiness, but perceived control did not. The overall model fit was significant, $F(2, 65) = 3.55$, $p = 0.03$, *adjusted* $R^2 = 0.07$.

Table 3. Regression analysis statistics for affective forecasting bias - unhappiness

| Predictor | *B* | *SE* | *β* | *t* | *p* |
|---|---|---|---|---|---|
| Trait anxiety (low, high) | 1.87 | 0.72 | 0.31 | 2.59 | 0.01 |
| Perceived control | -0.02 | 0.38 | -0.01 | -0.06 | 0.95 |

### 3.7 Exploratory Analyses Examining Whether Trait Anxiety and Reported Perceived Control Predicted Affective Forecast, Actual Experience, and Affective Memory

I conducted multiple linear regressions to determine whether trait anxiety and participants' reported perceived control are associated with affective forecast of happiness. Congruent with findings noted earlier, trait anxiety and perceived control did not significantly predict affective forecast of happiness (Table 4). The overall model fit was not significant, $F(2, 66) = 0.89$, $p = 0.42$, *adjusted* $R^2 = -0.03$.

Table 4. Regression analysis statistics for affective forecast - happiness

| Predictor | *B* | *SE* | *β* | *t* | *p* |
|---|---|---|---|---|---|
| Trait anxiety (low, high) | -0.46 | 0.42 | -1.14 | -1.09 | 0.28 |
| Perceived control | -0.11 | 0.22 | 0.06 | 0.49 | 0.62 |

Results further revealed no meaningful relationships between trait anxiety, perceived control, and affective forecast of unhappiness, as shown in Table 5. The overall model fit was not significant, $F(2, 65) = 1.25$, $p = 0.30$, *adjusted* $R^2 = 0.07$.

Table 5. Regression analysis statistics for affective forecast - unhappiness

| Predictor | *B* | *SE* | *β* | *t* | *p* |
|---|---|---|---|---|---|
| Trait anxiety (low, high) | 0.71 | 0.45 | 0.20 | 1.58 | 0.12 |
| Perceived control | 0.06 | 0.24 | 0.03 | 0.23 | 0.82 |

I additionally conducted a series of multiple linear regressions to determine whether trait anxiety and participants' reported perceived control predicted actual experience of happiness. Results are shown in Table 6 and did not reveal meaningful relationship between trait anxiety, perceived control, and actual experience of happiness. The overall model fit was not significant, $F(2, 66) = 0.68$, $p = 0.51$, *adjusted* $R^2 = -0.01$.

Table 6. Regression analysis statistics for actual experience - happiness

| Predictor | *B* | *SE* | *β* | *t* | *p* |
|---|---|---|---|---|---|
| Trait anxiety (low, high) | 0.18 | 0.51 | 0.04 | 0.36 | 0.72 |
| Perceived control | 0.31 | 0.26 | 0.15 | 1.17 | 0.25 |

Results for trait anxiety, perceived control, and actual experience of unhappiness are shown in Table 7, and demonstrated that trait anxiety and perceived control are not significantly

associated with actual experience of unhappiness. The overall model fit was not significant, $F(2, 66) = 1.48$, $p = 0.24$, *adjusted* $R^2 = 0.01$.

Table 7. Regression analysis statistics for actual experience - unhappiness

| Predictor | *B* | *SE* | *β* | *t* | *p* |
|---|---|---|---|---|---|
| Trait anxiety (low, high) | -1.15 | 0.71 | -0.20 | -1.62 | 0.11 |
| Perceived control | 0.06 | 0.36 | 0.02 | 0.17 | 0.87 |

Lastly, I conducted multiple linear regression analyses to see if trait anxiety and perceived control significantly predicted participants' affective memory of happiness and unhappiness. As shown in Table 8, there was no meaningful relationship between trait anxiety, perceived control, and affective memory of happiness, which in inconsistent with results noted above that suggested there was an interaction between trait anxiety and control condition that influenced affective memory of happiness. The overall model fit was not significant, $F(2, 55) = 1.20$, $p = 0.31$, *adjusted* $R^2 = 0.01$.

Table 8. Regression analysis statistics for affective memory - happiness

| Predictor | *B* | *SE* | *β* | *t* | *p* |
|---|---|---|---|---|---|
| Trait anxiety (low, high) | 0.13 | 0.45 | 0.04 | 0.28 | 0.78 |
| Perceived control | 0.35 | 0.23 | 0.21 | 1.54 | 0.13 |

Trait anxiety and perceived control did not significantly predict affective memory of unhappiness, as shown in Table 9. The overall model fit was not significant, $F(2, 55) = 0.001$, $p = 1.00$, *adjusted* $R^2 = -0.04$.

