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Expectancy bias in anxious samples

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Abstract

While it is well documented that anxious individuals have negative expectations about the future, it is unclear what cognitive processes give rise to this expectancy bias. Two studies are reported that use the Expectancy Task, which is designed to assess expectancy bias and illuminate its basis. This task presents individuals with valenced scenarios (Positive Valence, Negative Valence, or Conflicting Valence), and then evaluates their tendency to expect subsequent future positive relative to negative events. The Expectancy Task was used with low and high trait anxious (Study 1: $N = 32$) and anxiety sensitive (Study 2: $N = 138$) individuals. Results suggest that in the context of physical concerns, both high anxious samples display a less positive expectancy bias. In the context of social concerns, high trait anxious individuals display a negative expectancy bias only when negatively valenced information was previously presented. Overall, this suggests that anxious individuals display a less positive expectancy bias, and that the processes that give rise to this bias may vary by type of situation (e.g., social or physical) or anxiety difficulty.

Keywords

Trait Anxiety; Anxiety Sensitivity; Expectancy Bias; Extrapolation

It is well documented that the content of maladaptive cognitions in anxiety tends to be concerned with the prospect of harmful future events (Beck & Clark, 1988; Kendall & Ingram, 1989). Those who are clinically anxious are more likely to have negatively distorted expectations of the future than are non-anxious individuals (e.g., MacLeod, Tata, Kentish, &

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Jacobsen, 1997; Miranda & Mennin, 2007). Consistent with this focus, an anxiety-linked negative expectancy bias reflects an inflated tendency for anxious individuals to expect an increased probability of negative relative to positive events. This anticipation of a wide range of negative events has been demonstrated not only in individuals who are clinically anxious (e.g., Borkovec, Alcaine, & Behar, 2004; Dugas et al., 1998), but also in non-clinical individuals who are highly trait anxious (e.g., MacLeod & Byrne, 1996; Stöber, 2000). Although an anxiety-linked negative expectancy bias has been documented, current paradigms do not illuminate the conditions that give rise to this bias.

In this article, two studies are reported that use a paradigm that provides individuals with valenced information, and then evaluates their tendency to expect positive or negative events to occur in the future. This paradigm is used with both highly trait anxious (HTA) and highly anxiety sensitive (HAS) samples. Trait anxiety reflects the propensity to become anxious across many different contexts (Spielberger, 1983), while anxiety sensitivity reflects the fear of symptoms related to anxiety (e.g., bodily sensations, such as a racing heart) and the belief that these sensations have negative physical, social, or psychological consequences (Reiss, 1991; Reiss & McNally, 1985).

While the anxiety-linked tendency to anticipate negative future events has been demonstrated using a variety of paradigms, no methodology has revealed the conditions that give rise to this expectancy bias in anxious samples. Specifically, it is unclear whether this bias occurs regardless of the valence of previously presented information, or whether it is moderated by the valence of previously presented information. In this paper, we consider three potential hypotheses regarding conditions that may lead to an expectancy bias.

First, it may be that the expectancy bias seen among anxious individuals is pervasive, such that it is shown across situations. Specifically, anxious individuals may have a more negative expectancy bias (relative to non-anxious individuals), regardless of whether current or recent events are emotionally negative, are emotionally positive, or are conflicting in emotional valence (i.e., containing negative and positive elements). This possibility is referred to as the *Pervasive Expectancy Bias Hypothesis* (Pervasive-EBH). Pervasive in this context refers to the bias occurring irrespective of differently valenced prior information or preceding events; it does not imply that expectancy biases will persist regardless of context. If an anxiety-linked tendency to show a more negative expectancy bias (relative to non-anxious individuals) is found, but it is moderated by the valence of previously presented information, this would refute the validity of the Pervasive-EBH. The Expectancy Task allows us to test two such hypotheses.

The *Extrapolation Expectancy Bias Hypothesis* (Extrapolation-EBH) suggests that the anxiety-linked elevation in expectations of negative future events is moderated by the (negative or positive) valence of previously presented information. Thus, anxious individuals may expect relatively more negative future events because they exhibit biased extrapolation from current events, relative to non-anxious individuals. For example, anxious individuals may be disproportionately inclined to infer that negative current events will lead to negative future events. Should this be observed, then the degree to which anxious (compared to non-anxious) participants inflate the probability of future negative events will

be disproportionately greater when the information they are given indicates that these prior events proceeded in a negative manner.

A third hypothesis, the *Emotional Weighting Expectancy Bias Hypothesis* (Emotional Weighting-EBH), refers to the possibility that the anxiety-linked expectancy bias is moderated by whether or not previously presented information is unresolved or mixed with respect to valence. It is hypothesized that, following the presentation of both positive and negative previous information, anxious individuals may be more likely than non-anxious individuals to assign more weight to the negative (rather than positive) information, construing the overall event as relatively more negative. Consequently, following the presentation of both positive and negative previous information, anxious individuals may be more likely to expect negative future events to occur. The current research presents participants with conflicting (negative and positive) information in order to test this hypothesis. In summary, the three hypotheses presented here differ in terms of whether an anxiety-linked expectancy bias is moderated by the valence of previously presented information.

Evaluating these hypotheses requires a task that provides information about the manner in which a range of scenarios proceed, and then assesses participants' expectancies for alternative possible future events that differ in their emotional valence. By manipulating the valence of information initially presented in each scenario, it is possible to investigate the circumstances under which biased expectation for future positive versus negative events will characterize anxious participants.

In the current paper, a paradigm that meets these requirements is used with two anxious samples: the Expectancy Task (Cabeleira, Bucks, Teachman, & MacLeod, 2010). Originally introduced and developed by Cabeleira et al. (2010) and further validated by Steinman, Smyth, Bucks, MacLeod, and Teachman (2013), the Expectancy Task presents participants with information about a range of hypothetical scenarios. The scenarios relate to physical or social events, which may be processed differently by people with different types and levels of anxiety. Most importantly, the scenarios vary in valence, and can be negative (including only negative and neutral events), positive (including only positive and neutral events), or conflicting in valence (including an equal number of positive and negative events). After reading and imagining themselves in the scenarios, participants are required to rate the likelihood of three future events occurring next, which can be negative, positive, or neutral in valence, on a scale of 1 ("very unlikely to happen next") to 4 ("very likely to happen next"). These ratings reveal anxiety-related bias in the relative tendency to expect positive versus negative future events. By examining whether such expectancy bias is influenced by the valence of the information provided in the initial scenarios, the three anxiety-linked expectancy bias hypotheses described above can be tested.

In summary, the current studies have two key aims: 1) to determine whether anxious individuals (HTA in Study 1, HAS in Study 2) show an inflated tendency to anticipate relatively more negative future events relative to non-anxious individuals, which we term an anxiety-linked negative expectancy bias; and 2) to test the three hypotheses described above by evaluating whether such a bias is moderated by the valence of previous events.

Study 1

Method

Participants—Thirty-two first year psychology undergraduates from the University of Western Australia were recruited based on their score on the Trait form of the State-Trait Anxiety Inventory (STAI-T; Spielberger, 1983). The mean trait anxiety score for college students (Spielberger) was used to determine cut-off scores for inclusion in HTA and LTA groups. To be included in the HTA group, participants had to score at least one standard deviation ($SD = 9.67$) above this mean trait anxiety score ($M = 39.35$) for college students, thus scoring 50 or above on the STAI-T. To be included in the LTA group, participants had to score at least one standard deviation below this mean trait anxiety score for college students, thus scoring 29 or below on the STAI-T. There were 16 LTA participants (50% female), and 16 HTA participants (50% female). The mean age of the sample was 17.6 years ($SD = 1.16$; range 17–22 years), and race was reported as: 68.8% White, 21.9% Asian, 6.3% African, and 3.1% “other.” The University of Western Australia’s Human Research Ethics Committee (HREC) approved this study.

