Maternal Anxiety and Cognitive Biases Towards Threat in Their Own and Their Child’s Environment

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Abstract

Cognitive biases are known to play an important role in anxiety. In this study we investigate whether maternal anxiety is associated with biases in interpretation, attention and catastrophic processing about self-referent stimuli that may signal potential threat in the mother’s own environment. We also investigate whether maternal anxiety is associated with biases about stimuli that their own child may encounter or to child-related stimuli more broadly. Three hundred mothers with a child aged 6 to 10-years participated. All participants completed a trait anxiety measure and an ambiguous sentences task to assess interpretation bias for self- and child-referent situations. A subset of the sample completed a catastrophizing interview about a self- (*N* = 194) or child-referent (*N* = 99) worry topic and an attentional dot-probe task (*N* = 99) with general threat and child threat stimuli. Maternal anxiety was not significantly associated with an attentional bias for general or child threat stimuli but was significantly associated with a bias for threat interpretations of both self and child-referent situations. Higher maternal anxiety was also significantly associated with generating more catastrophic outcomes to both a self-referent and child-referent hypothetical worry situation. We consider whether maternal cognitive biases, which extend to influence how mothers process potential threats in their child’s world may be an important mechanism through which intergenerational transmission of anxiety could occur.

*Keywords:* Anxiety, Interpretation, Attention, Catastrophizing, Cognitive BiasMaternal Anxiety and Cognitive Biases Towards Threat in Their Own and Their Child’s Environment

A significant body of work has investigated ways in which parental characteristics may promote or protect against the development of childhood anxiety. This is important given the considerable evidence that anxiety runs in families ([Cooper, Fearn, Willetts, Seabrook, & Parkinson, 2006](#_ENREF_12); [Last, Hersen, Kazdin, Orvaschel, & Perrin, 1991](#_ENREF_32)). We ([Field & Lester, 2010](#_ENREF_22); [Lester, Seal, Nightingale, & Field, 2010](#_ENREF_34)) and others ([Creswell, Cooper, & Murray, 2010](#_ENREF_13); [Creswell & O'Connor, 2006](#_ENREF_14); [Creswell, O'Connor, & Brewin, 2006](#_ENREF_16)) have argued that given the evidence that a large proportion of unique variance in child anxiety can be explained by environmental influences (Eley, et al., 2003), characteristics of anxiety may be transmitted environmentally from parent to child. One such characteristic of anxiety is biases in cognitive processing. A cognitive bias is a deviation or distortion in information processing, which manifests in a tendency towards processing information in a way that systematically favors particular conclusions. Anxiety is typically associated with biases that favor the processing of threatening, negative or worrisome stimuli. Cognitive biases affect different stages of information processing including attention, interpretation, reasoning and memory ([Harvey, Watkins, Mansell, & Shafran, 2004](#_ENREF_26)). These biases are observed in clinically diagnosed anxiety disorders (e.g. specific phobias, generalised anxiety disorder) and also in individuals who self-report high trait anxiety using questionnaire measures. Trait anxiety is a stable individual difference in the tendency to perceive a stressful situation as threatening or dangerous and to respond to that situation with an increase in anxious mood ([Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983](#_ENREF_46)).

 In this study, we investigated whether maternal anxiety was associated with cognitive biases, focusing on interpretation bias, attentional bias and catastrophic processing. We focus solely on maternal cognitive biases; we do not assess paternal cognitive biases because Bögels and Phares ([2008](#_ENREF_7)) suggest that maternal and paternal factors may influence children’s anxiety in different ways with fathers being biologically and socially predisposed to interact and respond to their children differently than do mothers. We investigate a) whether maternal anxiety is associated with biases in interpretation, attention and catastrophic processing about self-referent stimuli that may signal potential threat in the mother’s own environment, b) whether maternal anxiety is associated with biases about stimuli that *their own child* may encounter or to child-related stimuli more broadly, c) whether associations between maternal anxiety and biases about self- and child-related stimuli differ significantly in magnitude and d) whether self-referent cognitive biases may mediate any links between maternal anxiety and biases about child-related stimuli. These questions have not received significant attention. A mediation effect, if observed could suggest a mechanism by which greater maternal anxiety drives a self-referent cognitive bias toward threat, which in turn may drive a cognitive bias toward threat involving their child. A maternal proclivity to preferentially attend to and interpret child-related stimuli as threatening and/or catastrophize about potential child-related worries may in turn drive specific maternal behaviors that promote child anxiety.

**Interpretation Bias**

Interpretation bias is defined as the systematic interpretation of ambiguous cues as threatening and are associated with high trait and clinical anxiety (e.g. [Amir, Beard, & Bower, 2005](#_ENREF_1); [Constans, Penn, Ihen, & Hope, 1999](#_ENREF_11); [Eysenck, Mogg, May, Richards, & Mathews, 1991](#_ENREF_20); [Kanai, Sasagawa, Chen, Shimada, & Sakano, 2010](#_ENREF_29); [Richards & French, 1992](#_ENREF_45)). Past work has examined the possible links between maternal and child interpretation bias. Creswell and O’Connor ([2006](#_ENREF_14)) demonstrated in a community-based school sample, that mother and child threat interpretation biases were correlated, with mothers’ expectations about how their child would interpret ambiguous situations partially mediating the association between mother and child interpretation bias. Associations between mother and child interpretation bias have also been shown longitudinally ([Creswell & O'Connor, 2011](#_ENREF_15); [Creswell, Shildrick, & Field, 2011](#_ENREF_17)). Creswell and colleagues have suggested that mothers who demonstrate a threat interpretation bias about their own experiences also expect their child to make threat interpretations. This finding appears consistent with the prevailing evidence: Anxious parents and parents of anxious children expect their child to respond to threat provoking situations with avoidant solutions ([Barrett, Rapee, Dadds, & Ryan, 1996](#_ENREF_5); [Cobham, Dadds, & Spence, 1999](#_ENREF_10)) and hold more negative expectations for their child’s future performance ([Kortlander, Kendall, & Chansky, 1991](#_ENREF_31)).

