Title: Interpretation bias in preschool children at risk for anxiety: a prospective study.

Running head: Interpretation bias in preschoolers

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Abstract

A story-stem paradigm was used to assess interpretation bias in preschool children. Data were available for 131 children. Interpretation bias, behavioural inhibition (BI) and anxiety were assessed when children were aged between 3 years 2 months and 4 years 5 months. Anxiety was subsequently assessed 12-months, 2-years and 5-years later. A significant difference in interpretation bias was found between participants who met criteria for an anxiety diagnosis at baseline, with clinically anxious participants more likely to complete the ambiguous story-stems in a threat-related way. Threat interpretations significantly predicted anxiety symptoms at 12-month follow-up, after controlling for baseline symptoms, but did not predict anxiety symptoms or diagnoses at either 2-year or 5-year follow-up. There was little evidence for a relationship between BI and interpretation bias. Overall, the pattern of results was not consistent with the hypothesis that interpretation bias plays a role in the development of anxiety. Instead, some evidence for a role in the maintenance of anxiety over relatively short periods of time was found. The use of a story-stem methodology to assess interpretation bias in young children is discussed along with the theoretical and clinical implications of the findings.

Keywords: Interpretation bias, information processing bias, anxiety, behavioural inhibition, temperament

Anxiety disorders are common in children and adolescents, with around 5% meeting criteria at any given time (Rapee, Schniering, & Hudson, 2009). Anxiety has been shown to have a significant effect on children's functioning, impacting peer relationships, schooling and the family environment (Essau, Conradt, & Petermann, 2000; Ezpeleta, Keeler, Alaatin, Costello, & Angold, 2001). Furthermore, anxiety that begins in childhood, if left untreated, often persists into adulthood (Kessler et al., 2005). Given the prevalence and impact of child anxiety, research has begun to examine possible causal or maintaining factors with the goal of improving understanding of the development of anxiety and ultimately informing treatment and early intervention. One area of interest in recent research has been the role of interpretation bias in the onset and maintenance of anxiety in children. A growing body of research supports the idea that, when faced with ambiguity, anxious children are more likely to resolve the ambiguity in a threat-related way (Creswell, Schniering, & Rapee, 2005; Hadwin, Frost, French, & Richards, 1997; Taghavi, Moradi, Neshat-Doost, Yule, & Dalgleish, 2000). To date, however, it is unclear whether this bias is present in preschool age children and what role interpretation bias plays in the development of anxiety over time. In the present prospective study, a story-stem paradigm is used to assess interpretation of ambiguous stories in a sample of preschool children assessed for anxiety concurrently and 12-months, 2 years, and 5 years later.

Several cognitive models have emphasised the role of biased information processing in anxiety (Beck, Emery, & Greenberg, 1985; Kendall, 1985; Muris & Field, 2008; Williams, Watts, MacLeod, & Mathews, 1997). For example, Beck et al. (1985) proposed that dysfunctional cognitions are at the core of anxiety pathology. Subsequent research, initially conducted with adults, has provided substantial evidence that anxiety is associated with a

bias to interpret ambiguous stimuli in a threat-related way (e.g. Amir, Foa, & Coles, 1998; Eysenck, Mogg, May, Richards, & Mathews, 1991). More recently, research has begun to examine interpretation bias in anxious children and, although the findings are slightly less consistent than in the adult literature, there is a growing body of research suggesting that anxious children also exhibit this bias (e.g. Creswell, et al., 2005; Hadwin, et al., 1997; Taghavi, et al., 2000). As several researchers have noted, however, this field has been limited by the application of adult models and methodologies to children (Field, Cartwright-Hatton, Reynolds, & Creswell, 2008; Hadwin & Field, 2010). Perhaps as a consequence of this, there is an absence of research examining interpretation bias in young children.

Although it is reasonably well-established that anxiety in both adults and older children is associated with interpretation bias, the nature of this relationship is not currently clear. There is some indication that interpretation bias may be a consequence or epiphenomenon of anxiety. For example, it has been demonstrated that, when anxiety decreases following Cognitive Behavioural Therapy, analogous decreases in interpretation bias are observed (Creswell, et al., 2005; Waters, Wharton, Zimmer-Gembeck, & Craske, 2008). Alternatively, interpretation bias may play a causal role in the onset or maintenance of anxiety. Recent research using cognitive bias manipulation or training paradigms has provided initial evidence to support this hypothesis. For example, Wilson, MacLeod, Mathews and Rutherford (2006) used a training program to induce an interpretation bias towards non-threat and an interpretation bias towards threat in two groups of non-anxious participants and found that, following an emotional event, anxiety was higher in those participants who had received the training towards threat. Furthermore, Mathews, Ridgeway, Cook, and Yiend (2007) found that, when participants were trained to make

benign interpretations, this led to significant decreases in anxiety symptoms. Recent

research has begun to utilise similar cognitive bias manipulation techniques with children.

