

Does attentional bias to threat ameliorate or exacerbate the detrimental effect of trait anxiety on behavioural preparedness for real-world danger?

RUNNING HEAD: Anxiety, attentional bias, and preparedness for danger.

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Abstract

Objective: Heightened trait anxiety is associated with impaired behavioural preparedness for natural hazards. However, little is known about the mechanisms that contribute to this association.

Research has shown that trait anxiety is associated with an attentional bias towards threat-relevant information, and some researchers have suggested that such vigilance could exacerbate the detrimental effect of trait anxiety on behavioural preparedness. Conversely, given the potentially adaptive role of attentional bias in promoting engagement in danger mitigation behaviour, it is also possible that attentional bias could ameliorate the negative association between anxiety and preparedness. The aim of the current study was to discriminate the validity of these two hypotheses.

Method: Participants were recruited from a bushfire-prone community in Western Australia and were assessed on measures of trait anxiety, attentional bias to threat, and current bushfire preparedness.

Results: As predicted, the results showed a negative correlation between trait anxiety and bushfire preparedness, and a positive correlation between trait anxiety and attentional bias to bushfire-related threat. Furthermore, the negative relationship between trait anxiety and preparedness was moderated by this attentional bias to bushfire-related threat, with the direction of this moderation showing that attentional bias further exacerbated this negative relationship.

Conclusions: This study is the first to show that in a situation where people are exposed to a real-world danger that can be mitigated through appropriate engagement in specific preparatory behaviours, attentional bias to danger-relevant threat serves to strengthen the observed negative association between trait anxiety and behavioural preparedness. Implications of these findings are discussed.

Keywords: Anxiety, attentional bias, bushfire, danger, natural hazards, preparedness

Key Points:

- Heightened trait anxiety is associated with impaired behavioural preparedness for natural hazards.
- Trait anxiety is associated with an attentional bias towards threat-relevant information.
- Attentional bias to threat can be an adaptive neurocognitive function when confronted with danger.
- Attentional bias to danger-relevant threat strengthens the negative association between trait anxiety and behavioural preparedness.
- In high trait anxious individuals, attentional bias to danger-relevant threat further impairs preparedness.
- In low trait anxious individuals, attentional bias to danger-relevant threat contributes to enhanced preparedness.

Does attentional bias to threat ameliorate or exacerbate the detrimental effect of trait anxiety on behavioural preparedness for real-world danger?

People differ widely in their dispositional tendency to experience anxiety, reflecting the personality dimension of trait anxiety. While low trait anxious individuals are able to remain calm in the face of adversity, those with high levels of trait anxiety experience elevated levels of anxiety in response to seemingly innocuous events. Such heightened anxiety vulnerability is associated with a range of dysfunctional outcomes. Research has shown that individuals with higher levels of trait anxiety are at an increased risk of developing clinical anxiety disorders (Chambers, Power, & Durham, 2004), have an elevated risk for experiencing certain physical illnesses such as coronary heart disease (Roest, Martens, de Jonge, & Denollet, 2010), and show impaired performance on cognitive tests (Patrick J. F. Clarke & MacLeod, 2013), competitive sports (Wilson, Wood, & Vine, 2009), and in academic and occupational settings (Owens, Stevenson, Hadwin, & Norgate, 2012; Putwain & Symes, 2011; Wennberg, Pathak, & Autio, 2013).

Evidence from the field of health psychology further suggests that heightened anxiety vulnerability is associated with poorer engagement in health protection and disease prevention. For example, in women with a family history of breast cancer, increased trait anxiety is associated with decreased adherence to self- and clinical breast examinations (Kash, Holland, Halper, & Miller, 1992; Lerman, Rimer, Trock, Balshem, & Engstrom, 1990). Similarly, those individuals at risk of melanoma skin cancer who are high in trait anxiety report engaging in fewer protective behaviours than is the case for at-risk individuals with moderate levels of trait anxiety (Bishop et al., 2007). Trait anxiety is also negatively associated with natural hazard preparedness in individuals living in areas prone to floods, heatwaves, or earthquakes (de Man & Simpson-Housley, 1988; Mishra & Suar, 2012; Paton, Smith, & Johnston, 2005).

While this negative relationship between trait anxiety and engagement in behaviour that serves to reduce the prospect of known dangers appears to be well supported, little is known about the mechanisms that contribute to this association. Some researchers have suggested that anxiety-linked impairments in preparedness for potential danger may be the result of biased attentional processes known to be associated with anxiety (Duval & Mulilis, 1999; Mishra & Suar, 2012). One such argument is that, because elevated trait anxiety is associated with increased vigilance for external threat cues, the resulting increase in perception of threat becomes more likely to provoke a flight response (avoidance) rather than fight response that involves actively engaging in the preparatory behaviours that combat the danger (Mishra & Suar, 2012). A related variant of this hypothesis is that the attentional vigilance for threat displayed by high trait anxious individuals,

leads these individuals to engage in emotion-focused coping rather than problem-focused coping (Duval & Mulilis, 1999).