A recent study addressed the question of whether parental anxiety biases parents to interpret ambiguous situations that their own child may encounter in a threatening way (i.e. the parents’ interpretation bias about child-referent situations). Lester et al. ([2009](#_ENREF_33)) showed that greater parental anxiety was associated with interpreting self-referent and child-referent ambiguous situations in a more threatening way. However, the association between parental anxiety and interpretation bias to child-referent situations was significantly weaker than that between anxiety and self-referent interpretation bias. The degree of self-referent threat interpretation bias also mediated the relation between parental anxiety and the tendency to interpret child-related ambiguous situations as threatening. This study was conducted on a small sample of both mothers and fathers with children aged four to 10-years old. The first aim of the current study was to replicate the pattern of findings in a larger sample of mothers with children aged six to 10-years. Based on Lester et al.’s ([2009](#_ENREF_33)) results we hypothesized that 1.) higher maternal anxiety would be associated with a greater propensity to interpret self-referent *and* child-referent ambiguous situations in a more threatening way. In addition, 2.) the association between maternal anxiety and self-referent interpretation bias would be significantly stronger than the association between maternal anxiety and child-referent interpretation bias. Furthermore, 3.) we hypothesized that mother’s own self-referent bias would mediate the relations between maternal anxiety and child-referent interpretation bias.

**Catastrophic Processing**

Anxiety and worry are also associated with a perseverative catastrophic processing style. This is the tendency for anxious individuals to perceive progressively worse outcomes to worry as a consequence of an automatic process in which they pose questions of the “what if…?” kind ([Kendall & Ingram, 1987](#_ENREF_30)). This processing style is often assessed using a catastrophizing interview ([Vasey & Borkovec, 1992](#_ENREF_49)). Individuals generate a topic that worries them and are then asked what it is about that topic that worried them with the number of catastrophic responses they produce serving as a marker of catastrophic processing. Adult chronic worriers generated a significantly greater number of catastrophizing steps than nonworriers ([Vasey & Borkovec, 1992](#_ENREF_49)). Anxious individuals also more readily catastrophized about completely hypothetical sources of potential worry: Davey and Levy ([1998](#_ENREF_18)) observed that anxious university students generated a greater number of possible catastrophic responses when asked “what worries you about being the statue of liberty?” than nonanxious controls.

There is some support for parental modeling of catastrophic processing and behavior in the development of child anxiety ([Moore, Whaley, & Sigman, 2004](#_ENREF_40)). Clinically anxious mothers with anxious children evidenced more catastrophic processing and behavior (defined as “blows problems out of proportion, lots of ‘what if’ questions” (p836)) during conversation tasks with their child than nonanxious mothers of nonanxious children ([Whaley, Pinto, & Sigman, 1999](#_ENREF_50)). In a second study, 60% of anxious mothers, irrespective of their child’s anxiety status, made catastrophizing statements, compared to approximately 10% of nonanxious mothers with a nonanxious child and 40% of nonanxious mothers with an anxious child ([Moore, et al., 2004](#_ENREF_40)). In the current study, we used a catastrophizing interview to explore whether maternal anxiety was associated with catastrophic processing about potentially worrisome situations that they could face but also situations that their child could encounter. We used an imagined hypothetical worry scenario to ensure that the worry scenario was standardized in content for self- and child-referent situations and to control for preexisting worry beliefs as it is highly unlikely that participants would have “practiced” the worry before. We hypothesized that 4.) higher maternal anxiety would be associated with generating a greater number of catastrophic steps to the self-referent situation. We also hypothesized that 5.) high anxious mothers would emit significantly more catastrophizing steps to the child-referent situation than less anxious mothers. In line with previous work ([Lester, et al., 2009](#_ENREF_33)), our present hypotheses for interpretation bias, and the broader notion that biases at different stages of information processing may be underpinned by a common mechanism ([Williams, Watts, MacLeod, & Mathews, 1997](#_ENREF_52)), we hypothesized that 6.) the association between maternal anxiety and self-referent catastrophic processing would be significantly stronger than the association between maternal anxiety and child-referent catastrophic processing. Due to investigating these associations in independent samples (see Method section for details) we were not able to explore mediated relationships.

**Attentional Bias**

High trait anxiety and clinical anxiety disorders have also been associated with attentional biases. In the context of anxiety, attentional biases are the tendency to preferentially attend to threat stimuli relative to neutral stimuli (for a review see [Bar-Haim, Lamy, Lee, Bakermans-Kranenburg, & van Ijzendoorn, 2007](#_ENREF_3); [Cisler & Koster, 2010](#_ENREF_9); [Garner, 2010](#_ENREF_24)). We are not aware of any studies investigating whether anxious mothers show an attentional bias toward threat stimuli that are related to their child or childhood more broadly. Our final aim, therefore, was to assess mothers’ patterns of attentional bias using a dot-probe task comprising three types of word pairs: General threat - neutral (e.g. coffin-typing), child-related threat - neutral (e.g. paedophile-handicraft) and neutral - neutral (e.g. concert-farming). In this way, we obtained a measure of mothers’ attentional bias for general threat and child threat stimuli. In a standard dot-probe trial, participants view two briefly presented stimuli (pictures or words), for example one neutral and one threat, followed by a target probe that appears with equal probability in the location of one of the preceding stimuli. Participants identify the presence of the probe as quickly and accurately as possible. Faster responses to probes that replace threat compared to neutral stimuli reveals an attentional bias toward threat. We hypothesized that 7.) greater maternal anxiety would be associated with an attentional bias toward general threat stimuli *and* an increased attentional bias toward child threat stimuli. In addition, we hypothesized that 8.) the association between maternal anxiety and general threat related attentional bias would be significantly stronger than the association between maternal anxiety and child threat related attentional bias. Furthermore, we hypothesized that 9.) mothers’ attentional bias to general threat stimuli would mediate the relations between maternal anxiety and child threat attentional bias.