Materials¹

Anxiety symptoms: The 20-item STAI (Spielberger, 1983) includes one scale to assess state anxiety (STAI-S) and one scale to assess dispositional trait anxiety (STAI-T). The reliability (Barnes, Harp, & Jung, 2002) and validity (Spielberger) of the scales are well established, and Cronbach’s alpha was .96 for the STAI-T and .91 for the STAI-S in the current study.

Expectancy Task: The Expectancy Task (Cabeleira et al., 2010) is a computerized reading judgment task designed to evaluate an individual’s tendency to anticipate positive or negative events to occur (labeled ‘expectancy bias’). The Expectancy Task involves presenting 64 scenarios (in 16 blocks of four) that vary in the extent to which positive, neutral, or negative events occur, then asking participants to judge the likelihood of future valenced events occurring in each of these scenarios. The Expectancy Task includes a Scenario Presentation Component and an Expectancy Rating Component.

In the Scenario Presentation Component, participants were asked to read and imagine themselves in a number of scenarios, each described by six statements: a Title, an Orienting Sentence, and four events (see Appendix for examples). The Title remained in the center of the computer screen for the duration of the scenario presentation, while the other five statements appeared directly below the Title, and each remained on the screen only until the participant pressed the spacebar, signaling that he or she had read the statement and was ready for the next statement to be shown. The four events in a scenario could be shown in any of three Passage Valence Conditions. In the Positive Valence condition, two positive and two neutral events were presented. In the Negative Valence condition, two negative and two neutral events were presented. In the Conflicting Valence condition, two negative and

¹Additional self-report measures were used in this study and are reported elsewhere. For a complete list of measures, please contact Cindy M. Cabeleira.

two positive events were presented. The neutral events were included to control for amount of information presented in each combination (i.e., such that each scenario consistently included four events, and each valence was consistently represented by two events). Order of valenced events (e.g., positive versus neutral) within a scenario was counterbalanced. A graphical depiction of the Scenario Presentation Component of the Expectancy Task is presented in Figure 1, which provides an illustrative example using a scenario relating to physical concerns delivered in the Conflicting Valence condition.

In the Expectancy Rating Component of the task, participants were asked to think about the likelihood of different specified candidate future events for each of the scenarios they had previously read and imagined themselves in. On each trial, participants read the Title and Orienting Sentence from one of the previously seen scenarios (and the four events previously presented as part of that scenario were represented as lines of stars below the orienting sentence), which remained on screen while participants were asked to rate their beliefs concerning the likelihood that each of the three specific events would happen to them within the scenario they imagined themselves experiencing. These candidate future events included one positive event, one negative event, and one neutral event, presented in a random order. These three candidate future events were displayed in the middle of the screen and participants were instructed to use a scale ranging from 1 (“very unlikely to happen next”) to 4 (“very likely to happen next”) to rate the subjective likelihood of each event. A graphical depiction of the Expectancy Rating Component of the Expectancy Task is presented in Figure 2, which provides an illustrative example using a scenario relating to physical concerns delivered in the Conflicting Valence condition. Scenarios were presented in blocks of four so that the load on memory would be minimal, with each block being followed by the expectancy ratings for the future events for the four scenarios. In total, 16 blocks of four scenarios were presented in this manner, totaling 64 scenarios.

Scenario event sets: Each of the 64 scenarios presented in the study was derived from its own Scenario Event Set. Each Scenario Event Set represented a hypothetical scenario related to either a physical or social concern, and included 11 items: a Title, an Orienting Sentence, and nine candidate events. Of the nine candidate events, three were positive, three were negative, and three were neutral (see Appendix). The four events actually presented in the Expectancy Task for any scenario were selected from its Scenario Event Set, in a manner that took account of the Passage Valence Condition for that scenario. Two of the three events of each valence to be presented in the scenario were randomly selected for display in the Scenario Presentation Component of the task, while the third event of each valence was shown in the Expectancy Rating Component of the task. All Scenario Event Sets were previously validated by an independent sample of 16 raters (see Cabeleira, 2010). Specifically, all Scenario Event Sets used in the current study were judged to be relevant to either physical or social concerns, and valenced ratings for events were consistent with the intended valence of each event (i.e., positive, negative, or neutral). Additionally, the positive and negative events were rated to have equivalent valence intensity.

Procedure—Participants were informed that the experiment was designed to illuminate how people differ in terms of their understandings of hypothetical scenarios. Participants

began the session by completing the STAI-S. Participants then completed eight practice scenarios of the Expectancy Task, followed by the full Expectancy Task. At the end of the session, participants received course credit for their participation and were debriefed.

Results

Descriptive Statistics—Chi-square tests revealed that the LTA and HTA groups did not differ by gender ($\chi^2 = .00, p = 1.000$) or race ($\chi^2 = 4.06, p = .541$), and an independent samples *t*-test demonstrated there was no significant difference between the LTA and HTA groups in terms of age ($t(30) = .91, p = .37, d = 0.32$). An independent samples *t*-test was used to compare both trait and state anxiety scores at baseline between groups (LTA vs. HTA). As expected, this revealed a significant group difference in trait anxiety, $t(30) = 27.79, p < .001, d = 9.82$, such that HTA participants reported higher trait anxiety than LTA participants. Unsurprisingly, a significant group difference was also observed for state anxiety, $t(30) = 5.16, p < .001, d = 1.82$, such that HTA participants reported higher state anxiety than LTA participants. Descriptive statistics for age, trait and state anxiety scores for each anxiety group are presented in Table 1.

Evidence for Expectancy Effects²—The Expectancy Task was scored by subtracting participants' average likelihood ratings for negative future events from their average likelihood ratings for positive future events to yield an expectancy bias index. The decision to create this relative, rather than absolute, bias index derived from a desire to simultaneously consider the valuing of positive and negative choices, given the external validity of needing to weigh multiple options simultaneously when predicting the future. A score of zero on this index would indicate that there was no difference between participants' ratings for the likelihood of negative and positive future events. A score on this index that is greater for participant A than for participant B would indicate that the former participant exhibited a relatively greater tendency to expect positive events, while the latter participant demonstrated a relatively greater tendency to expect negative events. A summary of the mean probability ratings for negative and positive future event statements is presented in Table 2, with mean ratings organized by Passage Valence condition (Negative Valence, Positive Valence, Conflicting Valence), Scenario domain (Physical, Social), and Anxiety group (LTA, HTA).

A repeated measures analysis of variance (ANOVA) with one between-subjects factor of Anxiety Group (LTA, HTA), and two within-subjects factors of Passage Valence Condition (Positive Valence, Negative Valence, Conflicting Valence) and Scenario Domain (Physical, Social), was conducted to examine whether an anxiety-linked difference in negative expectancy bias was evident, and, if so, under which experimental conditions it was observed. The results of the ANOVA revealed a significant main effect of Anxiety Group ($F(1, 30) = 22.71, p < .001, \eta_p^2 = .43$), reflecting the anticipated lower positive expectancy bias index scores for the HTA group ($M = 0.86, SD = 0.44$) compared to the LTA group ($M = 1.01, SD = 0.64$).

²An ANOVA revealed that the order of events (e.g., negative-neutral vs. neutral-negative) presented in the Scenario Presentation Component of the task did not influence the ratings made in the Expectancy Rating Component of the task (all $p > .05$). Thus, order of events was not included as a factor in the analyses presented.