There is ample evidence that high trait anxious individuals, and those with clinical anxiety disorders, do display an attentional bias to threat-related information relative to neutral information, particularly when this threat pertains to personally-relevant dangers (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van Ijzendoorn, 2007). One of the most common methods of assessing this attentional bias to threat is the attentional probe task (MacLeod, Mathews, & Tata, 1986). This task measures attentional distribution between pairs of stimuli (e.g. words) that differ in emotional valence, presented on a computer screen for a brief duration. Participants are required to discriminate the identity of a probe that subsequently appears in the location of either the threatening or neutral member of the stimulus pair. An attentional bias to threat is revealed by disproportionate speeding to discriminate probes appearing at the location of previously presented threatening stimuli, as compared to probes appearing at the location of previously presented neutral stimuli (MacLeod, Mathews, & Tata, 1986). Research has shown that anxious individuals display an attentional bias towards angry faces, negative pictures, words signifying social or physical threat, and cues that predict the delivery of an aversive stimulus (Amir, Elias, Klumpp, & Przeworski, 2003; Bar-Haim et al., 2007; Fox, Russo, & Dutton, 2002; Koster, Crombez, Verschuere, & De Houwer, 2006; Notebaert, Crombez, Van Damme, De Houwer, & Theeuwes, 2010, 2011). However, a recent meta-analysis showed that dispositionally anxious individuals display a more robust attentional bias towards threatening information that is related to their personal concerns, than to threatening information that unrelated to their concerns (Pergamin-Hight, Naim, Bakermans-Kranenburg, van Ijzendoorn, & Bar-Haim, 2015).

It seems reasonable to suppose that this attentional bias to threat may causally contribute to increased intensity of anxious mood state, particularly in response to situations that involve exposure to potential danger. Experimental research has provided support for this causal relationship between attentional bias to threat and anxiety reactivity (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002; Van Bockstaele et al., 2014). The strongest support comes from studies that have directly manipulated attentional bias, and shown that participants trained to reduce attentional bias to threat display reduced anxiety responses to stressful situations, compared to participants whose bias is not manipulated, and to participants trained to increase their attentional bias to threat (Browning, Holmes, & Harmer, 2010; Dandeneau, Baldwin, Baccus, Sakellaropoulo, & Pruessner, 2007; S. Hayes, Hirsch, & Mathews, 2010; MacLeod et al., 2002; Notebaert, Clarke, Grafton, & MacLeod, 2015).

Given that it appears to intensify anxiety responses to stressors, it is perhaps unsurprising that researchers have tended to conceptualise attentional bias to threat as a maladaptive process, that may contribute to the observed anxiety-linked impairment in preparedness behaviour (Duval & Mulilis, 1999; Mishra & Suar, 2012). According to this position, which will be termed the *maladaptive bias hypothesis*, anxiety-linked attentional bias to threat contributes to the negative relationship between trait anxiety and preparedness behaviour. However, some models of anxiety-linked information processing suggest that this attentional bias to threat represents a dysregulation of an otherwise adaptive neurocognitive function that is crucial for survival (e.g. Mathews & Mackintosh, 1998; Mogg & Bradley, 1998; Ohman & Mineka, 2001). Hence, it is not implausible that attentional vigilance for threat could instead increase the prospect of adaptive preparatory behaviours, when people are confronted by a genuine threat concerning a danger that can be mitigated by such action (Notebaert, Crombez, Vogt, et al., 2011). Thus, given this potentially beneficial consequence of attentional bias, it can alternatively be hypothesized that to the extent that individuals display such attentional bias to threat, this serve to attenuate the negative relationship between trait anxiety and preparedness behaviour. This hypothesis will be termed the *adaptive bias hypothesis*.

Although previous research has established that higher levels of trait anxiety are associated with reduced engagement in preparedness behaviour, it remains unknown whether attentional bias to threat attenuates the strength of this negative association, as predicted by the *adaptive bias hypothesis*, or strengthens this negative association, as predicted by the *maladaptive bias hypothesis*. No research to date has whether, and if so how, attentional bias to threat moderates the negative relationship between trait anxiety and impaired preparedness. To address this issue, it is necessary to recruit a participant cohort facing a danger that warrants engagement in clearly circumscribed preparatory behaviours, and to assess trait anxiety, attentional bias to threat information pertinent to this danger, and engagement in these preparatory behaviours. The current study fulfilled these requirements using participants recruited from a bushfire-prone community in Western Australia, in order to investigate whether attentional bias to bushfire-related threat information moderates the anticipated negative relationship between trait anxiety and bushfire preparation behaviours and, if so, whether the nature of such moderation support the adaptive bias hypothesis or the maladaptive bias hypothesis.

With its dry summer and flammable vegetation, Western Australia is one of the most fire-prone regions in the world (Bushfire CRC & AFAC, 2010). Between 2000 and 2007, emergency services responded to more than 8000 bushfires per year (Bryant, 2008), and the frequency and intensity of fires is set to increase each year (Steffen, Hughes, & Pearce, 2015). The fire season near the state capital in the South-West of Western Australia typically runs between November and April.

Each year, residents in fire-prone areas are urged to prepare their property for the upcoming fire season, as landowners have an important responsibility to contribute to bushfire risk management (Keelty, 2011). The area from which participants for the current study were recruited was designated bushfire-prone by the State Fire and Emergency Services Commissioner, meaning that it is likely to be subject to a bushfire attack (Fire & Emergency Services, 2015). The current study was conducted at the start of the summer of 2011-2012, a time when residents should have completed recommended preparatory behaviours to mitigate fire-related danger across the coming fire season. In the summer prior to execution of the current study, a bushfire had caused major damage to this community, underscoring this need to engage in the advised preparatory behaviours. Testing took place in a local community centre, where participants were assessed on measures of trait anxiety, attentional bias to threat, and current bushfire preparedness.