Table 9. Regression analysis statistics for affective memory - unhappiness

| Predictor | *B* | *SE* | *β* | *t* | *p* |
|---|---|---|---|---|---|
| Trait anxiety (low, high) | -0.02 | 0.51 | -0.01 | -0.05 | 0.96 |
| Perceived control | -0.01 | 0.26 | -0.003 | -0.02 | 0.98 |

# 4. DISCUSSION

Accurate affective forecasts have important implications for decision-making because people partly rely on their predicted emotional outcomes to inform future decisions (e.g., Lowenstein, 2007). People naturally want to pursue goals that they think would make them feel positive emotions and avoid ones that would make them feel negative emotions. Nonetheless, decades of research findings suggest that they are not always good at predicting how future events will make them feel, often over or under estimating future emotions (e.g., Dunn et al., 2007; Gilbert et al., 2002; Lench et al., 2011; Wilson et al., 2000). A plethora of factors have been shown to influence affective forecasting biases, including individual differences in trait anxiety (Dev et al., 2022; Wenze et al., 2012). Given people's reliance on affective forecast to guide future behaviors and decisions, biased forecasts may result in unnecessary and maladaptive avoidant behaviors in individuals with elevated symptoms of anxiety. In addition, the growing body of evidence on the relation between affective forecasting biases and anxiety symptoms suggests that affective forecasting biases may serve as a transdiagnostic risk factor that contribute to the etiology and maintenance of anxiety disorders (Arditte et al., 2020; Dev et al., 2022). These findings noted above necessitate further research into potential mechanisms underlying biased forecasts.

We proposed that low perceived control may serve as a mechanism by which biased forecasts persist in those with elevated anxiety symptoms. Specifically, reduced perceived control has been theorized as a transdiagnostic feature underlying anxiety disorders (Gallagher et al., 2014) as well as a vulnerability factor that predisposes people to the experience of anxiety (Barlow, 2000, 2002). As such, we theorized that, changes in perception of control would interact with trait anxiety to influence affective forecasting bias of negative emotion. Further, in

an effort to investigate why biased forecasts persist, we explored the relation between affective forecast, actual emotional experiences, and affective memory to determine if affective forecast predicts affective memory above and beyond actual emotional experiences in anxious individuals.

### 4.1. Anxiety, Perceived Control, and Affective Forecasting

The first question this study aimed to address is whether changes in perception of control would interact with trait anxiety to influence forecasting bias of negative emotion. Despite the lack of meaningful interaction between perceived control and trait anxiety as hypothesized, findings revealed that highly anxious individuals demonstrated greater biased forecast for negative emotion compared to their low anxiety counterparts. In other words, individuals with high trait anxiety overestimated how badly they would feel to a greater degree in response to being rejected compared to those with low trait anxiety. This finding is consistent with previous studies that have established a relation between affective forecasting biases of negative emotions and trait anxiety, such that highly anxious individuals tend to overestimate how badly they would feel in response to future events (Dev et al., 2022; Martin & Quirk, 2015; Wenze et al., 2012).

Additionally, exploratory analyses revealed that when forecasting biases were examined within the context of perceived control separately (e.g., high control versus low control), highly anxious individuals inflated how badly they would feel when they were in a condition of high versus low control, which may at first seem counterintuitive. However, one possible explanation for this phenomenon is that when given more control via availability of options and told that they "will have a lot of control," highly anxious people develop heightened expectations to do well and to be selected for the highly valued reward ($40). If highly anxious individuals were concerned about being rejected even having complete control over their decisions, it makes sense

that they would overestimate how badly they would feel in response to failure. Furthermore, a potential factor that could have partly influenced participants' overestimation of negative emotions was the pressure of being observed and evaluated by others. Strangers' evaluations coupled with a heightened perception of control may have increased individuals' negative affect at the time of prediction, resulting in biased forecast of negative emotion.