**Method**

**Participants**

Three hundred mothers recruited from a community setting (*M*age = 39.82 years, *SD* = 5.13, range 22–54) with a child aged six to 10-years (*M*age = 100.45 months, *SD* = 14.78, range 72–132, 161 male: 139 female) participated in three experiments (referred to as Sample A, B and C, with each sample consisting of 100 mothers) conducted over a 2-year period. These three experiments investigated different questions regarding the intergenerational transmission of fear of novel animals. Table 1 reports sample descriptive statistics across the entire 300 participants and then split by subsample. The three samples did not differ significantly on age, trait anxiety, child age and gender distribution. Participants were recruited via the distribution of consent forms in primary schools, online recruitment and advertisements in community magazines and email lists. The same recruitment information and procedures were used for all three samples. Participants were informed that the broader study in which these maternal measures were embedded, was investigating how fears may develop in school-aged children. No specific exclusion criteria were applied in terms of maternal (or child) anxiety level. All families received £25 for participation.

**Measures**

Data pertaining to mothers’ trait anxiety scores and performance on cognitive bias measures are presented here. Across the three experiments, all mothers completed an identical measure of trait anxiety and an ambiguous sentences task as a measure of interpretation bias. Sample C completed a dot-probe task as a measure of attentional bias. Mothers also completed a catastrophizing interview as a measure of catastrophic processing, which presented a child-referent worry topic in samples A and B and a self-referent worry topic in sample C.

**Trait anxiety inventory (**[**STAI, Spielberger, et al., 1983**](#_ENREF_46)**).** This scale comprises 20 statements with a four point Likert-type response scale. The STAI has well-established psychometric properties. Spielberger et al., ([1983](#_ENREF_46)) report Cronbach’s alphas of 0.91 and test–retest reliability coefficients between 0.73 and 0.77 over 104 days. Cronbach’s alpha in this sample was 0.84. The mean trait anxiety score of the current sample (collapsed across samples A, B and C) was 39.20 (*SD* = 9.59, range 20–68). Trait anxiety scores were relatively low: 89% were within 1.96 *SD* of the normative means ([Spielberger, et al., 1983](#_ENREF_46)) and only 5.4% met suggested clinical cut offs for GAD ([Turner, McCann, Beidel, & Mezzich, 1986](#_ENREF_48)).

**Interpretation bias: ambiguous sentences task.** Samples A, B and C completed the ambiguous sentences task (see Appendix for an example item). This task was programmed in EPrime 1.2. Twenty ambiguous descriptions with the potential to elicit a threat or nonthreat interpretation were presented in an individualized random order, with each description presented with a brief identifying title. Ten items involved ambiguous situations that participants might face (self-referent) and 10 described ambiguous situations involving their child (child-referent). Half of the items within the child- and self-referent sets related to physical threat concerns (e.g. you are amazed when the doctor gives you the results of your check-up) and half related to social threat concerns (e.g. at parents evening the teacher discusses your child’s behavior).

Participants were asked to imagine each situation before rating on a 9-point scale (1 = *very unpleasant* to 9 = *very pleasant*) how pleasant the situation would be for them. A test for recognition memory followed immediately. Biases were assessed for each description by presenting two disambiguating sentences, one reflecting a threat interpretation (threat target) and the other a nonthreat interpretation (nonthreat target) of the original description. Two foil sentences were also presented reflecting threat or nonthreat statements loosely relevant to the passage, but which could not be directly inferred from it. Target and foil sentences corresponding to each ambiguous situation were presented one at a time in random order, with each sentence accompanied by the identifying title (which was previously presented alongside the original ambiguous description). Disambiguating sentences corresponding to each original ambiguous description were presented in the same individualized random order as in the first phase of this task. Participants rated each target and foil sentence for similarity in meaning to the original situation using a 1 (*very different*) to 4 (*very similar*) scale. Mean recognition ratings to threat and nonthreat target and foil sentences were calculated, with a higher rating to threat (target) items indicative of a greater interpretive bias toward threat. The primary outcome measure was a summary bias score. Consistent with past approaches ([Lester, et al., 2009](#_ENREF_33); [Woud, Holmes, Postma, Dalgleish, & Mackintosh, 2011](#_ENREF_54)), bias scores were calculated by subtracting the mean rating for threat target sentences from the mean rating for nonthreat targets, and subtracting the mean rating for threat foil sentences from the mean rating for nonthreat foils, and then summing the results. A positive score reflected a tendency to interpret the ambiguous statements in a nonthreat way and a negative score a tendency toward threat interpretations.