In line with previous research, it was predicted that higher levels of trait anxiety would be associated with lower levels of bushfire preparedness. It also was predicted, on the basis of prior findings, that higher levels of trait anxiety would be associated with greater attentional bias to fire-relevant threat words. However, each of the two competing hypotheses under consideration generates a differing prediction concerning the moderating role of attentional bias on the relationship between anxiety and preparedness. According to the maladaptive bias hypothesis, anxiety-linked attentional bias to fire-related threat will contribute to the detrimental impact of trait anxiety on bushfire preparedness behaviour. This hypothesis generates the prediction that the moderating influence of this attentional bias on the relationship between trait anxiety and preparedness should be such that the strongest negative relationship between anxiety and preparedness will be observed in individuals who display the largest attentional bias to fire-related threat. In contrast, according to the adaptive bias hypothesis, anxiety-linked attentional bias to fire-related threat will attenuate the detrimental impact of trait anxiety on bushfire preparedness behaviour. Thus this hypothesis generates the quite different prediction that the moderating influence of this attentional bias on the relationship between trait anxiety and preparedness should be such that the negative relationship between anxiety and preparedness will be weakest in those individuals who display the largest attentional bias to fire-related threat.

Method

Participants

Participants were thirty-nine residents (19 female) of two adjacent suburbs, Kelmscott and Roleystone, on the rural-urban fringe of Perth in Western Australia. This area had been affected by a

severe bushfire in the summer prior to the execution of the study (approximately 9 months prior to data collection). While there was no loss of human life, the fire caused major destruction to property, with 72 homes completely destroyed and another 37 significantly damaged (Heath et al., 2011; McNeill, Dunlop, Heath, Skinner, & Morrison, 2013). Current participants were recruited from a database of residents who had, after prior post-fire interviews and survey studies, indicated their willingness to participate in future studies (Heath et al., 2011). Mean age was 56.13 years, range = 23-73. Participants on average had lived in their current property for 12.02 years (SD = 9.8) and had been resident of the area for 19.1 years (SD = 11.9).

Materials

Trait anxiety

Trait anxiety was measured using the trait version of the State-Trait Anxiety Inventory (STAI-T; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). The STAI-T is a self-report questionnaire consisting of 20 questions assessing dispositional anxiety. It requires participants to rate the frequency with which they generally experience anxiety symptoms (e.g. "I feel nervous and restless"). Items are scored on a 4 point scale, ranging from 'Almost never' to 'Almost always'. The STAI is a commonly used measure of trait anxiety, with well-established internal consistency, test-retest reliability, and validity across a variety of population groups (Barnes, Harp, & Jung, 2002; Spielberger et al., 1983). In the current study, Cronbach's alpha was .95.

Bushfire preparedness

To prepare for the bushfire season, residents are advised by Fire and Emergency Services to undertake a number of specified actions that reduce the risk of harm from potential bushfires. These encompass preparation of the house (e.g. sealing gaps), preparation of the external property (e.g. removing fuel load), planning (e.g. formulating a bushfire energy plan), communication of plans within the household and with neighbours (e.g. making sure everyone knows the evacuation route), and ensuring access to necessary resources and sources of information (e.g. water and radio). Generally, it is assumed that the more of these preparatory actions that are undertaken before the onset of the bushfire season, the more prepared a household is for the coming season (Dunlop, McNeill, Boylan, Morrison, & Skinner, 2014). In the current study behavioural preparedness for bushfires was assessed using a 68-item Bushfire Preparedness Inventory (BPI) measure, listing recommended bushfire preparation activities that people are advised to carry out before the bushfire season in order to minimise the likelihood of negative outcomes from any bushfires that may occur. The items were derived from materials developed and distributed by Australian,

Canadian, and American fire agencies, community disaster response organisations (DFES, 2012; Federal Emergency Management Agency, 2004; National Fire Protection Association, 2012; Northern Territory Government, 2010; Partners in Protection, 2003), and published research (Douglas, Gail, Petra, & Michael, 2006; Dunlop et al., 2014; Martin, Bender, & Raish, 2007; McLennan & Elliott, 2011; Whittaker, Haynes, Handmer, & McLennan, 2013). Example items are “*Cleared fuels (e.g. leaves, twigs, and long grass) for a distance of at least 20m around the house*”, and “*Obtained a portable battery-operated AM/FM radio*”.

Participants were asked to indicate for each item whether or not this action had already been carried out. Items that were not applicable (e.g. “*Ensured that all household members are aware of the fire plan*” for a single-person household) could be marked as such. Preparedness was defined as the proportion of applicable items on which participants indicated that the task had been completed. Thus scores on this Bushfire Preparedness Inventory could range from 0 to 1 with a higher score indicative of higher preparedness for the bushfire season. Cronbach’s alpha for this BPI was .91.