There was also a main effect of Passage Valence Condition ($F(2, 29) = 22.74, p < .001, \eta_p^2 = .61$). Follow-up analyses showed that ratings of future events differed significantly across the three passage valence types in the expected direction (all $p < .001$), such that Negative Valence passages ($M = -0.01, SD = 1.14$) yielded a relatively less positive expectancy index compared to the Conflicting Valence passages ($M = 0.50, SD = 0.73$), which in turn yielded a less positive expectancy index relative to the Positive Valence passages ($M = 1.16, SD = 0.68$). This suggests that the Expectancy Task is sufficiently sensitive to show expectancies are influenced by the valence of prior information.

Importantly, there was a significant 2-way interaction between Anxiety Group and Passage Valence Condition ($F(2, 29) = 6.46, p = .005, \eta_p^2 = .31$). This was further embedded in a significant 3-way interaction of Anxiety Group, Passage Valence Condition, and Scenario Domain ($F(2, 29) = 3.92, p = .031, \eta_p^2 = .21$; see Figure 3). No other significant effects emerged from this analysis. To understand the 3-way interaction, between group differences in the expectancy rating data were analyzed separately for each Scenario Domain.

For scenarios related to physical concerns, there was a main effect of Anxiety Group ($F(1, 17.19) = 19.94, p < .001, \eta_p^2 = .40$), such that HTA individuals had a less positive expectancy bias relative to LTA individuals (HTA $M = 0.13, SD = 0.42$; LTA $M = 0.98, SD = 0.63$). No significant 2-way interaction of Passage Valence Condition and Anxiety Group ($F(2, 29) = 2.14, p = .137, \eta_p^2 = .13$) was observed. In other words, both HTA and LTA individuals' expectancies were similarly affected by the valence of initial scenarios, indicating that extrapolation from valence of initial events did not vary by anxiety group, though the HTA group expected relatively less positive future events in general.

For scenarios related to social concerns, there was a main effect of Anxiety Group ($F(1, 24.13) = 20.88, p < .001, \eta_p^2 = .41$), that was subsumed by a significant 2-way interaction of Passage Valence Condition and Anxiety Group ($F(2, 29) = 11.73, p < .001, \eta_p^2 = .45$). Independent samples *t*-tests were conducted to compare the Anxiety Groups' expectancy index ratings for each Passage Valence type for the social scenarios. Results revealed that HTA participants showed less positive expectancy bias than LTA participants when scenarios were initially presented in the Negative Valence condition ($t(30) = 5.96, p < .001, d = 2.11$; HTA $M = -0.98, SD = 0.67$, LTA $M = 0.84, SD = 1.02$), or in the Conflicting Valence condition ($t(30) = 4.38, p < .001, d = 1.55$; HTA $M = 0.00, SD = 0.57$, LTA $M = 0.97, SD = 0.68$). There was no significant Anxiety Group difference in expectancy bias scores when scenarios were initially presented in the Positive Valence condition ($t(30) = 0.79, p = .435$; HTA $M = 1.09, SD = 0.85$, LTA $M = 1.32, SD = 0.77$), with both groups similarly rating positive future events as more likely to occur than negative future events. Thus, whenever the initial social scenario contained negative events (i.e., in both the Negative Valence and Conflicting Valence conditions), the HTA participants showed lower expectancy bias for future positive events, compared to the LTA participants. However, this was not the case when the initial scenario did not contain negative events (i.e., in the Positive Valence condition).

To further understand the significant 3-way interaction of Anxiety Group, Passage Valence Condition, and Scenario Domain, within anxiety group differences were examined next. For

the LTA group, there was the expected main effect of Passage Valence Condition ($F(1.43, 21.44) = 4.94, p = .026, \eta_p^2 = .25$). Least Significant Difference (LSD) comparisons revealed relatively greater positive expectancy when the preceding information was Positive ($M = 1.34, SD = .65$) relative to that containing negative information (i.e. Negative $M = 0.77, SD = .99; p = .031$, and Conflicting Valence passages $M = 0.92, SD = .62; p = .012$, respectively). There was no significant difference between the observed positive expectancy when preceding information was of a Negative Valence compared to a Conflicting Valence ($p = .370$). There was no significant 2-way Passage Valence Condition by Scenario domain interaction ($F(2, 30) = 0.53, p = .592, \eta_p^2 = .03$). Notably, the absolute value of the expectancy bias was positive across all three Passage Valence Conditions (i.e., t -tests indicated the bias value was significantly greater than zero; all $p < .05$).

For the HTA group, there was again a main effect of Passage Valence Condition ($F(2, 30) = 39.67, p = .000, \eta_p^2 = .73$), which was subsumed by a significant 2-way Passage Valence Condition by Scenario domain interaction ($F(2, 30) = 5.95, p = .007, \eta_p^2 = .28$). For social scenarios, LSD comparisons revealed relatively greater positive expectancy when the preceding information was of a Positive Valence ($M = 1.09, SD = .85$) compared to Conflicting Valence ($M = 0.00, SD = .57; p < .001$), which in turn resulted in greater positive expectancy than when the preceding information was of a Negative Valence ($M = -0.98, SD = .67; p < .001$). Further, the HTA group displayed a relatively negative expectancy bias (i.e., less than zero) in social scenarios when the preceding information was of a Negative Valence, ($t(15) = 5.83, p < .001, d = 1.46$), no expectancy bias (i.e., bias is not significantly different from zero, $t(15) = 0.00, p = 1.000$) when preceding information was of a Conflicting Valence (i.e., contains negative and positive information), and a positive expectancy bias when preceding information was of a Positive Valence ($t(15) = 5.15, p < .001, d = 1.28$).

For physical scenarios, LSD comparisons revealed a more positive expectancy bias when the preceding information was of a Positive Valence ($M = 0.85, SD = .65$), rather than being of a Conflicting Valence ($M = 0.14, SD = .67; p = .004$), which in turn resulted in greater positive expectancy than when the preceding information was of a Negative Valence ($M = -0.59, SD = .70; p = .002$). Further, participants displayed a negative expectancy bias in physical scenarios when the preceding information was of a Negative Valence, ($t(15) = 3.37, p = .004, d = 0.84$) and no expectancy bias was observed when preceding information was of a Conflicting Valence (i.e., contains negative and positive information; $t(15) = 0.84, p = .416$), and a positive expectancy bias when preceding information was of a Positive Valence ($t(15) = 5.27, p < .001, d = 1.31$).

Taken together, these results confirm the presence of an anxiety-linked expectancy bias. Interestingly, when examining the between-group effects, the cognitive mechanisms underpinning this anxiety-linked negative expectancy bias appear to differ for scenarios relating to physical concerns versus social concerns. With respect to physical scenarios, there was no evidence that valence of the prior information provided in the scenarios affected the magnitude of this anxiety-linked effect, thus providing no basis for refuting the Pervasive-EBH. With respect to social concerns, the HTA participants displayed a more negative/less positive expectancy bias only when negative events had already initially

occurred within these scenarios. These results for the HTA participants appear attributable to greater (negative) extrapolation from previous negative events, consistent with the Extrapolation-EBH. When examining the within-group effects, the LTA were pervasively more positive in their expectations of future events, while the expectancies of the HTA group were more consistent with the valence of previously presented information.

Discussion

This study had two aims: 1) to determine whether HTA individuals do indeed show an inflated tendency to expect negative future events relative to LTA individuals, and 2) to investigate whether such an anxiety-linked bias is moderated by the emotional tone of previously presented information. The findings confirmed that, compared to LTA participants, HTA participants showed a more negative/less positive expectancy bias, consistent with previous research (e.g., Miranda & Mennin, 2007). Furthermore, the present study also sheds light on the nature of this bias, revealing that it differs between high and low anxiety groups depending on the type of concerns (physical or social) depicted in events.