**Catastrophic processing: catastrophizing interview.** The catastrophizing interview was modelled on the procedure used by Startup and Davey ([2001](#_ENREF_47)). The interview began by presenting participants with a hypothetical worry scenario by asking them “what worries you about X (in which X is the worry scenario)?” Sample A and B (*N* = 194 completed interviews) completed the child-referent scenario: “Imagine that *your child* is Nelson standing on his column in Trafalgar Squarei and that this is a worrisome state of affairs for you”. Sample C (*N* = 99 completed interviews) completed the self-referent version: “Imagine that *you* are Nelson…” The experimenter repeated the questions replacing the participant’s answer to the first question for X, for example if the participant replies “I am worried about my child being so high up”, the experimenter then asks “what is it that worries you about your child being so high up?” Participants wrote their responses to each step on a response sheet and were asked to keep each response to a single sentence. The interview was terminated when the participant could think of no more responses, did not want to continue or if they gave two or more identical answers. The number of steps generated was calculated as the primary outcome measure, with a higher number of steps representing a tendency toward increased catastrophic processing.

**Attentional bias: dot probe task.** A detection dot-probe task was completed by sample C only. This task comprised 48 general threat-neutral (e.g. Coffin - Typing), 48 child threat-neutral (e.g. Paedophile - Handicraft) and 48 neutral-neutral (e.g. Concert – Farming) word pairs, followed by a probe consisting of a single dot. A further 32 neutral-neutral filler word pairs were used, which were not followed by a probe. Word pairs were matched for number of letters and frequency according to norms derived by Hofland and Johannson ([1982](#_ENREF_28)). Nine parents (who did not take part in the main experiment) rated each of the general threat, child threat and neutral words for threat content (0 = *not at all threatening*, 4 = *extremely threatening*). The child threat words were also rated on how strongly they were associated with childhood/children (0 = *not at all associated*, 4 = *very strongly associated*). Threat words were rated as significantly more threatening than neutral words (*M* = 0.04), *t*(93.88) = 37.50, *p* < .001 general = 2.30, child = 2.18, neutral = 0.04) but there was no significant difference in threat ratings to general (*M* = 2.30) and child (*M* = 2.18) threat words, *t*(92.27) = 1.01, *p* = .31. The association ratings for the child threat words (*M* = 2.28) also differed significantly from 0, *t*(47) = 21.19, *p* < .001.

This task was programmed in EPrime 1.2. Each trial began with a fixation cross presented for 1000ms in the middle of the computer screen followed by a word pair presented in a random order for each participant, with one word above the other, vertically separated by 3cm. Word pairs were presented in white, upper case letters against a black background for 500ms. The probe remained on screen for a maximum duration of 3000ms or until a response was made using a response box button. Threat and neutral words appeared equally often in the top and bottom positions and the probe appeared with equal probability, in either the position of the threat or neutral word. On no-probe trials the next trial began after 1000ms. Participants were asked to fixate on the cross between trials and to respond as quickly and accurately as possible as to which side of the screen the probe appeared. Participants completed a short practice phase consisting of 6 trials before undertaking experimental trials presented in a single block, with stimuli presented in a random order. Reaction times were calculated for each combination of conditions yielding mean reaction times for child threat incongruent (probe appears in location of the neutral word of a threat-neutral word pair), child threat congruent (probe appears in location of the threat word of a threat-neutral word pair), general threat incongruent and general threat congruent conditions. The primary outcome measure was a summary bias score. Bias scores were calculated independently for child and general stimuli by subtracting reaction times on congruent trials from reaction times on incongruent trials, with a positive score indicative of speeded responding (vigilance) to probes appearing in the location of threat stimuli.

**Procedure**

Informed consent was obtained and testing occurred in a quiet space in the laboratory at the University of Sussex. A small number of participants in sample A were seen at the child’s school, however the same testing protocol was used irrespective of testing location. Ethical approval was granted by the School of Psychology Research Ethics Committee, University of Sussex with the studies conducted in accordance with APA ethical guidelines. Mothers attended a single study session lasting approximately 1 hour 30 minutes. The study began with a brief overview of the experimental session and the mother then completed the Spielberger Trait Anxiety Inventory. The experimenter then administered the catastrophizing interview to the mother. Mother and child then completed several tasks not directly relevant to the hypotheses investigated in this manuscript. Mothers were then administered the ambiguous sentences task and in Sample C, the dot-probe task (in a counterbalanced order). At the end of the experiment, participants were fully debriefed.

**Statistical Analyses**

Inspection of the data revealed some variables to be positively skewed, which is relatively common when studying psychopathology phenomena in nonclinical samples recruited from the normal population. However, the central limit theorem tells us that sampling distributions will be normally distributed in large samples (usually defined as above 40, but the threshold is certainly below the current *N* of 300). Analyses were performed using bootstrapped *t* tests and Pearson correlation coefficients, using 2000 resamples and 95% bias corrected and accelerated confidence intervals because these methods perform robustly in a wide array of situations. For the sake of convention, formal *p* values are presented: These are calculated on the assumption that the sampling distributions are normal (which in a sample as large as this they should be). However, we place more weight on interpreting the bootstrap corrected confidence intervals and effect sizes because they should be accurate regardless of the distribution of the sample data.

**Results**

**Interpretation Bias**

 Data were available from samples A, B and C on this task. Mean recognition ratings were calculated for each participant and from these a bias score was computed for self and child-referent items (see Table 2).

**Hypothesis 1: higher maternal anxiety would be associated with a greater threat interpretation bias for self-referent and child-referent ambiguous situations.** To explore associations with anxiety, correlational analyses were performed between independent bias scores for self-referent and child-referent items (see Table 2 for mean scores) and maternal anxiety. As hypothesized, a significant association was observed between greater maternal anxiety and a) a bias toward threat interpretations of self-referent situations, *r* (299)= −.39, *p* < .001, [−.48, −.30] and b) a bias toward threat interpretations of child-referent situations, *r* (299)= −.23, *p* < .001, [−.33, −.12]. Self and child-referent bias indices were also strongly correlated with each other, *r* (299) = .70, *p* < .001.