Attentional bias assessment task stimuli

An attentional-probe procedure was used to assess attentional bias to threat. This assessment task presented pairs of stimuli, each containing a threat-related member and a neutral member. Two subsets sets of threat-neutral word pairs were developed. In one subset the threat words all were bushfire-related, whereas in the other subset the threat words were unrelated to bushfire. It was desirable that the bushfire-related and the bushfire-unrelated threat word sets were as similar as possible in all respects, except for their bushfire-relatedness. To achieve this, an initial candidate set of 238 threat and neutral words were generated, and were rated by 7 independent judges. Each word was rated on its emotional tone (from -3: Extremely negative, to +3: Extremely positive), and its degree of relatedness to the bushfire-linked concerns (from 0: Not related, to 6: Extremely related). From this initial list, two sets of 24 word pairs were created. The first set consisted of bushfire-related threat words, each paired with a neutral words that was matched in word length and written frequency (e.g. SCORCHED – BOOKCASE). The second set consisted of bushfire-unrelated threat words, each paired with a neutral word that was match in word length and written frequency (e.g. HATE – TEXT). The threatening words were rated significantly more negatively than the neutral words as required, both within the subset containing bushfire-related threat words, $t(23) = 21.56$, $p < .001$, and within the subset containing bushfire-unrelated threat words, $t(23) = 22.98$, $p < .001$. The bushfire-related and bushfire –unrelated threat words did not differ in emotional valence, $t < 1$ ($M = -2.21$, $SD = 0.53$ and $M = -2.20$, $SD = 0.38$, respectively), but the former subset of threat words

was rated significantly higher than the latter in terms of the degree to which these were associated with bushfires-relevant concerns, $t = 26.15$, $p < .001$ ($M = 4.95$, $SD = 0.54$ and $M = 0.75$, $SD = 0.53$, respectively). The neutral words within the subsets containing bushfire-related and bushfire irrelevant threat words did not differ from one another either in emotional tone, $t < 1$ ($M = .14$, $SD = 0.18$ and $M = .18$, $SD = 0.35$, respectively) or in bushfire relatedness, $t < 1$ ($M = 0.68$, $SD = 0.62$ and $M = 0.66$, $SD = 0.60$, respectively).

Attentional Bias Assessment Task

Attentional bias to threat-related stimuli was measured using the attentional-probe task (MacLeod et al., 1986). On each trial a white fixation cross was presented for 1000ms in the centre of the screen on a black background, after which one of the stimulus word pairs was presented in white block text 3 mm in height (.29 visual angle) for 500ms. One member of the pair was presented 15 mm (1.43 visual angle) above fixation and the other 15 mm below fixation. Next a probe stimulus consisting of two red dots appeared in the location vacated by one of the two words. The two dots in the probe stimulus were either aligned horizontally (. .) or vertically (:). The probe appeared in top and bottom location with equal frequency, and each probe type was used on 50% of trials. Participants were asked to indicate the orientation of the dots by pressing the left mouse button when these were aligned horizontally, and the right mouse button when they were aligned vertically, as rapidly as possible without compromising accuracy. The reaction time and accuracy to make this decision were recorded on each trial. The participant's response cleared the screen and the next trial began after a 1000ms inter-trial interval. The location of the threat member of the word pair was determined randomly on each trial within the constraint that it appeared in top and bottom location with equal frequency. Each word pair was presented twice, once with the target replacing the threat word and once with the target replacing the neutral word, to yield a total of 96 trials. Word pairs from both stimulus subsets were presented intermixed in a random order.

An attentional bias towards threatening information is revealed in this assessment task by speeded discrimination of probes presented at the threat word location, relative to probes presented at the neutral word location. Two attentional bias indices were created, each reflecting the magnitude of this relative speeding to probes in the locus of the threat stimuli, but one computed from those trials that presented bushfire-related threat words, and the other computed from trials that presented bushfire-unrelated threat words. For each index, a higher score signifies a greater attentional bias to threat.

Procedure

Participants were tested in a local community centre by appointment. Each participant was first informed about the task requirements and the nature of the material that they would view, after which they gave their informed consent. Participants then completed the trait anxiety questionnaire. Next, they performed the attentional bias assessment task on a desktop computer. Finally, participants filled out the bushfire preparedness inventory. These measures were part of a larger assessment battery within this sample. Participants were given a 10\$ voucher as a token of appreciation for their time and effort. The study was approved by the University of Western Australia's Human Research Ethics Office.

Results

Data treatment

Probe discrimination latency data were treated for outliers in line with previous research (e.g. Enock, Hofmann, & McNally, 2014; Notebaert et al., 2015). Incorrect responses (4.46% of data), as well as response latencies shorter than 200ms or longer than 2000ms, and those deviating more than 2SD from an individual's mean responses time for that trial type (4.49% of data), were not employed in the computation of the attentional bias indices.

Univariate outliers were identified by inspecting z scores of trait anxiety scores and attentional bias measures. One participant, whose trait anxiety score had a z score value greater than 3.29, was identified as an outlier (Field, 2013), and removed from further analyses. As bushfire preparedness inventory scores were missing for this individual, removal of this participant had no influence on the moderation analysis. In all analyses reported below, missing data were deleted listwise.

Distribution of key measures

Trait anxiety scores

It was important to ensure that the distribution of trait anxiety scores did not violate normality (skew < |2| and kurtosis < |7|; Curran, West, & Finch, 1996). As can be seen from Table 1, the scores from the STAI questionnaire ranged from 20 to 58 and were within the normality limits. Therefore trait anxiety in this sample was deemed appropriate to be further examined using parametric analyses to test the hypotheses.

Behavioural preparedness inventory (BPI) scores

Similarly, it was important to confirm that the distribution of preparedness scores did not violate normality. As can be seen from Table 1, PBI scores ranged from 0 to .96, and the assumptions for normality were met. This provides reassurance that the appropriate conclusions can be drawn from the reported parametric analyses.