These findings, although inconsistent with the hypothesis, sheds light on a potential mechanism by which biased forecasts of negative emotions persist in those with high trait anxiety. Accumulating evidence suggests that low perceived control is predictive of various affective disorders (Brown & Naragon-Gainey, 2013; Moulding & Kyrios, 2007; Vujanovic et al., 2010; Stapinski et al., 2010). However, our study suggests that in a context in which highly anxious individuals are placed under pressure (e.g., their performance is being observed and evaluated by others), a high perception of control may inadvertently increase the internal pressure highly anxious people exert on themselves. Moreover, it may also be possible that when participants were verbally told that they "will have a lot of control," participants were under the impression that the "MBA students" were also aware of this fact, thus increasing the pressure to perform well and to be selected for the highly valued task. Besides the increased pressure as a potential explanation for the results, prior work suggest that a person's attribution may attenuate the impact of a low perception of control (e.g., see Litt, 1988). In other words, when individuals perceive that the outcome of the prescreen task is outside of their control by being told that they have "no control," they might have made an attribution that the rejection was a result of external circumstances rather than a product of personal deficits, thus explaining the lack of biased forecast in highly anxious within the low control condition (e.g., I was told I would have no control over the task so the prescreen questions must be near impossible to pass!).

### 4.2 Affective Forecast, Affective Memory, and Actual Experiences

Because research has shown a consistent but small bias in affective memory, and affective memory serves an important function in judgments and decision-making, it is imperative to investigate why biased memory persists. We hypothesized that affective forecast would predict affective memory above and beyond actual experiences in anxious individuals. However, our results suggest that affective forecasts, actual emotional experiences, and trait anxiety did not predict affective memory. Our result is also consistent with previous findings that suggest anxious individuals are indeed accurate in recalling their emotional experiences (Hughes et al., 2022; Wenze et al., 2012), further confirming the conceptualization of anxiety as a "forward-looking" disorder.

A surprising finding that emerged from this study was the influence of control and trait anxiety on participants' affective memory bias of happiness. Specifically, when participants were given a lot of control over how they completed the prescreen task (e.g., low control condition), those with low trait anxiety exhibited greater degree of affective memory of happiness compared to those with high trait anxiety. In other words, people with low anxiety thought they felt happier about being rejected at the time of recall compared to their high anxiety counterparts. Nonetheless, exploratory regression analysis further suggested there was no significant relationship between trait anxiety, participants' reported perceived control, and affective memory of happiness, which contrasted the initial findings. Several potential explanations may explicate these results.

While the initial result is generally consistent with previous research that suggest people tend to overestimate the intensity of past emotions (e.g., Levine et al., 2006), the contradictory pattern observed in this study is perplexing as anxiety has often been linked to increased

tendency to recall more threatening information (e.g., Herrera et al., 2017). It may be the case that the observed effect of control condition and trait anxiety on affective recall of happiness was partly due to participants' awareness of the deception when trying to recall how they had felt. Their awareness of the deception, therefore, may have influenced what they thought had happened rather than what did happen. In addition, theorists have proposed that people employ a number of strategies to estimate past emotions, one of which is focusing on periods of peak emotional intensity (Frederickson & Kahneman, 1993). As such, when individuals with low anxiety were asked to recall how happy they had felt about being rejected in the high versus low control condition, it may be the case that they focused on the instance of peak emotional intensity to estimate their happiness. However, their happiness about the rejection may have been confounded by their sense of relief from being released from a particularly stressful event (e.g., being observed and evaluated by strangers while being told that they had no control over the prescreen task).

### 4.3 Limitations and Future Directions

It is imperative to understand how mechanisms underlying anxiety may influence biased predictions. One major limitation of this study is although we measured trait anxiety using a clinical cut-off (Ercan et al., 2015), our sample utilized an undergraduate student population rather than a clinical sample. Thus, future research should consider screening for clinical levels of anxiety using structured or semi-structured interviews in order to determine whether perceived control influences biased forecasts of negative emotions in other anxiety disorders (e.g., generalized anxiety disorder, social anxiety disorder). Doing so would allow for comparisons between individuals with clinical levels of anxiety and healthy controls to further parse out cognitive mechanisms that contribute to the etiology and maintenance of different anxiety

disorders. Another limitation is the smaller than anticipated sample size, which reduces the overall power of the study. A potential issue arising from a lack of statistical power is that the study may be unable to detect meaningful relationships that indeed exist. As such, future studies should try to replicate these findings to determine whether the same patterns can be observed in larger samples.