**Hypothesis 2: the association between maternal anxiety and self-referent interpretation bias would be stronger than between maternal anxiety and child-referent interpretation bias.** We used Hotelling’s *t*­-test of dependent correlations ([e.g. Field, 2009](#_ENREF_21)) to test this hypothesis. The strength of the correlations between interpretation bias and maternal anxiety differed significantly, *t*(297) = 3.36, *p* < .001 with the association significantly weaker for threat biases about situations that their own child may encounter (*r* = −.23) than for self-referent situations (*r* = −.39).

**Hypothesis 3: the relations between maternal anxiety and child-referent interpretation bias would be mediated by self-referent interpretation bias.** To test this hypothesis, mediation analyses were performed using the regression approachoutlined by Baron and Kenny ([1986](#_ENREF_4))**.** Maternal anxiety significantly predicted self-referent interpretation bias (path a, see Figure 1); second, the mediator, self-referent interpretation bias had a direct effect, significantly predicting child-referent interpretation bias (path b) and third, the significant total effect that existed between maternal anxiety and child-referent interpretation bias (path c) became non-significant when the mediator variable was controlled for (path c’). This is consistent with the presence of a mediation effect in which maternal anxiety exerts an indirect effect on child-referent interpretation bias via the mother’s self-referent bias. Indirect effects were computed using Preacher and Hayes ([2008](#_ENREF_43)) SPSS macro to quantify the reduction of the effect of maternal anxiety on child-referent interpretation bias as a result of controlling for the mediator. Self-referent interpretation bias significantly mediated the effect of maternal anxiety on child-referent interpretation bias, *b =* −.035, [−.04, −.02], *Z* = −6.71, *p* < .001. This result is consistent (albeit not conclusive due to the cross-sectional nature of the data) with greater maternal anxiety driving a self-referent interpretation bias towards threat, which in turn drives a bias for interpreting ambiguity involving their child in a threatening way.

**Catastrophic Processing**

Data were available from sample A and B for analyses involving the child-referent scenario, while data from sample C only was used in analyses for the self-referent scenario.

**Hypotheses 4 and 5: greater maternal anxiety would be associated with greater catastrophic processing to a) a self-referent worry situation and b) a child-referent worry situation.** To test these hypotheses correlational analyses were performed between maternal anxiety and number of catastrophizing steps generated. As hypothesized, increased maternal anxiety was significantly associated with generating a greater number of catastrophic steps in response to the self-referent hypothetical situation, *r* (99) =.26, *p* = .005, [.11, .41]. A similar pattern was observed for the child-referent hypothetical situation, *r* (193) = .14, *p* = .03, [.01, .27].

**Hypothesis 6: the association between maternal anxiety and self-referent interpretation bias would be stronger than between maternal anxiety and child-referent interpretation bias.** To compare the strength of correlations between maternal anxiety and self-referent catastrophic processing and between maternal anxiety and child-referent catastrophic processing, a Fisher *r*-to-Z transformation was undertaken due to the use of independent samples. The correlation coefficients did not differ significantly, *Z* = 1.00, *p* = .32 indicating that the magnitude of the association between maternal anxiety and catastrophic processing of self- and child-referent situations was comparable.

**Attentional Bias**

 Data were available from sample C only. Only trials on which a probe was presented were analysed. Trials with errors (49 trials, 0.34%) and anticipatory responses (< 200ms, 44 trials, 0.31%) were eliminated. To reduce the effect of outliers ([Ratcliff, 1993](#_ENREF_44)), reaction times, which exceeded 2.5 *SD* above each individual mean were excluded (372 trials, 2.61%). Mean reaction times for each combination of trials are reported in Table 3 and from these bias scores were computed for general threat and child threat related stimuli.

**Hypothesis 7: greater maternal anxiety would be associated with an attentional bias toward general threat stimuli and child threat stimuli.** To test this hypothesis, correlational analyses were performed between independent bias scores for general-threat and child-threat stimuli and maternal anxiety. We found no significant association between maternal anxiety and attentional bias to general threat stimuli, *r* (99)= .08, *p* = .21, [−.12, .27]. For child-related stimuli, the association with maternal anxiety was small, *r* (99)= −.16, *p* = .06, [−.38, .07], and had a confidence interval that crossed zero. Also the coefficient was negative, indicative of increasing anxiety being associated with greater avoidance of threat.

**Hypothesis 8: the association between maternal anxiety and general threat attentional bias would be stronger than between maternal anxiety and child threat attentional bias.** We used Hotelling’s *t*­-test of dependent correlations to test whether the strength of association between maternal anxiety and general threat bias (*r* = .08) and between anxiety and child threat bias (*r* = −.16) differed significantly. The correlation coefficients differed significantly, *t*(96) = 1.88, *p* < .05, as expected given the different direction of associations with anxiety for general (positive association – vigilance toward general threat) relative to child-related stimuli (negative association – avoidance of child threat). General and child-related bias indices were also significantly correlated with each other under the assumption of a normal distribution, *r* (99) = .19, *p* < .03 [−.02, .38], however the bootstrapped confidence interval crossed zero

**Hypothesis 9: the relations between maternal anxiety and child-related attentional bias would be mediated by general-related attentional bias**. The conditions for mediation were not met. In brief, maternal anxiety did not significantly predict general-related attentional bias (path a, *p* =.42) and while the mediator, general-related attentional bias significantly predicted child-related attentional bias (path b, *p* = .05), the total effect between maternal anxiety and child-related attentional bias did not attain statistical significance (path c, *p* = .11).