Attentional bias index scores

It was also important to ensure that the distribution of the attentional bias to threat index scores was consistent with normality. As can be seen from Table 1, the index reflecting attentional bias (AB) to bushfire relevant threat ranged from -110.86ms to 96.58ms, while the index reflecting attentional bias to bushfire irrelevant threat ranged from -82.00 to 82.00. In both cases these attentional bias index scores were normally distributed, affirming that parametric analyses are appropriate.

Table 1. Means, SDs, range, skewness, and kurtosis values of each of the key variables.

	<i>N</i>	<i>M</i>	<i>SD</i>	Range	Skewness	Kurtosis
STAI-T	34	34.00	9.65	20 – 58	.516	-.164
BPI	35	.48	.24	.00 – .96	-.187	-.662
AB bushfire-related threat	36	2.20	49.28	-110.86 – 96.58	-.408	.211
AB bushfire-unrelated threat	36	2.15	35.64	-82.00 – 82.00	-.177	.225

Association between trait anxiety and bushfire preparedness

First, we examined whether there was evidence of the anticipated negative relationship between trait anxiety and bushfire preparedness. Consistent with our expectation, heightened anxiety vulnerability was associated with reduced bushfire preparedness, as indicated by the significant negative correlation between trait anxiety scores and BPI scores, which was a large effect, $r(32) = -.550, p = .001$.

Association between trait anxiety and attentional bias to threat

Next, we sought to determine whether there was a relationship between trait anxiety and attentional bias towards bushfire-related threat, as we anticipated would be the case in this bushfire-exposed cohort. This expectation was confirmed by the presence of a significant positive correlation between trait anxiety scores and the index of attentional bias to bushfire-related threat, $r(32) = .396, p = .025$, which was of medium effect size. There was no significant correlation between trait anxiety and attentional bias for bushfire-unrelated threat in this cohort, $r(32) = -.289, p = .109$.

Moderating role of attentional bias on the relationship between trait anxiety and bushfire preparedness

To test whether the relationship between trait anxiety scores and bushfire preparedness index scores was moderated by attentional biases to threat, a simple moderation model was tested, as illustrated in Figure 1. The moderation analysis was performed according to guidelines provided by A. F. Hayes (2013), using PROCESS (A. F. Hayes, 2012). This method uses an ordinary least squares regression approach to estimate moderation effects. Two different models were tested, one in which attentional bias for bushfire-related threat served as moderator, and one in which attentional bias for bushfire-unrelated threat served as moderator. For each moderation model, an interaction term was created by multiplying STAI-T scores by attentional bias scores. Evidence for moderation would be provided by the finding that this interaction term significantly predicts bushfire preparedness. With the current sample size, this moderation model has .71 power to detect a large effect.

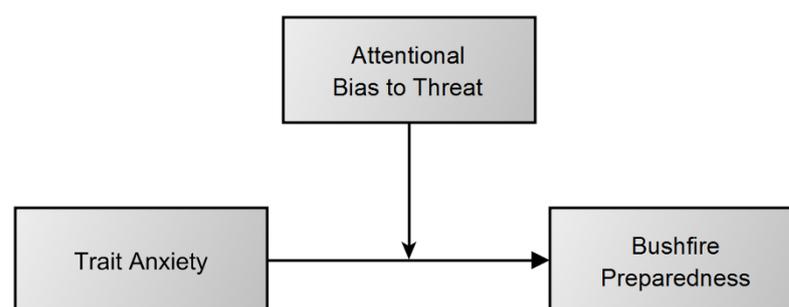


Figure 1. The conceptual moderation model.

Before testing the hypothesized moderating role of attentional bias to bushfire-related threat on the relationship between trait anxiety and bushfire preparedness, we examined whether attentional bias to bushfire unrelated threat exerted a moderating impact on this relationship. The model considered trait anxiety (STAI-T scores) as the predictor, bushfire preparedness index scores

as the outcome variable, and attentional bias to bushfire-unrelated threat as moderator. Although, the overall model was significant, explaining 35.4% of the variance in preparedness, $F(3, 26) = 4.751$, $p = .009$, $R^2 = .354$, $MSE = .046$, the interaction term was not a significant predictor ($p > .1$), indicating there attentional bias to bushfire-unrelated threat did not moderate the negative relationship between trait anxiety and bushfire preparedness.

We went on to examine whether, as predicted by both hypotheses under consideration, attentional bias to bushfire-related threat would moderate the negative relationship between trait anxiety and bushfire preparedness. Again the model considered trait anxiety (STAI-T scores) as the predictor, and bushfire preparedness as the outcome variable, but the moderator variable was now attentional bias to bushfire-related threat. The moderation model was again significant, explaining 40.46% of the variance in bushfire preparedness, $F(3, 26) = 5.889$, $p = .003$, $R^2 = .405$, $MSE = .042$. More critically, as can be seen from the statistics describing this moderation model, provided in Table 2, there was now a strong trend for the interaction term to predict bushfire preparedness, supporting the expectation that attentional bias to bushfire-related threat would moderate the negative relationship between trait anxiety and bushfire preparedness.

Table 2. Statistics describing significant moderation model involving attentional bias to bushfire-related threat.