For example, Muris and colleagues used a creative task to show that interpretation bias

could be modified in children (Muris, Huijding, Mayer, & Hameetman, 2008; Muris, Huijding,

Mayer, Remmerswaal, & Vreden, 2009). This research did not, however, examine whether

changes in interpretation bias led to changes in anxiety. Vassilopoulos, Banerjee, and

Prantzalou (2009), on the other hand, used a bias modification paradigm to reduce negative

interpretation bias in high socially anxious children and found significant reductions in both

interpretation bias and social anxiety symptoms.

On the whole, bias manipulation research has been interpreted as providing initial

evidence that interpretation bias plays a causal role in anxiety (Mathews & Mackintosh,

2000; Salemink, van den Hout, & Kindt, 2007; Vassilopoulos, et al., 2009). It is important to

consider, however, whether interpretation bias acts as a *maintenance* factor in anxiety or

plays a role in the *development* of anxiety. In the majority of bias modification studies, it is

difficult to determine between these possibilities because, if a maintaining factor is

removed, anxiety would be expected to decrease, even if the maintaining factor did not play

a role in the onset or development of anxiety. Studies in which a stressor is included

following bias modification (e.g. Wilson, et al., 2006) have addressed this limitation and

provided preliminary evidence that interpretation bias may play a role in the development

of anxiety. However, it is essential that these finding are extended and replicated by

prospective longitudinal research evaluating the development of anxiety outside of the

laboratory.

Only three longitudinal studies have explicitly examined the relationship between interpretation bias and anxiety in children. Muris, Jacques and Mayer (2004) examined interpretation bias in a sample of non-clinical children aged between 9 and 13 years, at two time points, 4 weeks apart. Although anxiety was significantly related to interpretation bias at both timepoints, there was no evidence for a longitudinal relationship between interpretation bias and anxiety symptoms. Given the short follow-up period used, recent research has examined the prospective relationship between interpretation bias and anxiety over a one-year period (Creswell & O'Connor, 2011) and a three-year period (Creswell, Shildrick, & Field, in press). In both of these studies no evidence that interpretation bias was related to change in anxiety symptoms over time was found. In fact, the reverse relationship was found; anxiety symptoms predicted change in interpretation bias over time. To date, therefore, there is little evidence from longitudinal research to suggest that interpretation bias plays a causal role in the development of child anxiety.

Related to this question is the extent to which interpretation bias is present in at-risk populations; if biased information processing is related to the development of anxiety, then it might be expected to be present not only in anxious samples, but also in those who are at-risk for anxiety. Following this reasoning, Waters, Craske, Bergman, and Treanor (2008) studied interpretation bias in children of anxious mothers. Relative to children of control mothers, there was no evidence that children of anxious mothers were more likely to exhibit an interpretation bias. Using a similar approach, Muris, Meesters, and Rompelberg (2006) examined the relationship between interpretation bias and the temperament styles neuroticism and effortful control. A significant relationship was found between temperament and interpretation bias but there was no evidence that interpretation bias

mediated the temperament – anxiety relationship. To our knowledge, the studies of Muris et al. (2006) and Waters, Craske et al. (2008) are the only studies to have examined interpretation bias in at-risk groups. The results of both of these studies were interpreted as consistent with the view that interpretation bias is an epiphenomenon of anxiety rather than causally related to anxiety.