**Discussion**

The present study investigated whether maternal anxiety was associated with cognitive biases in interpretation, attention and catastrophic processing about a) stimuli that signal potential threat in the mother’s own environment, and b) situations that *their own child* may encounter or to child-related stimuli more broadly. The following hypotheses were supported: maternal anxiety was significantly associated with an interpretation bias toward threat for situations in the mother’s own environment. Likewise, maternal anxiety was significantly associated with a bias toward interpreting situations that their own child may encounter in a more threatening way. However, the association between maternal anxiety and self-referent interpretation bias was significantly stronger than that between maternal anxiety and child-referent interpretation bias. Levels of self-referent interpretation bias mediated relations between anxiety and the tendency to view child-related situations as threatening. Higher maternal anxiety was significantly associated with generating more catastrophic outcomes to both a self-referent and child-referent hypothetical worry situation; the size of these correlations did not differ significantly. Inconsistent with our hypotheses, no significant associations were seen with maternal anxiety for either general or child-related attentional bias and conditions for mediation were not met.

**Interpretation Bias**

The present findings are consistent with past research suggesting that interpretation biases toward threat are associated with self-report high trait anxiety. We extend this literature to show that maternal anxiety is associated with interpretation biases towards potential threats in their child’s environment. However, the two indices of interpretation bias demonstrated a substantial correlation. It remains possible that, in fact, self- and child-referent interpretations represent proxies for a more general proclivity toward threat interpretations, while respective associations with anxiety may in part be explained by shared method variation. However, we consider this unlikely, given that the association between anxiety and child-referent bias was significantly weaker than the association between maternal anxiety and self-referent bias.

We replicated Lester et al.’s ([2009](#_ENREF_33)) finding that the relation between anxiety and an interpretation bias for child-referent situations was mediated by mothers’ self-referent interpretation bias. One plausible account is that maternal anxiety drives a self-referent interpretation bias, which in turn may drive a bias for interpreting ambiguity in the child’s world in a threatening way. In this way, anxious mothers may learn to view their child’s world in accordance with their own threatening perspective of the world. However, our mediation model was based on cross-sectional data so we can only speculate on how the causal relations between maternal anxiety and self and child-referent interpretation bias unfold over time ([Maxwell & Cole, 2007](#_ENREF_36)). Other variables are highly likely to moderate the effect that maternal anxiety exerts on mothers’ interpretation biases about child-referent stimuli, for example child anxiety levels (and interpretation biases). Highly anxious children, by virtue of their own tendency to interpret ambiguity in a threatening way, may act to encourage threat interpretations from their mother. While we have demonstrated that maternal anxiety is associated with biases about situations that their own child may encounter, we are unable to determine what effect these biases may have on children’s anxiety levels and interpretation biases.

**Catastrophic Processing**

Higher maternal anxiety was associated with generating a significantly greater number of catastrophic steps to a hypothetical self-referent and child-referent worry situation. These findings add to the literature suggesting a possible role for parental modeling of catastrophic processing and behavior in the development of child anxiety ([Moore, et al., 2004](#_ENREF_40)). Unlike our interpretation bias findings, we observed a similar magnitude of association with anxiety for self- and child-referent situations. However, in contrast to interpretation bias the content of the worry scenario was standardised for self- and child-referent situations. This may have led to greater similarity in association with anxiety, especially given that the nature of the worry scenario could have constrained the type of catastrophic responses generated. Furthermore past work also indicates that anxiety and worry are associated with a general iterative style independent of whether the catastrophising interview focuses on existing worries, hypothetical worries and even positive aspects of an individual’s life ([Davey & Levy, 1998](#_ENREF_18)) and here it seems self- or child-referent content. Of note, the comparison between self- and child-referent stimuli was across independent samples – future work would benefit from examining associations between maternal anxiety and catastrophic processing style to self- and child-referent worry situations in the same sample. This would be a stronger test of whether the magnitude of association is comparable for self- and child-referent worry situations. The present effects are also limited to responses to hypothetical and not real life worrisome situations. How mothers respond to real-life worries may prove to be more relevant to understanding the possible role of maternal catastrophic processing style in the intergenerational transmission of anxiety.

**Attentional Bias**

Attentional bias for general threat stimuli did not differ significantly as a function of maternal anxiety, thereby failing to replicate the widely reported association between high trait and clinical anxiety and attentional biases to threat ([see Bar-Haim, et al., 2007](#_ENREF_3)). This contradicts the pervasive view that facilitated processing of threat stimuli is a universal characteristic of human cognitive processing (e.g. [Mathews & Mackintosh, 1998](#_ENREF_35); [Mogg & Bradley, 1998](#_ENREF_37)). Several explanations for the failure to observe the hypothesized effects should be considered. First, a recent meta-analysis ([Bar-Haim, et al., 2007](#_ENREF_3)) determined that null bias effects are often observed in unselected control groups drawn from the general population with average anxiety levels. Trait anxiety levels were quite mild in this sample (Sample C) with 88% of mothers within 1.96 *SD* of normative means (see methods section for data on full sample). This sample may have been insufficiently extreme in their anxiety or restricted in the range of anxiety scores to reveal the hypothesized attentional bias effectsii. However, if this explanation were true it is surprising that the sample *was* sufficiently anxious to reveal biases in interpretation and catastrophic processing.