	Coefficient	se	t	p	LLCI	ULCI
STAI-T	-.0108	.0047	-2.3164	.0287	-.0205	-.0012
AB to bushfire-related threat	.0067	.0032	2.0892	.0466	.0001	.0133
STAI-T * AB to bushfire-related threat	-.0002	.0001	-2.0500	.0506	-.0004	.0000

Note. STAI-T = Trait anxiety; AB = Attentional bias; LLCI = Lower bound confidence interval; ULCI = Upper bound confidence interval.

The predictive capacity of the interaction term variable fell just on the margin of conventional significance, $p = .051$ (95% Confidence interval $-.0004$ to $.0000$), with this moderator explaining an additional 9.6% of the variance in preparedness. Given the small sample size, we performed a bootstrapping procedure to obtain a more robust estimation of the confidence interval of the interaction term (Bollen & Stine, 1990; Shrout & Bolger, 2002). This procedure involved drawing 10,000 artificial samples from the original observations, and estimating the coefficient of the interaction term in each sample. Next, the 95% confidence interval was estimated from the 2.5

and 97.5 percentiles of the bootstrapped distribution of the coefficients. The resulting interval ranged from -.0004 to -.001. As this interval does not include zero, this bootstrapping procedure suggests the interaction term was statistically significant.

The validity of the two alternative hypotheses can be discriminated by considering the direction of this moderation effect, which is shown in Figure 4. This figure displays bushfire preparedness scores for individuals with low trait anxiety scores (1 SD below the mean, or a STAI-T score of 24.71), average trait anxiety scores (the mean, or a STAI-T score of 34.04), and high trait anxiety scores (1 SD above the mean, or a STAI-T score of 43.37), as a function of their scores indexing attentional bias to bushfire-related threat (AB-bushfire). For each level of the predictor, three data points are represented for the moderator, corresponding to a level of attentional bias 1 SD below the mean (-47.08ms), average (2.02ms), and 1 SD above the mean (51.48ms). Thus, the data 1 SD below the mean represent attentional avoidance of threat (as the attentional bias index scores are negative), whereas the data 1SD above the mean represent attentional vigilance towards threat.

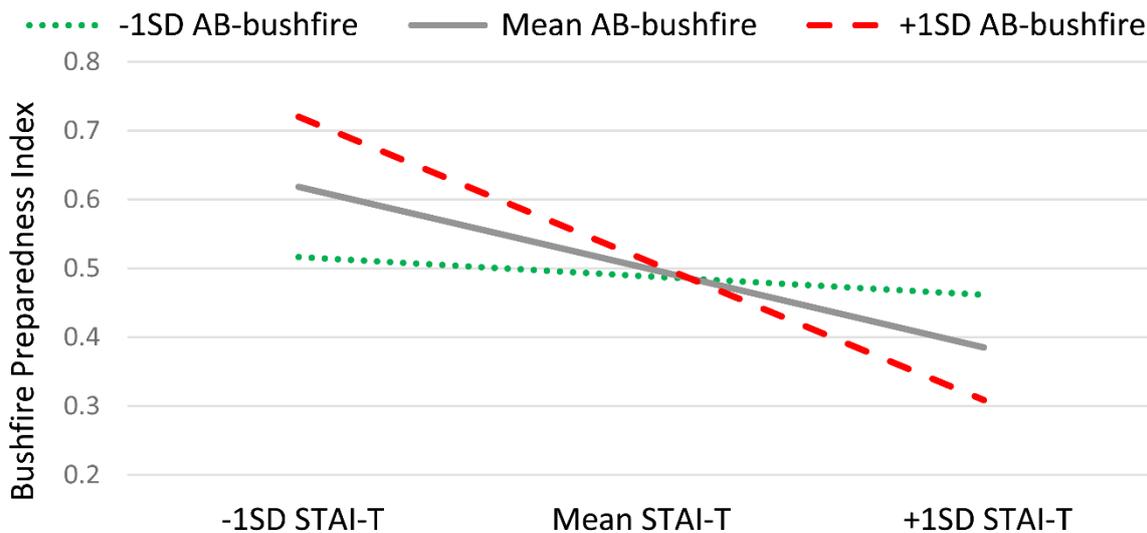


Figure 2. The moderating effects of attentional bias to bushfire-related threat (AB-bushfire) on the relationship between trait anxiety (STAI-T) and bushfire preparedness.

As can be seen in Figure 2, the nature of the moderating impact of attentional bias to bushfire-related threat, on the negative association between trait anxiety and bushfire preparedness, was that this negative association between trait anxiety and bushfire preparedness was strengthened by the attentional bias to bushfire-related threat. Thus, this negative association was strongest in those individuals who showed the greatest evidence of attentional vigilance for

bushfire-related threat (red striped line) and was weakest in those individuals who shows the least evidence of attentional vigilance for bushfire-related threat (green dotted line). Indeed, while the negative relationship between trait anxiety and bushfire preparedness was significant for individuals who showed high and moderate levels of attentional vigilance to bushfire-related threat (+1SD AB-bushfire, effect = $-.021$, CI = $-.031$ to $-.010$, $p < .001$; Mean AB-bushfire, effect = $-.012$, CI = $-.021$ to $-.010$, $p = .003$), no such negative association between trait anxiety and bushfire-related threat was observed in those individuals who showed the least evidence of attentional vigilance for bushfire-related threat (-1SD AB-bushfire, effect = $-.003$, CI = $-.018$ to $.012$, $p = .703$). This pattern of moderation supports the predictions generated by the “maladaptive bias hypothesis”, according to which attentional bias to bushfire-related threat contributes to the negative association between trait anxiety and bushfire preparedness, and directly contradicts the predictions generated by the “adaptive bias hypothesis” that attentional bias to bushfire-related threat should ameliorate this negative association.