One of the most commonly studied precursors to anxiety is the temperament style behavioural inhibition (BI). Children who are considered to be behaviourally inhibited tend to be shy, reticent and cautious in new or novel situations (Garcia-Coll, Kagan, & Reznick, 1984). Several research groups have shown that BI is associated with elevated anxiety risk over longitudinal follow-up (Chronis-Tuscano et al., 2009; Hirshfeld et al., 1992; Schwartz, Snidman, & Kagan, 1999). To date, little is known about the relationship between cognitive biases and BI, although some recent research has begun to explore this question by studying attentional bias in adolescents assessed for BI during childhood. Perez-Edgar et al. (2010) found that BI, as assessed across multiple time points between the ages of 14-months and 7-years, was associated with attentional bias for threat in adolescence. Along with other studies conducted by the same group (Perez-Edgar & Fox, 2005) this provides initial evidence that BI may be associated with a threat-related attentional bias. The relationship between BI and interpretation bias has yet to be assessed. However, cognitive theories of anxiety propose that a common mechanism underpins attention and interpretation biases (Mathews, Mackintosh, & Fulcher, 1997). Consequently, it may be anticipated that children who are behaviourally inhibited will also exhibit an interpretation bias.

In the present research a story-stem approach is used to assess interpretation bias in preschool children classified as behaviourally inhibited or uninhibited, and the longitudinal

relationship between interpretation bias and anxiety is examined. In the story-stem

paradigm, children are provided with the beginning of a story and asked to tell the rest of

the story using dolls and props; responses are videoed and then coded systematically. This

methodology provides a means of assessing 'children's views of themselves and their world'

(p.1336, Warren, Oppenheim, & Emde, 1996). Initially developed to provide insight into

children's internal representations of their attachment relationship, the story-stem

procedure has subsequently been used extensively for this purpose and to examine

negative expectations (Bretherton, Ridgeway, & Cassidy, 1990; Cassidy, 1988; Warren et al.,

1996). For example, Warren, Emde, and Sroufe (2000) asked a sample of children aged 5 to

6 years to complete story stems related to child transgressions, moral dilemmas, separation

and threat. These authors found a significant relationship between negative story endings

and child anxiety symptoms both concurrently and at 12-month follow-up. In the present

research this procedure is modified and ambiguous story-stems are presented in order to

assess child interpretation bias.

The present research had four principal aims: (1) to pilot a method of assessing

interpretation bias in preschool children based on the story-stem paradigm described

above; (2) to assess whether behaviourally inhibited and uninhibited children differ on

interpretation bias; (3) to examine the relationship between interpretation bias and anxiety

in preschool-aged children; (4) to examine whether interpretation bias in preschool children

predicts the development of anxiety over time three time points, 12 months, two years and

five years after the initial assessment. A number of hypotheses were evaluated: (1) that

children classified as behaviourally inhibited will exhibit an interpretation bias relative to

those classified as behaviourally uninhibited; (2) that interpretation bias will be significantly

associated with both anxiety diagnoses and anxiety symptoms; (3) that participants

interpretation bias at baseline would significantly predict anxiety diagnoses and symptoms

over time, after controlling for baseline anxiety.

Method

Participants

The original sample comprised 102 behaviourally inhibited (BI) and 100 behaviourally

uninhibited (BUI) children, recruited as part of a longitudinal study of predictors of child

anxiety. The sample has been described in detail elsewhere (Hudson, Dodd, & Bovopoulos,

submitted). Participants were recruited through local preschools and via an advertisement

in a free parenting magazine. After completing an initial screening questionnaire (Short

Temperament Scale for Children - STSC; Sanson, Smart, Prior, Oberklaid, & Pedlow, 1994)

children scoring one standard deviation above or below the normative mean on the

Approach Scale were classified as behaviourally inhibited or behaviourally uninhibited

respectively. The STSC has adequate validity and good internal consistency and reliability

(e.g., Sanson et al., 1994). In the current screening sample, the internal consistency for the

approach scale was Cronbach alpha = .92. The STSC has been used in previous research to

classify children as behaviourally inhibited and a significant relationship with anxiety has

been reported (Rapee, Kennedy, Ingram, Edwards, & Sweeney, 2005). Children with a

developmental disorder or with parents who were unable to read a standard English

newspaper were excluded from the study.

Due to missing or incomplete data, the final sample used for analyses included 131

participants (63 male, 68 female). Of this sample, 65 scored in the inhibited range on the

STSC (30 male, 35 female) and 66 scored in the uninhibited range on the STSC (33 male, 33
female). These participants were aged between 3 years 2 months and 4 Years 5 months
(mean = 4 years, standard deviation = 4 months) when initially assessed. Follow-up
assessments were conducted 12-months later, two years later and five years later. Of this
final sample, 91% lived with both parents, 67% described their ethnicity as Oceanic, with the
majority of the remainder being European, 61% reported above average family income, the
majority of mothers were either working part-time (48%) or at home by choice (41%) and
had completed post-school qualifications (84%).