Although the results revealed an interesting pattern of biased forecast for negative emotion in highly anxious individuals, the pattern was not consistent with the a priori hypothesis. It is possible that our perceived control manipulation had unintended effects on participants' actual perception of control as noted previously. Specifically, participants with high trait anxiety might have internalized additional pressure from being told that they had a great deal of control over the prescreen task. Furthermore, this heightened pressure to perform well while being observed and evaluated by strangers could engender participants' own evaluation of their self-efficacy, thus skewing their forecasts of future negative emotions. Future research should aim to replicate the results using the same experimental paradigm to determine if the same effects can be observed. They should also examine whether changes in self-efficacy could potentially moderate the relationship between perceived control and affective forecasting biases in anxious individuals.

Overall, our findings are consistent with previous conceptualization of anxiety as a "forward-looking" disorder by showing that highly anxious individuals are biased in how they forecast their future emotions. Thus, our study solidifies the needs to further examine potential mechanisms that may influence this relationship. A better understanding of the mechanisms by which affective forecasting biases persist may assist in future development of interventions that

specifically target ways in which anxious individuals forecast their future emotions, preventing them from engaging in unnecessary avoidance behaviors that may dampen adaptive learning.

REFERENCES

Amat, J., Baratta, M. V., Paul, E., Bland, S. T., Watkins, L. R., & Maier, S. F. (2005). Medial prefrontal cortex determines how stressor controllability affects behavior and dorsal raphe nucleus. *Nature neuroscience*, *8*(3), 365-371.

Amir, N., Beard, C., & Bower, E. (2005). Interpretation bias and social anxiety. *Cognitive Therapy & Research*, *29*(4).

Arditte Hall, K. A. A., Coleman, K., & Timpano, K. R. (2020). Associations between social anxiety and affective and empathic forecasts: A replication and extension in a Mechanical Turk sample. *Behavior therapy*, *51*(3), 365-374. https://doi.org/10.1016/j.beth.2019.06.004

Arditte Hall, K. A. A., Joormann, J., Siemer, M., & Timpano, K. R. (2018). The impact bias in self and others: Affective and empathic forecasting in individuals with social anxiety. *Behaviour research and therapy*, *106*, 37-46. https://doi.org/10.1016/j.brat.2018.05.001

Arnaudova, I., Kindt, M., Fanselow, M., & Beckers, T. (2017). Pathways towards the proliferation of avoidance in anxiety and implications for treatment. *Behaviour Research and Therapy*, *96*, 3–13. https://doi.org/10.1016/j.brat.2017.04.004

Arntz, A., & Schmidt, A. J. M. (1989). Perceived control and the experience of pain. In *Stress, personal control and health* (pp. 131–162). John Wiley & Sons.

Bargh, J. A., & Chartrand, T. L. (1999). The unbearable automaticity of being. *American Psychologist, 54*(7), 462–479. https://doi.org/10.1037/0003-066X.54.7.462

Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J., & van IJzendoorn, M. H. (2007). Threat-related attentional bias in anxious and nonanxious individuals: A meta-

analytic study. *Psychological Bulletin, 133*(1), 1–24. https://doi.org/10.1037/0033-2909.133.1.1

Barlow, D. H. (1991). Disorders of Emotion. *Psychological Inquiry*, *2*(1), 58–71. https://doi.org/10.1207/s15327965pli0201_15

Barlow, D. H. (2000). Unraveling the mysteries of anxiety and its disorders from the perspective of emotion theory. *American Psychologist*, *55*(11), 1247–1263. https://doi.org/10.1037/0003-066X.55.11.1247

Barlow, D. H. (2004). *Anxiety and Its Disorders: The Nature and Treatment of Anxiety and Panic*. Guilford Press.

Brown, T. A., & Naragon-Gainey, K. (2013). Evaluation of the unique and specific contribution of dimensions of the triple vulnerability model to the prediction of *DSM-IV* anxiety and mood disorder constructs. *Behavior Therapy, 44*, 277–292. doi:10.1016/j.beth.2012.11.002.

Brown, T. A., White, K. S., Forsyth, J. P., & Barlow, D. H. (2004). The structure of perceived emotional control: Psychometric properties of a revised Anxiety Control Questionnaire. *Behavior Therapy, 35*, 75–99. doi:10.1016/S0005-7894(04)80005-4.

Charpentier, C. J., De Neve, J. E., Li, X., Roiser, J. P., & Sharot, T. (2016). Models of affective decision making: how do feelings predict choice?. *Psychological science*, *27*(6), 763-775.