Discussion

The main aim of the current study was to determine whether attentional bias to danger-relevant threat increases or attenuates the degree to which elevated trait anxiety compromises adaptive engagement in behavioural preparation for real-world danger. We distinguished two alternative hypotheses that generate differing predictions regarding the moderating role of such attentional bias. According to the adaptive bias hypothesis, anxiety-linked attentional bias to danger-relevant threat will increase engagement in danger mitigation behaviour, thereby attenuating the negative relationship between trait anxiety and behavioural preparation. This hypothesis predicts that the weakest negative association between trait anxiety and behavioural preparedness will be observed in those individuals who display by the greatest attentional bias to danger-relevant threat. In contrast, according to the maladaptive bias hypothesis, this anxiety-linked attentional bias will compromise effective planning, thereby strengthening the negative relationship between trait anxiety and behavioural preparation. This hypothesis predicts that the strongest negative association between trait anxiety and behavioural preparedness will be observed in those individuals who display the greatest attentional bias to danger threat. We examined the relationship between trait anxiety, attentional bias to threat, and behavioural preparation for danger in a real-world setting, by assessing residents in a bushfire-prone community. The results of this study confirmed a negative relationship between trait anxiety and bushfire preparedness, in line with the previous research observation that heightened trait anxiety is associated with reduced engagement in adaptive behavioural preparation. Results also confirmed that trait anxiety was positively correlated

with attentional bias to bushfire-related threat, as anticipated. Moreover, the negative relationship between trait anxiety and bushfire preparedness was moderated by this attentional bias to bushfire-related threat. The direction of this moderation supported the prediction generated by the maladaptive bias hypothesis. Specifically, the strongest negative correlation between trait anxiety and bushfire preparedness was observed in those individuals who displayed the greatest attentional bias to bushfire-related threat. These findings directly contradict the predictions generated by the adaptive bias hypothesis, which stated that the negative correlation between trait anxiety and bushfire preparedness would be attenuated in those individuals who displayed the greatest attentional bias to bushfire-related threat.

These current findings indicate that, and least in this present setting, anxiety-linked attentional bias to bushfire threat did not serve an adaptive function across all individuals. The individuals who were least prepared for the upcoming bushfire season were those with the highest levels of anxiety vulnerability and the greatest vigilance for bushfire-related threat. Thus, in high trait anxious participants, attentional bias to bushfire threat was associated with the lowest preparedness for bushfire danger. Interestingly, the reverse pattern of effects was observed in low trait anxious participants, where greater attentional bias to bushfire threat was associated with better bushfire preparedness. In fact, the individuals who were best prepared for the upcoming fire season were those with the lowest levels of trait anxiety and the greatest attentional bias to bushfire-related threat. Thus it appears that, while attentional bias to danger-relevant threat may have the maladaptive effect of reducing engagement in danger preparation behaviour among high trait anxious individuals, it may serve the adaptive function of increasing behavioural preparation for danger among low trait anxious individuals. This latter observation is consistent with the suggestion that attentional vigilance for threat can be an adaptive neuro-cognitive mechanism that promotes appropriate engagement in danger mitigation behaviour in situations. However, the current findings suggest that this adaptive function of attentional vigilance for threat may be restricted to low trait anxious individuals.

It seems paradoxical that attentional bias to bushfire-related threat is associated with opposing behavioural preparedness patterns in high and low trait anxious individuals. It is interesting to consider why this might be the case. One possibility is that, while biased attention to danger-relevant threat may lead both high and low trait anxious individuals to perceive the danger as more likely and/or severe, this triggers a “flight” response in high trait anxious individuals, and a “fight” response in low trait anxious individuals (Mishra & Suar, 2012). The “fight” response involves activity confronting the danger, and so fosters behavioural engagement in preparation activities that can overcome it. Instead, the “flight” response evokes the feeling that the danger cannot be successfully

confronted, thereby reducing the prospect of engagement in such preparation behaviours. Another variant of this theme, that again implicates trait-linked differences in the responses evoked by increased perception of danger, suggests that high trait anxious individuals may respond by engaging in emotion-focused coping strategies, such as distraction from the danger, to reduce state anxiety, while low trait anxious individuals may respond by engaging in problem-focused coping strategies, such as taking steps to reduce the danger itself (Kashdan, Barrios, Forsyth, & Steger, 2006). Emotion-focused coping is not always maladaptive (Aldao & Nolen-Hoeksema, 2012; Aldao, Sheppes, & Gross, 2015; Bonanno, Papa, Lalande, Westphal, & Coifman, 2004). In situations where the risk of potential negative outcomes cannot be mitigated by one's actions (for example as when one is a passenger in a plane during turbulence), emotion-focused coping is an entirely appropriate strategy as problem focused strategies will have no influence on the outcome. However, when the risk of genuine danger can be substantially attenuated through behavioural action, then problem-focused coping likely becomes more adaptive, as the short-term affective benefits of emotion-focused coping will be outweighed by continuing exposure to the unmitigated danger. Given that both coping styles can be adaptive, but each is best suited a particular type of situation, it follows that the rigid application of one particular coping style or emotion regulation strategy across all situations can be considered maladaptive (Aldao et al., 2015). It remains to be investigated whether high trait anxious individuals are less flexible than low trait anxious individuals in terms of coping strategies. If so, and if this leads them to adopt their preferred emotion-focused coping style to situations where dangers are controllable, this could partly explain the observed negative association between trait anxiety and danger preparedness.