Anxiety-related effects may have been too small to be detected due to analyses being underpowered. However, the real issue here is not the significance of the effect but its size. The sample size for attentional bias was smaller than for other analyses (*N* = 99), but was nevertheless large enough to assume good precision of the effect size estimate. The resulting effect for child-related stimuli was small (*r* = –.16) suggesting that even if the experiment was powered to detect this effect, we would be dealing with a relatively weak effectiii. In fact, this effect size was comparable to that observed between anxiety and child-referent catastrophic processing (*r* = .14). However, the analyses for catastrophic processing had greater power to detect a small effect given the larger sample size (*N* = 194 vs. *N* = 99).Third, the word stimuli may have been insufficiently threatening to elicit attentional bias to threat. Threat words were rated as significantly more threatening than the neutral counterparts, but the mean score showed them to be of only moderate threat content. Past work has suggested that while highly anxious individuals selectively attend to both mildly threatening and very threatening stimuli, nonanxious individuals demonstrate a bias only with extreme threat stimuli (e.g. [Mogg & Bradley, 1999](#_ENREF_38); [Wilson & MacLeod, 2003](#_ENREF_53)).

Greater maternal anxiety was associated with a small (trend) effect for greater avoidance of child threat stimuli. Although this effect is small in size, and we caution against overinterpretation, we would also encourage replication given that this is the first tentative evidence to our knowledge of an association between maternal anxiety and attentional bias to stimuli related to child threat. Directing attention away from child threat stimuli may represent a strategic attempt by more anxious mothers to alleviate an anxious mood state elicited by the threat stimuli ([Mogg, Bradley, Miles, & Dixon, 2004](#_ENREF_39)). Child threat words were, however, rated as only moderately associated with childhood/children. Pictorial stimuli could be trialled in future work, as these may be better able to depict child threat, which in turn may increase the chances of observing attentional biases for child-related threat stimuli.

 **Implications**

Associations with anxiety were not consistent across the three types of bias, particularly for self-related stimuli. This inconsistency, while potentially accountable for by methodological factors, is also of theoretical interest. Information processing models often imply reciprocal or additive effects for more than one cognitive bias in the maintenance of psychological disorders, which is consistent with these different types of bias being underpinned by a common mechanism ([Mathews & Mackintosh, 1998](#_ENREF_35); [Williams, et al., 1997](#_ENREF_52)). There is some evidence to favor a common mechanism: Cognitive bias modification studies have experimentally modified one type of bias, e.g. trained attention toward threat, and have then observed congruent effects on a different type of bias, e.g. increased interpretation bias toward threat ([Amir, Bomyea, & Beard, 2010](#_ENREF_2); [Hirsch, Mathews, & Clark, 2007](#_ENREF_27); [White, Suway, Pine, Bar-Haim, & Fox, 2011](#_ENREF_51)). Neuroimaging studies have also implicated common amygdala-prefrontal circuitry underlying attention to threat and interpretation of emotional stimuli ([Bishop, 2007](#_ENREF_6)). However, the mixed findings for self-referent stimuli are perhaps more consistent with an independent pathways account in which different classes of bias reflect distinct, orthogonal aspects of threat-related information processing ([White, et al., 2011](#_ENREF_51)). For child-related stimuli, a more consistent pattern of effects was seen. Associations with anxiety were strongest for interpretation bias while the effect size for catastrophic processing and attentional bias was of a similar magnitude but attained statistical significance for catastrophic processing only. A tentative picture emerges in which maternal anxiety is weakly associated with attentional avoidance, greater catastrophic processing, and more strongly associated with an increased tendency to select threat interpretations.

These maternal characteristics could raise risk for their child experiencing anxiety by increasing the anxiogenic learning experiences that mothers provide for their child ([Lester, et al., 2009](#_ENREF_33); [Lester, et al., 2010](#_ENREF_34)). Maternal cognitive biases about child-related situations could represent one possible mechanism, which drives anxious mothers to provide more verbal threat information, negative vicarious learning and direct aversive conditioning experiences to their child and to reinforce similar cognitive biases and avoidance behaviors by their child ([Field, Lester, & Cartwright-Hatton, 2008](#_ENREF_23)). A recent study is broadly consistent with this hypothesis ([Muris, van Zwol, Huijding, & Mayer, 2010](#_ENREF_42)). Mothers who were given threatening narratives about a novel animal imparted more threat information to their child, which led to higher fear beliefs in their child, compared to mothers who received positive narratives. When mothers were given ambiguous information, the extent to which they transmitted threat information was dependent on maternal anxiety. High anxious mothers were more likely to transmit threat information, arguably as a consequence of them interpreting the ambiguous information in a more threatening way.

If it is proven that maternal cognitive biases about situations that their child could encounter are a viable mechanism for the intergenerational transmission of anxiety, then this raises the interesting possibility that maternal cognitive biases could be a target for intervention. Intervening at the level of maternal cognitions using a family-focused treatment approach (Cartwright-Hatton, et al., 2011), or even direct intervention approaches, for example cognitive bias modification methods ([Hallion & Ruscio, 2011](#_ENREF_25)) may be beneficial in terms of the prevention and treatment of child anxiety. However, the effect sizes for associations with maternal anxiety were small to moderate, and the potential benefits of intervening at the level of maternal cognitions may be relatively modest. However, anxiety is a complex, multifactorial disorder and multiple related mechanisms of relatively modest effect are likely to prove important for intergenerational transmission.