In scenarios relating to physical concerns, the observed anxiety-linked expectancy bias was not moderated by the emotional tone of previous events. Of course the absence of an interaction here cannot be interpreted as absolute evidence for the Pervasive-EBH, given that a conclusion cannot be sustained on the basis of confirming predicted null results. Perhaps with greater power (e.g., a larger sample size), valence may have moderated the anxiety-linked expectancy bias in physical scenarios, and there are of course numerous other factors not investigated here that could have moderated the anxiety-linked effect. Notwithstanding, with respect to the factors investigated here, the Pervasive-EBH appears to most parsimoniously accommodate the results.

When participants were required to judge the likelihood of future events in scenarios related to social concerns, the anxious participants only demonstrated a more negative/less positive expectancy bias than non-anxious participants when negative events had already occurred within the initial description of these scenarios (i.e., in the Negative Valence and Conflicting Valence conditions). This pattern of results is consistent with greater negative extrapolation, whereby anxious individuals showed an elevated tendency to infer that future events will continue to be negative when previous events have been negative (matching the Extrapolation-EBH).

These different findings for the physical versus social scenarios were unexpected. As mentioned earlier, sample sizes were small in this study, thus limiting power to detect significant effects. It is possible that a pattern of results consistent with the Extrapolation-EBH may have occurred for the physical scenarios if the study was conducted with a larger sample. Another challenge in interpreting this difference is that social concerns may be more personally relevant for this sample of young, HTA individuals than physical concerns, given the automatic “attention-grabbing power of negative social information” (Pratto & John, 1991, p. 380). Thus, perhaps these individuals were more likely to make greater use of previously presented, valenced information in forming their future expectations about socially related matters.

In terms of the within anxiety group effects observed, the LTA appeared to have a pervasively positive expectancy bias regardless of scenario type (i.e., physical or social) or prior valence (though degree of positivity clearly differed by prior valence), while the expectancies of the HTA were more consistent with the valence of preceding information (i.e., positive bias in Positive Valence passages, negative bias in Negative Valence passages, and no significant bias in Conflicting Valence passages) for scenarios relating to both social and physical concerns.

To address issues of power and relevance of scenario concerns, and replicate and extend the findings of Study 1, Study 2 uses a much larger, alternate anxious sample for which physical concerns tend to be more personally relevant.

Study 2

While the presence of an expectancy bias in trait anxious samples has been previously explored, it is unclear whether this phenomenon is consistent across different types of anxious samples, or if anxiety subtypes differ in their expectancies and the conditions under which negative expectancy biases arise. Anxiety sensitivity involves the fear of anxiety-related symptoms, including various bodily sensations (Cox, Parker, & Swinson, 1996) and the belief that these sensations have negative physical, social, or psychological consequences (Reiss, 1991; Reiss & McNally, 1985). Study 2 aims to explore if an anxiety-linked expectancy bias in scenarios relating to physical concerns will once again *not* be moderated by the valence of previous events and linked to a *Pervasive Expectancy Bias* (in line with the Study 1 findings), or whether an *Extrapolation Expectancy Bias* will emerge (akin to findings for the social scenarios in Study 1). Given high anxiety sensitive (HAS) individuals are known to have concerns about the physical consequences of anxiety, the physical scenarios may be more relevant than they were for the HTA group in Study 1. No research to the authors' knowledge has investigated expectancy bias in HAS individuals in a manner that can test whether results are consistent with a Pervasive-EBH, Extrapolation-EBH, or Emotional Weighting-EBH account.

In Study 2, the Expectancy Task was used with low anxiety sensitive (LAS) and HAS samples. Only scenarios related to physical events (e.g., going to the doctor, or exercising) were included in this version of the Expectancy task given our interest in better understanding the nature of expectancies for this material in a sample known to have concerns about physical sensations (Clark, 1986). Note that the scenarios included did not all perfectly align with fears of bodily sensations. Rather, the scenarios included a broad range of physical concerns. Given the relationship between health anxiety and anxiety sensitivity (e.g., Wheaton, Berman, & Abramowitz, 2010), it is probable that many of the scenarios were personally relevant for participants with HAS, and we wanted to sample the physical domain broadly. Of note, we used a much larger sample in Study 2, which addresses power concerns in Study 1.

Additionally, in Study 2, we consider another potential moderator of expectancies – the role of priming concerns tied to the physical scenarios to make those concerns salient before forming expectancies. The inclusion of this moderator follows mixed results in the field

about the role of such primes in the expression of cognitive biases in anxious samples. For instance, priming concerns related to specific fears have led to enhancement of recall biases in a spider-fearful sample (e.g., Smith-Janik & Teachman, 2008), but also reduction of attention biases in a snake-fearful sample (e.g., Mathews & Sebastian, 1993). On the contrary, priming concerns related to specific fears had no effect on memory biases in another spider phobic sample (see Study 1 in Watts & Dalgeish, 1991). Thus, we are interested in how an analogous prime tied to physical concerns will alter the expression of expectancy bias. It is hypothesized that priming physical concerns will increase state anxiety for the HAS group, but not the LAS group. In response to this prime, it is tentatively hypothesized that the difference in expectancy bias between LAS and HAS individuals will be magnified following priming of physical concerns because the prime will make those concerns salient, but given prior mixed results, this evaluation is somewhat exploratory.

Finally, to test whether expectancy bias is related to markers of anxiety beyond only questionnaire measures of anxious symptoms, a measure of anxiety experienced during an anxiety sensitivity-relevant stressor was included. It is predicted that expectancy bias will be related to anxiety experienced during an anxiety-relevant trigger, speaking to the predictive validity of expectancy bias.

Method

Participants—Participants were recruited through the University of Virginia’s psychology department participant pool, based on their responses to the Anxiety Sensitivity Index (ASI; Reiss, Peterson, Gursky, & McNally, 1986). Students who scored 14 or below on the total ASI (so they were at least .5 standard deviations below ASI college student norms; Peterson & Reiss, 1992) were invited to participate in the LAS group. Students who scored 23 or greater on the total ASI (so they were at least .5 standard deviations above ASI college students norms; Peterson & Reiss) were invited to participate in the HAS group³. One hundred and thirty-nine students participated in the study. One participant was excluded from analyses, due to being an outlier in age (8.16 years above the rest of the sample’s mean). Sixty-eight LAS students (63.2% female) and 70 HAS students (65.7% female) were included in analyses. The mean age was 18.84 ($SD = .93$, range = 17 – 22 years). Seventy-one percent of participants reported their race as White, 14.5% as Asian, 8.0% as Black/African American, 5.1% as Bi- or multiracial, and 1.4% as “other.” The University of Virginia’s Institutional Review Board (IRB) approved this study.

Materials⁴

Anxiety symptoms: The Anxiety Sensitivity Index (ASI; Reiss et al., 1986) is a 16-item questionnaire that measures an individual’s concern over symptoms associated with anxiety (e.g., “It scares me when my heart beats rapidly”). The ASI has good reliability and validity

³To be invited to the LAS group, individuals also had to score a 9.71 or below on the ASI Physical Concerns Subscale (ASI-PC; matching the one standard deviation cutoff above the mean of a healthy non-anxious sample; Teachman, Smith-Janik, & Saporito, 2007). To be invited to the HAS group, individuals also had to score a 12.66 or greater on the ASI-PC (matching the one standard deviation cutoff below the mean of a sample with panic disorder; Teachman et al.).

⁴The materials reported are part of a larger study assessing cognitive biases in anxiety sensitivity. For a complete listing of measures, please contact Shari A. Steinman.

(Peterson & Reiss, 1993), and includes items relevant to physical, social, and mental incapacitation concerns. Cronbach's alpha for the ASI was .95 in the current study.