Our findings showed that heightened trait anxiety was associated with an increased attentional bias to bushfire-related threat, but not with an increased attentional bias to bushfire-unrelated threat. These findings are consistent with the results of a recent meta-analysis, which concluded that the anxiety-linked attentional bias is content-specific (Pergamin-Hight et al., 2015). This meta-analysis did not specify whether anxiety-linked attentional bias is restricted to stimuli relating to individuals' concerns, or whether it is evident across concern-related and concern-unrelated threatening information but amplified for the former type of information as compared to the latter. However, several individual studies suggest that, in line with the present findings, anxiety-linked attentional bias is restricted to, rather than amplified for, concern-related threatening information (Ashley, Honzel, Larsen, Justus, & Swick, 2013; Becker, Rinck, Margraf, & Roth, 2001; Pineles, Shipherd, Mostoufi, Abramovitz, & Yovel, 2009).

There are some limitations to the current study that need to be acknowledged. First, the sample size is modest, which limits the power to detect small effects. Second, as this is a cross-

sectional study, no causal interpretations can be made about the nature of the observed relationships. For example, while high levels of trait anxiety may cause an individual to be less prepared, it could also be the case that individuals who are less prepared are more prone to more frequently exhibit symptoms of anxiety. In order to assess the causal nature of the relationship between trait anxiety and preparedness, longitudinal studies could track individuals' trait anxiety and preparedness over time, to examine whether a change in anxiety precedes a change in preparedness, or vice versa. Similarly, while increased attentional bias to bushfire-related threat in high trait anxious individuals may render these individuals less prepared for bushfires, it could also be the case that high anxious individuals who are less prepared for bushfires exhibit a greater attentional bias to bushfire-related threat as a result. The causal nature of the relationship between attentional bias and preparedness can be investigated by manipulating attentional bias, and assessing the consequent impact on preparatory behaviour. Attentional bias can be manipulated through attentional bias modification (ABM) paradigms, which can be used to transiently induce an attentional bias in a lab-based setting (MacLeod et al., 2002; Notebaert et al., 2015). Thus, ABM can be used to differentially induce an increase or decrease in attentional bias to bushfire-related threatening information, after which the consequent impact on preparedness intentions can be assessed. If such research demonstrates that attentional bias makes a causal contribution to preparedness, this will inform practical applications of this research. While one avenue to improve community preparedness may be to counsel individuals with high levels of trait anxiety to become less anxious, another potential avenue is to modify patterns of attentional bias that drive a lack of preparedness. Specifically, extended multisession ABM can be implemented online or via a smartphone application (e.g. Clarke et al., 2016) in the lead up to the fire-season, to encourage the pattern of attentional selectivity associated with optimal preparedness. The findings from the current study suggest that the specific attentional pattern to be encouraged may differ as a function of individuals' level of trait anxiety. While encouraging attentional vigilance for bushfire-related threat may be the best approach to increase preparedness in low trait anxious individuals, the same approach may be detrimental to preparedness in high trait anxious individuals, who may benefit more from training aimed at encouraging attentional avoidance of bushfire-related threat.

A third limitation of the present study is that the sample consisted of individuals within a very particular type of community, who not only lived in a bushfire-prone area but one that had recently affected by a bushfire. It remains to be seen whether the pattern of obtained effects replicates in other bushfire-exposed communities, perhaps including those that have not recently experienced a bushfire. We hope that the bushfire preparedness inventory, developed for use in the current study, will be of continuing value to such further research. Since the time of the present

study, our fellow investigators have further developed this measure, and successfully validated it (Dunlop et al., 2014), and so this preparedness measure will allow future researcher to deepen understanding of the emotional and cognitive contributors to bushfire preparedness. A fourth limitation is that this study examined the moderating role of anxiety-linked attentional bias on preparation for only one type of danger. While bushfire represents a significant risk for many Australians, which can be substantially reduced through appropriate forms of behavioural preparation, many other forms of danger also can be attenuated through adaptive preparatory action, that can be compromised by elevated anxiety vulnerability. For example, a negative relationship between anxiety and dangers preparedness has been observed in the context of different natural hazards (floods, earthquakes), and future research could usefully examine whether the present findings, that attentional bias to danger-relevant threat serves to strengthen this association, generalises to these and other types of danger .

In summary, this study is the first to show that in a situation where people are exposed to a real-world danger that can be mitigated through appropriate engagement in specific preparatory behaviours, attentional bias to danger-relevant threat serves to strengthen the observed negative association between trait anxiety and behavioural preparedness. Thus, even in contexts where attentional vigilance for threat could potentially serve an adaptive function, it appears to compromise the well-being of individuals high in anxiety vulnerability. While future research is needed to examine the causal nature of the presently observed, these findings have potentially important implications for researchers and practitioners who aim to improve preparedness through increasing vigilance for threat, as this may not be the optimal strategy, particularly for individuals high in anxiety vulnerability.

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