Chorpita, B. F., & Barlow, D. H. (1998). The development of anxiety: The role of control in the early environment. *Psychological Bulletin*, *124*(1), 3–21. https://doi.org/10.1037/0033-2909.124.1.3

Coles, M. E., & Heimberg, R. G. (2005). Recognition bias for critical faces in social phobia: a replication and extension. *Behaviour research and therapy*, *43*(1), 109-120. https://doi.org/10.1016/j.brat.2003.12.001.

Coles, M. E., Turk, C. L., & Heimberg, R. G. (2007). Memory bias for threat in generalized anxiety disorder: the potential importance of stimulus relevance. *Cognitive Behaviour Therapy*, *36*(2), 65-73. https://doi.org/10.1080/16506070601070459

Cutler, S. E., Larson, R. J., & Bunce, S. C. (1996). Repressive coping style and the experience and recall of emotion: A naturalistic study of daily affect. *Journal of Personality*, *64*(2), 379-405.

Dev, A. S., Arditte Hall, K. A., & Timpano, K. R. (2022). The relationship between psychiatric symptoms and affective forecasting bias. *Journal of Behavior Therapy and Experimental Psychiatry*, 101825. https://doi.org/10.1016/j.jbtep.2022.101825

DeWall, C. N., Baumeister, R. F., Chester, D. S., & Bushman, B. J. (2016). How often does currently felt emotion predict social behavior and judgment? A meta-analytic test of two theories. *Emotion Review*, *8*(2), 136-143.

Dunn, E. W., Biesanz, J. C., Human, L. J., & Finn, S. (2007). Misunderstanding the affective consequences of everyday social interactions: The hidden benefits of putting one's best face forward. *Journal of Personality and Social Psychology, 92*(6), 990–1005. https://doi.org/10.1037/0022-3514.92.6.990

Ercan, I., Hafizoglu, S., Ozkaya, G., Kirli, S., Yalcintas, E., & Akaya, C. (2015). Examining Cut-Off Values for the State-Trait Anxiety Inventory/Examinando los puntajes de corte para el inventario de ansiedad estado-rasgo. *Revista Argentina de Clinica Psicologica*, *24*(II), 143.

Fredrickson, B. L., & Kahneman, D. (1993). Duration neglect in retrospective evaluations of affective episodes. *Journal of personality and social psychology*, *65*(1), 45.

Gallagher, M. W., Bentley, K. H., & Barlow, D. H. (2014). Perceived control and vulnerability to anxiety disorders: A meta-analytic review. *Cognitive therapy and research*, *38*, 571-584.

Gilbert, D. T., Pinel, E. C., Wilson, T. D., Blumberg, S. J., & Wheatley, T. P. (1998). Immune neglect: A source of durability bias in affective forecasting. *Journal of Personality and Social Psychology*, *75*(3), 617–638. https://doi.org/10.1037/0022-3514.75.3.617

Gilbert, D. T., Pinel, E. C., Wilson, T. D., Blumberg, S. J., & Wheatley, T. P. (2002). Durability bias in affective forecasting. In T. Gilovich, D.Griffin, & D. Kahneman (Eds.), Heuristics and biases (pp. 292–312). New York, NY: Cambridge.

Hayes, S. C., & Wilson, K. G. (1994). Acceptance and Commitment Therapy: Altering the Verbal Support for Experiential Avoidance. *The Behavior Analyst*, *17*(2), 289–303. https://doi.org/10.1007/BF03392677

Herrera, S., Montorio, I., Cabrera, I., & Botella, J. (2017). Memory bias for threatening information related to anxiety: An updated meta-analytic review. *Journal of Cognitive Psychology*, *29*(7), 832-854. https://doi.org/10.1080/20445911.2017.1319374

Higgins, E. T., Rholes, W. S., & Jones, C. R. (1977). Category accessibility and impression formation. *Journal of experimental social psychology*, *13*(2), 141-154.

Hoerger, M. (2012). Coping strategies and immune neglect in affective forecasting: Direct evidence and key moderators. *Judgment and Decision Making*, *7*(1), 86–96.