The Positive and Negative Affect Schedule-Fear Subscale (PANAS-FS; Watson & Clark, 1994) is a widely used self-report measure of affect based on adjective ratings. The PANAS has good reliability and validity (Watson & Clark). In the current study, only the 6-item fear subscale was administered to determine if the physical sensations prime affected state fear. Across administrations, the average Cronbach's alpha was .82 (range = .74 – .87).

Physical Sensation Prime Manipulation: Participants were randomly assigned to either a physical sensation Prime or No Prime condition to test the impact of a prime on the expression of expectancies. To prime physical sensations relevant to anxiety (and, in turn, presumably alter state fear for the HAS group), participants in the Prime condition were asked to complete the Candle-Blowing task. This task was derived from the widely used Panic Control Treatment manual (Barlow & Craske, 1994) and has been used in previous studies examining anxiety reactions (e.g., Gordon & Teachman, 2008; Steinman & Teachman, 2010). In the Candle-Blowing task, participants were asked to imagine that their index finger was a candle that they must blow out repeatedly for 45 seconds. To standardize the tempo of breathing, participants were asked to blow with the beat of a metronome set to 100 beats per minute. Although this task is harmless, it produces temporary physical sensations, such as sweating, numbness, dizziness, hot flashes, and tingling.

In the No Prime condition, participants were asked to work on a Word Search Task, which was related to animals. This task was designed to match the conditions for overall time, but not to prime anxiety-sensitive relevant concerns or alter state fear.

Expectancy Measure: The Expectancy Task (Cabeleira et al., 2010) used in Study 1 was also used in Study 2 to evaluate the tendency to expect relatively positive versus negative future events to occur in the described scenarios. However, this study presented only the 32 scenarios relating to physical concerns (and excluded the 32 scenarios relevant to social concerns). Additionally, given the Expectancy Task was originally developed in Australia, minor modifications were made so that the wording was more prototypical of American English (e.g., “queuing” was changed to “waiting in line”).

Physical Sensation Stressor: To evaluate how expectancy bias is related to anxiety following an anxiety sensitivity-relevant stressor, participants were asked to complete the Straw Breathing task. Note this task was completed after the Expectancy Task by all participants, unlike the Candle-Blowing task, which was a between-subjects manipulation that preceded the Expectancy Task. Similar to the Candle-Blowing task, the Straw Breathing task was derived from the widely used Panic Control Treatment manual (Barlow & Craske, 1994) and has been used in previous studies examining anxiety reactions (e.g., Gordon & Teachman, 2008; Steinman & Teachman, 2010). In the Straw Breathing task, participants were asked to breathe through a thin straw for up to two minutes, while holding their nostrils shut. Similar to the Candle-Blowing task, the straw breathing task is harmless, but elicits temporary sensations, such as dizziness, suffocation, and lightheadedness. Anxiety was

measured by the PANAS-FS by asking participants to indicate how they felt when their anxiety was at its peak during the task.

Procedure—Participants were informed that the purpose of the study was to investigate how people decide what happens next after reading short stories. Participants were unaware that they were recruited for the study based on their level of anxiety sensitivity. After informed consent, participants completed a brief demographics form, followed by the PANAS-FS to get a baseline measure of state fear. Next, participants were assigned to the Prime ($n = 70$) or No Prime ($n = 68$) condition. The prime conditions were balanced for AS group and for gender. Participants in the Prime condition completed the Candle-Blowing task, while those in the No Prime condition completed the Word Search task. The PANAS-FS was administered after both tasks. Next, all participants completed four practice Expectancy Task scenarios that were unrelated to physical concerns, followed by the full Expectancy Task (and the PANAS-FS). All participants then completed the Straw Breathing physical sensation stressor followed by the PANAS-FS. Next, participants completed a final administration of the PANAS-FS to ensure they did not have residual anxiety at the end of the study. Finally, all participants were fully debriefed.

Results

Descriptive Statistics—As predicted, chi-square tests revealed that the LAS and HAS groups did not differ by gender ($\chi^2 = .09, p = .761$) or race ($\chi^2 = 5.77, p = .217$). An independent samples *t*-test demonstrated there was not a significant difference between the LAS and HAS groups in terms of age ($t(136) = 1.88, p = .063, d = .32$). As expected, the LAS group had significantly lower baseline levels of state anxiety ($M = 6.62, SD = 1.43$) relative to the HAS group ($M = 7.81, SD = 2.52; t(107.87) = 3.42, p = .001, d = .58$). Additionally, as expected, chi-square tests revealed that gender ratio ($\chi^2 = .09, p = .761$) and race ($\chi^2 = 3.05, p = .550$) did not differ between participants assigned to the Prime and No Prime conditions. Further, independent samples *t*-tests revealed that there was no significant difference between the prime conditions in baseline fear as measured by the PANAS-FS ($t(135) = .78, p = .439, d = .13$) or age ($t(136) = 1.63, p = .106, d = .28$). See Table 3 for descriptive statistics separated by Anxiety Group and Prime Condition.

Effect of Prime Condition on State Fear—To evaluate the effect of the physical sensation prime condition on state fear (measured by the PANAS-FS), a repeated measures ANOVA with two between-subjects factors: Anxiety Group (LAS, HAS) and Prime Condition (Prime, No Prime), and one within-subjects factor: Time (Baseline, Post Prime Condition Task), was conducted. Results indicated a main effect of Time, such that on average, all participants reported higher levels of state fear following the prime condition task relative to baseline ($F(1,132) = 5.30, p = .023, \eta_p^2 = .04$). Not surprisingly, there was also a main effect of Anxiety group, indicating that participants in the HAS group reported higher levels of state fear than participants in the LAS group ($F(1, 132) = 15.85, p < .001, \eta_p^2 = .11$). Finally, there was the expected significant Time by Anxiety group by Prime Condition interaction ($F(1, 132) = 5.93, p = .016, \eta_p^2 = .04$).

Follow up tests to understand the interaction showed that, for the LAS group, there was a main effect of Prime Condition, such that participants in the Prime condition reported higher state fear than those in the No Prime condition ($F(1, 65) = 5.14, p = .027, \eta_p^2 = .07$). However, no main or interactive effects with Time emerged (all $p > .10$). For the HAS group, there was not a significant main effect of Prime Condition ($F(1, 67) = .38, p = .543, \eta_p^2 = .01$), or Time ($F(1, 67) = 3.81, p = .055, \eta_p^2 = .05$), but there was the expected significant Time by Prime Condition interaction ($F(1, 67) = 6.50, p = .013, \eta_p^2 = .09$). As expected, for HAS participants in the No Prime condition, reported state fear was not significantly different at the two time points ($t(33) = .43, p = .673, d = .07$). However, for HAS participants in the Prime condition, reported state fear was significantly higher following the Candle-Blowing task, relative to baseline ($t(34) = 3.16, p = .003, d = .55$). Overall, these results suggest that the Candle Blowing prime increased state fear for the HAS group, but did not change state fear over time for the LAS group, supporting interpretation of the prime as an anxiety sensitivity-relevant stressor.⁵ Of note, on average, PANAS-FS scores following the prime condition tasks were low ($M = 7.49, SD = 2.24$, range = 6–17), suggesting that while the prime increased fear for the HAS group, the prime was somewhat weak.

Evidence for Expectancy Effects⁶—As in Study 1, an expectancy bias index was calculated by subtracting the likelihood of future negative events from the likelihood of future positive events. A summary of the mean probability ratings for negative and positive future event statements is presented in Table 4, with mean ratings organized by Passage Valence condition (Negative Valence, Positive Valence, Conflicting Valence), Anxiety Group (LAS, HAS), and Prime condition (No Prime, Prime). A repeated measures ANOVA with two between-subjects factors: Anxiety Group (LAS, HAS) and Prime Condition (Prime, No Prime), and one within-subjects factor: Passage Valence Condition (Conflicting Valence, Positive Valence, Negative Valence) was conducted.