**Limitations**

Anxiety levels were mainly in the mild to moderate range. This may have reduced the potential to observe associations between anxiety and bias measures. It is, therefore, unclear how generalizable these results are to high anxious and clinically disordered mothers. Data were also collected from three different subsamples and while these samples did not differ on demographic variables, nor were any interactions with sample present in our analyses, it is possible that this introduced unsystematic variance. While the same protocol was followed for administration of tasks across the three samples, not all samples completed the dot-probe task or the same catastrophizing interview, which therefore limited our power to detect effects using these measures (although the samples were large enough to assume precise effect size estimates). In addition, task administration was not fully counterbalanced and it is plausible that this may have affected our findings. For practical reasons, a small number of participants were tested in a school setting rather than the University laboratory. However, it was not possible to test the effect that research setting had on the pattern of findings. We also focused solely on mothers. Future work could determine whether anxious fathers demonstrate cognitive biases towards potential threats in their child’s world, particularly as recent research has suggested that paternal factors may be more important than maternal factors in child anxiety ([Bögels & Phares, 2008](#_ENREF_7)). Future work should consider further the role of child anxiety in eliciting cognitive biases from their parents as parenting is not a one way street ([Muris & Field, 2008](#_ENREF_41)). Finally, the psychometric properties of the tasks used have not been systematically investigated. However, we chose tasks that based on the extant literature are sensitive to detecting interindividual differences in cognitive processing.

**Summary**

This study has shown that maternal anxiety is associated with an increased tendency toward threat interpretation biases and catastrophic processing for not only self-referent stimuli, but also for child-referent stimuli. However, we found no significant evidence that maternal anxiety was associated with attentional biases toward threat for general threat stimuli, and weak evidence for avoidance of child-related threat stimuli. Patterns of cognitive processing (for both self- and child-related stimuli) were not fully consistent across different forms of cognitive bias. Notwithstanding this, our findings could have wider implications not only for our understanding of the processes involved in intergenerational transmission of cognitive biases and anxiety, but also for its prevention. A focus for future work should be to illuminate the precise causal mechanisms underpinning the transmission of anxiety from mother to child.

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**Appendix**

Example child-referent item from the ambiguous sentences task

Ambiguous Sentence: “The teacher tells you that your child was responsible”

How similar in meaning to the original sentence? (1 = *very different in meaning*, 4 = *very similar in meaning*)

Threat target: “The teacher says that your child broke the window”

Nonthreat target: “The teacher says that your child’s behaviour was very mature”

Threat foil: “The teacher says that your child’s homework is late”

Nonthreat foil: The teacher says that your child’s handwriting has improved

**Footnotes**

iNelson’s column is an iconic British monument situated in Trafalgar Square in London built to commemorate Admiral Horatio Nelson who died at the Battle of Trafalgar in 1805. The monument is 51.59 meters tall comprising a column and statue of Nelson.

ii To investigate the possibility that an attentional bias to threat may be present in those mothers only with high anxiety levels, the analyses were repeated with only those mothers scoring half a standard deviation or more above the population norms. All analyses were nonsignificant. However, only 45 individuals met the half a standard deviation cut-off, thereby dramatically reducing power to detect significant effects.

iii Although we believe that post hoc power estimates of our analysis are uninformative when the observed effect size can be interpreted in its own right such an analysis revealed, as you would expect given the nonsignificant result, that these analyses were underpowered (*β* = 0.48 for the association between anxiety and child stimuli and *β* = .20 for general stimuli.) To achieve 80% power given the effect size of *r =* –.16 for the association between maternal anxiety and child threat related attentional bias would have required a sample size of 240 participants. However, we reiterate the point that even had we had 240 participants this would not change the fact that we would have a very weak association (its *p*-value would not make the effect any less weak).

Table 1

*Sample Descriptives (Mean and SD)*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Entire****(N=300)**  | **Subset A****(N = 100)** | **Subset B****(N = 100)** | **Subset C****(N = 100)** | **Test statistic**  | ***df*** | ***p*** |
| **Maternal age (years)** | 39.82 (5.13) | 39.58 (4.81) | 39.21 (5.36) | 40.67 (5.15) | 2.21 | 2, 297 | .11 |
| **Maternal trait anxiety** | 39.20 (9.59) | 38.21 (9.84) | 39.84 (9.84) | 39.55 (9.09) | 0.82 | 2, 296a | .44 |
| **Child age****(months)** | 100.45 (14.78) | 99.11 (14.64) | 100.14 (15.00) | 102.11 (14.67) | 1.06 | 2, 297 | .35 |
| **Child gender****(M:F)** | 161:139 | 54:46 | 54:46: | 53:47 | .03 | 2 | .99 |

*Note:* a Trait anxiety not available for one participant in subset B

Table 2

*Mean (and SD) Recognition Ratings and Bias Scores for the Ambiguous Sentences Task*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Item Type** | **Threat target** | **Non-threat target** | **Threat foil** | **Non-threat foil** | **Bias index** |
| **Self-referent** | 1.94 (0.51) | 2.68 (0.55) | 1.36 (0.35) | 1.84 (0.54) | 1.22 (1.02) |
| **Child-referent** | 1.70 (0.47) | 2.56 (0.63) | 1.34 (0.33) | 1.90 (0.61) | 1.45 (1.16) |

Table 3

*Mean (and SD) Reaction Times (ms) and Bias Scores for the Attentional Dot-Probe Task*

|  |  |  |  |
| --- | --- | --- | --- |
| **Item Type** | **Congruent trial** | **Incongruent trial** | **Bias index** |
| **General** | 409.47 (65.40) | 406.85 (62.72) | -2.62 (24.39) |
| **Child** | 412.61 (69.01) | 417.48 (71.75) | 4.87 (24.45) |

**Self-Referent Interpretation Bias**

**b path**

*b* = 0.82 (0.72),

*p* < .001

**a path**

*b* = -.0.04 (-0.39),

*p* < .001

**Child-Referent Interpretation Bias**

**Maternal Trait Anxiety (STAI)**

**c path** *b* = -0.03 (-0.23), *p* < .01
**c’ path** *b* = .01 (0.06), *p* = .20

*Figure 1:* Mediation model of the relation between maternal anxiety and interpretation of ambiguous child-referent situations. Unstandardized (standardized) betas are reported with associated significance levels