Hoerger, M., Chapman, B., & Duberstein, P. (2016). Realistic affective forecasting: The role of personality. *Cognition and Emotion*, *30*(7), 1304–1316. https://doi.org/10.1080/02699931.2015.1061481

Hoerger, M., Quirk, S. W., Lucas, R. E., & Carr, T. H. (2009). Immune neglect in affective forecasting. *Journal of Research in Personality*, *43*(1), 91–94. https://doi.org/10.1016/j.jrp.2008.10.001

Hughes, C. D., King, A. M., Bailey, K., Alba, M. C., Hoelscher, E., & Rizvi, S. L. (2022). How Will You Feel on Valentine's Day? Affective Forecasting and Recall Biases as a Function of Anxiety, Depression, and Borderline Personality Disorder Features. *Journal of Social and Clinical Psychology*, *41*(5), 491-516.

Kalisch, R., Wiech, K., Critchley, H. D., & Dolan, R. J. (2006). Levels of appraisal: a medial prefrontal role in high-level appraisal of emotional material. *Neuroimage*, *30*(4), 1458-1466

Kalisch, R., Wiech, K., Herrmann, K., & Dolan, R. J. (2006). Neural correlates of self-distraction from anxiety and a process model of cognitive emotion regulation. *Journal of cognitive neuroscience*, *18*(8), 1266-1276.

Lench, H. C., Levine, L. J., Perez, K., Carpenter, Z. K., Carlson, S. J., Bench, S. W., & Wan, Y. (2019). When and why people misestimate future feelings: Identifying strengths and weaknesses in affective forecasting. *Journal of Personality and Social Psychology*, *116*(5), 724–742. https://doi.org/10.1037/pspa0000143

Lench, H. C., Safer, M. A., & Levine, L. J. (2011). Focalism and the underestimation of future emotion: When it's worse than imagined. *Emotion*, *11*(2), 278–285. https://doi.org/10.1037/a0022792

Levine, L. J., Safer, M. A., & Lench, H. C. (2006). Remembering and misremembering emotions. *Judgments over time: The interplay of thoughts, feelings, and behaviors*, 271-290.

Litt M. D. (1988). Self-efficacy and perceived control: cognitive mediators of pain tolerance. *Journal of personality and social psychology*, *54*(1), 149–160. https://doi.org/10.1037//0022-3514.54.1.149

Loewenstein, G. (2007). Affect Regulation and Affective Forecasting. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 180–203). The Guilford Press.

MacLeod, C., & Cohen, I. L. (1993). Anxiety and the interpretation of ambiguity: a text comprehension study. *Journal of Abnormal Psychology*, *102*(2), 238.

Maier, S. F., & Watkins, L. R. (2005). Stressor controllability and learned helplessness: The roles of the dorsal raphe nucleus, serotonin, and corticotropin-releasing factor. *Neuroscience & Biobehavioral Reviews*, *29*(4), 829–841. https://doi.org/10.1016/j.neubiorev.2005.03.021

Manuel, A., & Wade, T. D. (2013). Emotion regulation in broadly defined anorexia nervosa: Association with negative affective memory bias. *Behaviour research and therapy*, *51*(8), 417-424.

Mathersul, D. C., & Ruscio, A. M. (2020). Forecasting the Future, Remembering the Past: Misrepresentations of Daily Emotional Experience in Generalized Anxiety Disorder and Major Depressive Disorder. *Cognitive Therapy and Research*, *44*(1), 73–88. https://doi.org/10.1007/s10608-019-10048-5

Mathews, R. C., Buss, R. R., Stanley, W. B., Blanchard-Fields, F., Cho, J. R., & Druhan, B. (1989). Role of implicit and explicit processes in learning from examples: A synergistic

effect. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *15*(6), 1083.

Martin, S. M., & Quirk, S. W. (2015). Social anxiety and the accuracy of predicted affect. *Cognition and Emotion*, *29*(1), 51-63.

Mohr, C., Binkofski, F., Erdmann, C., Büchel, C., & Helmchen, C. (2005). The anterior cingulate cortex contains distinct areas dissociating external from self-administered painful stimulation: a parametric fMRI study. *Pain*, *114*(3), 347-357.

Mohr, C., Leyendecker, S., Petersen, D., & Helmchen, C. (2012). Effects of perceived and exerted pain control on neural activity during pain relief in experimental heat hyperalgesia: a fMRI study. *European Journal of Pain*, *16*(4), 496-508.

Moulding, R., & Kyrios, M. (2007). Desire for control, sense of control and obsessive-compulsive symptoms. *Cognitive Therapy and Research, 31*, 759–772. doi:10.1007/s10608-006-9086-x.