As in Study 1, the ANOVA revealed a main effect of Anxiety Group ($F(1,134) = 4.02, p = .047, \eta_p^2 = .03$), such that the HAS group had a more negative/less positive expectancy bias index score ($M = 0.53, SD = 0.43$) than the LAS group ($M = 0.68, SD = 0.44$). Thus, this second study confirmed that anxious (compared to non-anxious) participants demonstrated a lowered relative expectation for positive (vs. negative) future events.⁷ As can be seen in Figure 4, the average expectancy bias score (averaged across the difference passage valence conditions) was significantly different from zero, suggesting a general tendency to expect positive relative to negative future events ($t(137) = 16.18, p < .001, d = 1.38$). However, the tendency to display a positive expectancy bias was lower for HAS participants, relative to LAS participants. Also as in Study 1, there was a main effect of Passage Valence Condition

⁵Note that PANAS data were positively skewed, so analyses were re-run with log transformed data. This did not change the pattern of results. Additionally, each group (i.e., LAS No Prime, LAS Prime, HAS No Prime, HAS Prime) had at least one outlier at both time-points (baseline PANAS-FS, and after the Prime condition administration of PANAS-FS) prior to transformation, so it is unlikely that outliers specific to one group are driving effects. Outliers were defined as data points at least 1.5 box lengths outside of interquartile range when looking at boxplots.

⁶Similar to Study 1, an ANOVA revealed that the order of events (e.g., negative-neutral vs. neutral-negative) presented in the Scenario Presentation Component of the task did not influence the ratings made in the Expectancy Rating Component of the task (all $p > .05$). Thus, order of events was not included as a factor in the analyses presented.

⁷Note that when the outlier due to age is included, this main effect becomes $F(1,135) = 3.40, p = .067, \eta_p^2 = .03$.

($F(2,133) = 52.45, p < .001, \eta_p^2 = .44$). Follow-up analyses showed that expectancy bias index scores across the three passage valence types all significantly differed from each other in the anticipated direction (all $p < .001$), with Negative Valence passages ($M = 0.09, SD = 0.77$) yielding a relatively less positive expectancy index compared to Conflicting Valence passages ($M = 0.63, SD = 0.53$), which in turn were less positive than Positive Valence passages ($M = 1.10, SD = 0.71$). These findings replicate Study 1. Notably, there was not a significant Anxiety Group by Passage Valence Condition interaction ($F(2, 133) = .91, p = .406, \eta_p^2 = .01$). Hence, both anxious and non-anxious individuals' expectations concerning future events were equally affected by the valence of initial events that occurred in each scenario, indicating that extrapolation from the valence of initial events did not vary by anxiety level, though the HAS group expected relatively less positive future events in general. This replicates the pattern of effects shown by HTA participants on these same physical passages in Study 1.

Finally, there were no main or interactive effects of Prime Condition (all $p > .10$), suggesting that prime condition did not affect expectancy. This is consistent with some prior null findings for the effect of anxiety-relevant primes on cognitive processing biases (e.g., Watts & Dalgeish, 1991), but counter to the expectation that the prime would make the physical concerns salient, enhancing the expression of an expectancy bias.

Relationship between Expectancy Bias and Response to the Stressor—To test whether the expectancy bias is related to *in vivo* fear responding, a correlation was computed between the expectancy index score and fear in response to the physical sensation stressor (Straw-Breathing). Scores on the PANAS-FS following the physical sensation stressor ranged from 6 to 24, with a mean of 11.69 ($SD = 4.36$). As expected, results suggested that a less positive expectancy bias is related to greater state fear during the physical sensation stressor, as measured by the PANAS-FS ($r(135) = -.19, p = .023$).

Discussion

As was found for HTA individuals in Study 1, participants with HAS also displayed a less positive expectancy bias relative to participants with LAS. Furthermore, replicating the pattern of effects shown on physical scenarios by HTA participants in Study 1, the anxiety-linked expectancy bias observed on these physical scenarios in Study 2 was unaffected by the valence of the preceding events that occurred within these physical scenarios. Although the current study included a larger sample and thus greater power to detect significant effects than Study 1, the replicated absence of an interaction with valence still needs to be interpreted with caution given it relies on a null result. However, Pervasive-EBH remains the most parsimonious account for the obtained results. Given that Study 2 only included physical scenarios, we do not know what type of expectancy bias HAS individuals would have when presented with scenarios relevant to other domains (e.g., social). In retrospect, it would have been ideal to include social scenarios along with physical scenarios in Study 2; however, due to practical reasons (e.g., added time it took to do candle blowing and straw breathing tasks), we were unable to include the social scenarios in this study.

Further, Study 2 demonstrated a relationship between expectancy bias index scores and fear experienced during a physical sensation stressor. This suggests that expectancy bias is related to actual anxiety experienced in response to a stressor (vs. only a questionnaire measure of trait levels of anxiety sensitivity), and highlights the predictive validity of expectancy bias. Finally, results suggested that priming a physical stressor did not independently or interactively affect expectancy bias. While this is contrary to the hypothesis that the prime would make physical concerns salient, and in turn augment the anxiety-linked expectancy bias, it is consistent with past null findings for the effect of anxiety-relevant primes on processing biases (e.g., Watts & Dalgeish, 1991). Future studies might consider using a stronger prime (that increases state anxiety more than the prime used in the current study) to evaluate if a stronger physical prime would have a significant impact on the anxiety-linked expectancy bias.

General Discussion

In this article, we report two studies that use the Expectancy Task, a recently developed paradigm that provides individuals with different forms of valenced information, and then evaluates their tendency to expect positive or negative events to occur in the future. The studies shared two goals: 1) to examine expectancy bias in anxious (HTA and HAS) samples, and 2) to determine the conditions that give rise to expectancy bias. Study 2 had the additional goal of exploring the effect of priming physical sensations on expectancy.

In both Studies 1 and 2, high anxious (both trait anxious and anxiety sensitive) groups showed a more negative/less positive expectancy bias relative to low anxious individuals. In this respect, the results confirm previous evidence of threat expectancy bias in trait anxious participants (e.g., MacLeod et al., 1997; Miranda & Mennin, 2007) and extend this evidence to anxiety sensitive participants. Additionally, the results suggested a relationship between expectancy bias and various indicators of anxiety, such that a greater negative expectancy bias was associated with higher levels of subjective fear experienced during a stressor. This further supports an association between anxiety and expectancy bias.

An important feature of the Expectancy Task is that it is designed not only to determine if an expectancy bias exists, but also to illuminate possible cognitive underpinnings of this bias by evaluating the experimental conditions that give rise to the bias. In Study 1, for passages related to social concerns, the HTA group only displayed elevated expectancy for negative future events when initial scenarios included negative events, or a mix of negative and positive events. Although speculative, one reason that the negative expectancy bias may diminish in the context of positive social scenarios may be that even HTA individuals likely have more experience with social interactions going well, so this may seem more plausible than a potential physical concern turning out well. Along these lines, it will be interesting in future research to evaluate the expectancy bias in highly socially anxious individuals, given this group may more pervasively expect social interactions to go badly.

In Study 2, which employed only the scenarios related to physical concerns, HAS participants demonstrated heightened expectancy for less positive/more negative future events. This was unaffected by the valence of the information provided concerning the

initial events that previously took place in each scenario, and is in line with the Pervasive-EBH. This replicates results from the physical scenarios from Study 1, and is in line with findings reported by Steinman et al. (2013) from an online version of the Expectancy Task given to an unselected sample varying in trait anxiety. Past research has suggested that anxious individuals tend to disqualify, or not learn from, past positive experiences (e.g., Beck, 1976; Heimberg & Becker, 2002), which may explain why the HAS group in Study 2 expected negative future events to occur, even following Positive Valence or Conflicting Valence scenarios. Future attempts to manipulate expectancy bias, as is done in cognitive bias modification research (e.g., Mathews & Mackintosh, 2000), can help determine if the bias is causally related to the onset or maintenance of anxiety problems.