Mogg, K., & Bradley, B. P. (1998). A cognitive-motivational analysis of anxiety. *Behaviour research and therapy*, *36*(9), 809-848.

Paterson, R.J. & Neufeld, R.W. (1995). What are my options? Influences of choice availability on stress and the perception of control. *Journal of Research in Personality*. *29*(2), 145-167.

Robinson, M. D., & Clore, G. L. (2002). Belief and feeling: Evidence for an accessibility model of emotional self-report. *Psychological Bulletin*, *128*(6), 934–960. https://doi.org/10.1037/0033-2909.128.6.934

Rotenberg, K. J., Lancaster, C., Marsden, J., Pryce, S., Williams, J., & Lattimore, P. (2005). Effects of priming thoughts about control on anxiety and food intake as moderated by dietary restraint. *Appetite*, *44*(2), 235-241.

Safer, M. A., & Keuler, D. J. (2002). Individual differences in misremembering pre-psychotherapy distress: personality and memory distortion. *Emotion*, *2*(2), 162.

Salomons, T. V., Johnstone, T., Backonja, M. M., & Davidson, R. J. (2004). Perceived controllability modulates the neural response to pain. *Journal of Neuroscience*, *24*(32), 7199-7203.

Salters-Pedneault, K., Tull, M. T., & Roemer, L. (2004). The role of avoidance of emotional material in the anxiety disorders. *Applied and Preventive Psychology*, *11*(2), 95–114. https://doi.org/10.1016/j.appsy.2004.09.001

Schrader, G., Davis, A., Stefanovic, S., & Christie, P. (1990). The recollection of affect. *Psychological Medicine*, *20*(1), 105-109.

Scott, B. G., & Weems, C. F. (1994). Resting vagal tone and vagal response to stress: Associations with anxiety, aggression, and perceived anxiety control among youth. *Psychophysiology.* doi:10.1111/psyp.12218.

Spielberger, C.D., R.L. Gorsuch, R.L., Lushene, R., Vagg, P.R., Jacobs, G.A. (1983). Manual for the state-trait anxiety inventory (Form Y). *Consulting Psychologist Press*, Palo Alto, CA.

Stapinski, L. A., Abbott, M. J., & Rapee, R. M. (2010). Fear and perceived uncontrollability of emotion: Evaluating the unique contribution of emotion appraisal variables to prediction of worry and generalized anxiety disorder. *Behaviour Research and Therapy, 48*, 1097–1104. doi:10.1016/j.brat.2010.07.012.

Thomas, D. L., & Diener, E. (1990). Memory accuracy in the recall of emotions. *Journal of personality and social psychology*, *59*(2), 291.

Vujanovic, A. A., Marshall, E. C., Gibson, L. E., & Zvolensky, M. J. (2010). Cognitive–affective characteristics of smokers with and without posttraumatic stress disorder and panic psychopathology. *Addictive Behaviors, 35*(5), 419–425. https://doi.org/10.1016/j.addbeh.2009.12.005

Wenze, S. J., Gunthert, K. C., & German, R. E. (2012). Biases in Affective Forecasting and Recall in Individuals With Depression and Anxiety Symptoms. *Personality and Social Psychology Bulletin*, *38*(7), 895–906. https://doi.org/10.1177/0146167212447242

Wiech, K., Kalisch, R., Weiskopf, N., Pleger, B., Stephan, K. E., & Dolan, R. J. (2006). Anterolateral Prefrontal Cortex Mediates the Analgesic Effect of Expected and Perceived Control over Pain. *Journal of Neuroscience*, *26*(44), 11501–11509. https://doi.org/10.1523/JNEUROSCI.2568-06.2006

Wilson, T. D., & Gilbert, D. T. (2005). Affective forecasting. *Current Directions in Psychological Science*, *14*(3), 131.

Wilson, T. D., Wheatley, T., Meyers, J. M., Gilbert, D. T., & Axsom, D. (2000). Focalism: A source of durability bias in affective forecasting. *Journal of Personality and Social Psychology, 78*, 821–836. http://dx.doi.org/10.1037/0022-3514.78.5.821

Wirtz, D., Kruger, J., Scollon, C. N., & Diener, E. (2003). What to do on spring break? The role of predicted, on-line, and remembered experience in future choice. *Psychological Science*, *14*(5), 520-524.