It is intriguing that valence moderated the anxiety-linked expectancy bias when scenarios were related to social concerns (in Study 1), but not when events were related to physical concerns (in both Studies 1 and 2). It would be interesting to determine whether HAS individuals also show greater extrapolation from negative events when processing social scenarios. If they do, this would suggest that the tendency for anxious individuals to extrapolate more strongly from prior negative events is more readily observed when these negative events are of a social nature. In contrast, if HAS individuals do not display this pattern of results even when processing social scenarios, this would instead suggest that the mechanisms that underpin negative expectancy bias may differ across anxious samples.

While we have demonstrated that expectancy bias, observed for the physical and social scenarios, differs in groups of participants selected on the basis of their differing levels of anxiety, this does not permit the conclusion that anxiety alone is implicated in the observed effect. Anxiety is correlated with other dimensions of temperament, such as depression and neuroticism (Jylhä & Isometsä, 2006). Therefore it would be valuable to include measures of depression, and perhaps neuroticism, in addition to anxiety, in future studies of this nature, in order to potentially differentiate their respective contribution to observed patterns of expectancy bias. We speculate that the observed expectancy biases are not unique to anxiety alone, given the prominence of a negative future focus (e.g., hopelessness) in other disorders, like depression. However, the specific nature of expectancy biases may differ in anxiety and in depression. For example, it may be that attenuation of positive expectancies may characterize depression, while amplification of negative expectancies may be more characteristic of anxiety. Delineating the patterns of expectancy associated with each dimension of emotion will be an important objective for future research.

It is important to consider the potential role of response bias in the observed effects. A response bias effect, reflecting an inflated tendency to endorse more extreme negative responses, regardless of actual expectancy, could mimic an expectancy bias in this kind of assessment task. The fact that we obtained different findings for the physical and social scenarios weighs against the plausibility of a response bias account. Moreover, the finding that anxiety-linked expectancy effects were moderated by the valence of previous events precludes a response bias explanation of the present group difference. Nevertheless, it would be prudent for future research to more directly assess for response bias effects. For instance, if negative and positive foil items (reflecting future events that do not plausibly follow from the previously presented scenarios) were included in the Expectancy Task, then negative

response bias would be directly revealed by preferential endorsement of the negative foils. Further, to mitigate the impact of such response bias, future investigators may usefully seek to develop methods of assessing expectancy that bypass the need for self-report. For example, it may be possible to infer a higher level of expectancy for certain continuation events on the basis of speeded comprehension latencies to encode such events in a self-paced reading task. More implicit assessment of expectancy bias would also reduce the degree to which observed effects could plausibly be attributed to experimenter demand.

Of note, neither of the present studies found evidence to support the Emotional Weighting-EBH. In other words, in both studies, the anxiety-linked expectancy bias was not found to be the strongest in the Conflicting Valence condition. This finding suggests that anxious individuals' heightened expectancy for future negative events (relative to non-anxious individuals) cannot be solely attributed to the conflicting nature of previously presented information and the construed emotional valence of such information. Given the current finding, it seems unlikely that anxious individuals' less positive expectations of the future would be remediated by only reducing their tendency to misconstrue emotionally contradictory information as predominantly negative in tone. Rather, it may be beneficial for clinicians to directly target anxious clients' biased patterns of future expectations across both emotionally conflicting and non-conflicting situations, to encourage the development of an increased expectation for positive events and a reduced expectation for negative events.

In Study 1, when observing expectancies within each anxiety group, LTA participants were more positive in their expectancies following positive information alone, compared to negative information alone or information conflicting in emotional valence. However, they tended to have a positive absolute bias (e.g., above zero) in their expectancies across all of these differently valenced conditions, and this was true for both social and physical scenarios. In contrast, the expectancies of HTA participants were more consistent with the valence of previous information, with a positive absolute bias when previous information was positive, a negative bias when previous information was negative, and no expectancy bias (neither positive or negative) when preceding information was of a conflicting valence. In Study 2, both high and low anxiety sensitive participants tended to have a positive absolute expectancy bias across passage valence conditions, highlighting the importance of looking at both relative and absolute bias.

Finally, no effects of priming physical sensations on expectancy bias were found in Study 2. This is consistent with past null findings for effects of anxiety-relevant primes on processing biases (e.g., Watts & Dalgeish, 1991), but inconsistent with other findings suggesting that state anxiety can enhance (MacLeod & Mathews, 1988), or attenuate (Mathews & Sebastian, 1993) cognitive biases, and contrary to our hypothesis that the prime would highlight physical concerns and magnify the anxiety-linked expectancy bias. Given that the prime findings were null, it is difficult to tease apart whether the lack of effects is meaningful, or due to a methodological issue. One possibility is that the effect of the prime may have simply dissipated quickly, obscuring the opportunity to see its' effects. Another possibility is that the prime's effect was not strong enough to affect expectancy bias. Given the mixed findings in the literature about the effects of state anxiety on cognitive biases more broadly,

it is clear that more work is needed to determine the relationship between state anxiety and expectancy bias, and the moderators of this relationship.

The current research has some limitations. First, the samples comprised only young adult, college students, which are not representative of the general population. Second, analogue, rather than clinical, samples were used. However, the anxious participants had very high levels of anxiety symptoms, similar to those found in diagnosed samples. Third, as mentioned earlier, depressive symptoms were not assessed in these studies. More focused investigation of depressive symptoms would be helpful in evaluating the unique contribution of depression and anxiety to different forms of expectancy bias.

Fourth, our choice to use a relative strategy to calculate the bias index (i.e., subtracting average ratings of negative future events from average ratings of positive future events) has the advantage of simultaneously accounting for ratings of both positive and negative events, but has the disadvantage that we cannot determine to what extent the observed expectancy biases are driven by an evaluation that positive effects are especially unlikely or that negative effects are especially likely; an interesting question for future research. Similarly, interpretation of within-groups effects (e.g., evaluating whether bias is positive, negative, or does not exist) are somewhat clouded by our use of a relative strategy to calculate bias, given that we do not have an objective measure of whether the positive and negative events occur equally often (i.e., whether they have, or are perceived to have, comparable base rates). However, several measures were taken to validate the Scenario Event Sets (e.g., ensuring that positive and negative events had equivalent valence intensity; see Cabeleira, 2010), which allows for more confidence in interpreting the results.

Fifth, while it seems unlikely that presenting scenarios in blocks of 4 (before requiring ratings to be made) would place significant demands on memory for younger adults, there was no explicit measure of the role of memory in this task. This leaves open the possibility that memory may influence the results found when using this task. Future research could explore this possibility by varying the number of scenarios presented before the Rating Component of the task. Lastly, it is possible that participants' perceptions of the frequency with which the candidate future events tend to occur in general (i.e., perceived base rates) might have influenced their responses, separately from their perceptions concerning the likelihood that the candidate events would occur for themselves in particular. It could be interesting, in future research, to ask participants to provide two expectancy ratings: how likely each event is to occur to others, and how likely each event is to occur to oneself.

Despite these limitations, these studies provide valuable new information about anxiety-linked expectancy bias, revealed through the recently developed Expectancy Task. The results confirm that anxious individuals do display a less positive/more negative expectancy bias. Furthermore, they demonstrate that the conditions that give rise to this bias may differ depending upon the type of information being processed, with the inflated expectation of future negative *social* events reflecting a heightened tendency to extrapolate from present negative social events, while the inflated expectation of future negative *physical* events occurred regardless of the valence of prior information. A better understanding of the cognitive conditions that give rise to the negative expectancy bias shown by anxious

individuals may not only shed light on why they ‘expect the worst,’ but could also identify the processes that can be targeted therapeutically to attenuate such expectations.

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Appendix

Example of a Scenario Event Set:

Title: Going to the Doctor

Orienting Sentence: You go to the doctor’s rooms

Negative: You find out you need a biopsy done

Negative: The doctor prescribes you medication that can have bad side effects

Negative: The doctor warns you all your family is at risk of diabetes

Positive: The doctor says your heart sounds very healthy

Positive: The doctor informs you that you are at a healthy weight

Positive: The doctor says she is happy with your exercise regime

Neutral: A bird flies past the window

Neutral: The telephone rings

Neutral: You notice a car drive by outside

Sample scenarios of different valence types based on above Scenario Event Set:

1. Positive Valence

Title: Going to the Doctor

Orienting Sentence: You go to the doctor’s rooms

Positive: The doctor informs you that you are at a healthy weight

Positive: The doctor says she is happy with your exercise regime

Neutral: A bird flies past the window

Neutral: You notice a car drive by outside

2. Negative Valence

Title: Going to the Doctor

Orienting Sentence: You go to the doctor's rooms

Negative: You find out you need a biopsy done

Negative: The doctor prescribes you medication that can have bad side effects

Neutral: A bird flies past the window

Neutral: You notice a car drive by outside

3. Conflicting Valence

Title: Going to the Doctor

Orienting Sentence: You go to the doctor's rooms

Negative: You find out you need a biopsy done

Negative: The doctor prescribes you medication that can have bad side effects

Positive: The doctor informs you that you are at a healthy weight

Positive: The doctor says she is happy with your exercise regime

Example of an Expectancy Rating Trial:

Title: Going to the Doctor

Orienting Sentence: You go to the doctor's rooms

How likely is it that...

Negative: The doctor warns you all your family is at risk of diabetes

Positive: The doctor says your heart sounds very healthy

Neutral: The telephone rings

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Going to the Doctor

Going to the Doctor
You go to the doctor's rooms

Going to the Doctor

You find out you need a biopsy done

Figure 1.

A graphical depiction of the Scenario Presentation Component of the Expectancy Task which provides an illustrative example using a scenario relating to physical concerns delivered in the Conflicting Valence condition. (Minor visual modifications were made in Study 2.)

Going to the Doctor
You go to the doctor's rooms

RATING? The doctor warns you all your family is at risk of diabetes
 The doctor says your heart sounds very healthy
 The telephone rings

1 – Very UNLIKELY to happen next
 2 – Somewhat UNLIKELY to happen next
 3 – Somewhat LIKELY to happen next
 4 – Very LIKELY to happen next

Figure 2.

A graphical depiction of the Expectancy Rating Component of the Expectancy Task which provides an illustrative example using a scenario relating to physical concerns delivered in the Conflicting Valence condition. (Note that the word “RATING” moves to subsequent statements once a rating has been entered. Minor visual modifications were made in Study 2.)

Figure 3.

Study 1: Expectancy bias by scenario type, valence condition, and level of trait anxiety.

Note. Expectancy bias was scored by subtracting average ratings of negative future events from average ratings of positive future events, so higher scores indicate a more positive bias.

Figure 4.

Study 2: Expectancy bias by valence condition and level of anxiety sensitivity.

Note. Expectancy bias was scored by subtracting average ratings of negative future events from average ratings of positive future events, so higher scores indicate a more positive bias.

Table 1

Study 1: Descriptive statistics for low and high trait anxious groups.

Measures	Low Trait Anxious (LTA) <i>n</i> = 16 <i>M</i> ± <i>SD</i>	High Trait Anxious (HTA) <i>n</i> = 16 <i>M</i> ± <i>SD</i>
Age	17.75±1.39	17.38±0.89
STAI-T	25.88±2.63	54.81±3.23
STAI-S	27.19±5.86	40.06±8.08

Note. STAI-T = State-Trait Anxiety Inventory – Trait Score
STAI-S = State-Trait Anxiety Inventory – State Score

Table 2

Study 1: Summary of mean probability ratings for negative and positive future event statements, with mean ratings organized by Passage valence condition (Negative Valence, Positive Valence, Conflicting Valence), Scenario domain (Physical, Social) and Anxiety group (LTA, HTA).

Passage Valence	Future Valence	Low Trait Anxious (LTA) <i>n</i> =16		High Trait Anxious (HTA) <i>n</i> =16	
		Social scenarios <i>M</i> ± <i>SD</i>	Physical scenarios <i>M</i> ± <i>SD</i>	Social scenarios <i>M</i> ± <i>SD</i>	Physical scenarios <i>M</i> ± <i>SD</i>
Negative Valence	Negative	2.1±0.6	2.2±0.8	2.9±0.4	2.8±0.5
	Positive	2.9±0.5	2.9±0.5	2.0±0.4	2.2±0.4
Positive Valence	Negative	1.8±0.5	1.9±0.5	2.0±0.6	2.2±0.4
	Positive	3.1±0.4	3.2±0.5	3.1±0.4	3.0±0.4
Conflicting Valence	Negative	2.0±0.5	2.1±0.4	2.6±0.4	2.6±0.5
	Positive	3.0±0.4	2.9±0.4	2.6±0.3	2.8±0.4

Table 3

Study 2: Descriptive statistics for No prime and Prime conditions in low and high anxiety sensitive groups.

Measures	Low Anxiety Sensitive (LAS) <i>n</i> = 68		High Anxiety Sensitive (HAS) <i>n</i> = 70	
	No Prime Condition <i>n</i> = 33	Prime Condition <i>n</i> = 35	No Prime Condition <i>n</i> = 35	Prime Condition <i>n</i> = 35
	<i>M</i> ± <i>SD</i>	<i>M</i> ± <i>SD</i>	<i>M</i> ± <i>SD</i>	<i>M</i> ± <i>SD</i>
Age	18.82±0.98	18.57±0.78	19.11±1.02	18.86±0.88
ASI	7.44±3.64	7.71±3.32	34.89±8.67	35.93±8.49
PANAS-FS	6.24±.66	6.97±1.82	7.88±2.63	7.74±2.44

Note. ASI = Anxiety Sensitivity Index

PANAS-FS = Positive and Negative Affect Schedule – Fear Subscale (Baseline)

Study 2: Summary of mean probability ratings for negative and positive future event statements, with mean ratings organized by Passage valence condition (Negative Valence, Positive Valence, Conflicting Valence), Anxiety group (LAS, HAS), and Prime condition (No Prime, Prime).

Table 4

Passage Valence	Future Valence	Low Anxiety Sensitive (LAS)			High Anxiety Sensitive (HAS)		
		No Prime <i>M</i> ± <i>SD</i> <i>n</i> = 33	Prime <i>M</i> ± <i>SD</i> <i>n</i> = 35		No Prime <i>M</i> ± <i>SD</i> <i>n</i> = 35	Prime <i>M</i> ± <i>SD</i> <i>n</i> = 35	
Negative Valence	Negative	2.3±0.6	2.5±0.5		2.4±0.5	2.4±0.4	
	Positive	2.6±0.5	2.4±0.4		2.5±0.5	2.5±0.5	
Positive Valence	Negative	1.8±0.4	1.9±0.4		1.9±0.5	2.0±0.5	
	Positive	3.1±0.5	3.1±0.5		3.0±0.4	3.0±0.5	
Conflicting Valence	Negative	2.1±0.5	2.2±0.5		2.3±0.4	2.3±0.4	
	Positive	2.9±0.3	2.9±0.4		2.9±0.3	2.8±0.4	