Measures

   Observed behavioural inhibition. In addition to the STSC, behavioural inhibition was
assessed by observing participants' behaviour in response to a number of novel stimuli
including a novel toy, a masked experimenter and an unfamiliar peer. Behaviours used to
determine inhibition status included i) time spent proximal to the mother, ii) amount of
time staring at the peer, iii) total time spent talking, iv) number of approaches to the
stranger and v) number of approaches to the peer. A participant was defined as
behaviourally inhibited based on observation, if they scored above an established cut-off on
three or more of these five behaviours. The cutoffs were as follows: total time spent talking
during stranger and peer components combined - less than 1 min, total time within arm's
length of mother during stranger and peer components combined - greater than 1 min, total
time spent staring at peer - greater than 2 min, frequency of approach to stranger - one or
less, frequency of approach to peer - one or less (Rapee et al.2005). Inter-rater reliability for
observed behavioural inhibition was determined by having a second trained coder

independently score the videotapes for 25% of the sample. The inter-rater reliability for overall BI classification based on observation was kappa = .789.

Child anxiety disorders. Participants' mothers were interviewed using the Anxiety Disorders Interview Schedule for *DSM-IV,* Parent Version (ADIS-P; Silverman & Albano, 1996). At baseline, items referring to school were changed to 'preschool.' Previous research has shown that the ADIS-P can be used to reliably diagnose anxiety disorders in preschool children (Rapee, et al., 2005). Diagnoses based on the criteria set out by the DSM-IV (American Psychiatric Association, 1994) were assigned by graduate students in psychology or qualified clinical psychologists trained by the second author. A second clinician coded 22% of cases and good inter-rater reliability was found for presence of a clinical anxiety diagnosis (kappa = .858).

The ADIS-P was also conducted at two-year follow-up and five-year follow-up. At five-year follow-up, children and mothers were interviewed and diagnoses were made based on their combined responses. At both two-year follow-up and five-year follow-up 20% of cases were coded by a second clinician and good inter-rater reliability was found for presence of a clinical anxiety diagnosis (kappa = .797; kappa = .854).

Child anxiety symptoms. At baseline, 12-month follow-up and two-year follow-up, mothers completed the Preschool Anxiety Scale, adapted from the Spence Children's Anxiety Scale (PAS; Spence, Rapee, McDonald, & Ingram, 2001). The PAS provides an overall measure of child anxiety symptoms. The measure has good construct validity, satisfactory internal consistency and good cross-informant and test-retest reliability (Broeren & Muris, 2008; Spence, et al., 2001). Internal consistency for the total score in this sample was Cronbach's alpha = .93. This was consistent across time-points.

At five year follow-up mothers completed the Spence Children's Anxiety Scale (SCAS; Spence, 1998). The SCAS yields a total score as an overall measure of child anxiety symptoms. The SCAS has good internal consistency, with α coefficients of greater than 0.90, adequate test-retest reliability over 6 months and good convergent and discriminant validity (Spence, 1998). Internal consistency for the total score in this sample was Cronbach's alpha = .90.

Interpretation bias. To assess interpretation bias, a story-stem methodology was used based on that used in previous research with children aged between 3 and 8 years (Bretherton, Ridgeway, & Cassidy, 1990; Warren et al., 2000). The story-stem approach has been used to systematically assess children's attachment relationships and negative expectations in several previous studies (Bretherton, et al., 1990; Oppenheim, Emde, & Warren, 1997; Oppenheim, Nir, Warren, & Emde, 1997; Warren, Huston, Egeland, & Sroufe, 1997) and has been shown to have adequate psychometric properties particularly in relation to construct and predictive validity (Holmberg, Robinson, Corbitt-Price, & Wiener, 2007; Solomon & George, 1999; Warren et al., 1996). In the present research, the story-stem methodology was used as described by Bretherton and Oppenheim (2003) but three ambiguous story-stems were presented to participants to permit assessment of children's interpretations. The story-stems were as follows: (1) "This is the park. Here is the family walking in the park, and look there is this high, high rock. Bob / Jane wants to climb the rock"; (2) "Look these children are playing a fun game. Bob / Jane wants to join in. He/she is getting closer. It looks like the children are laughing"; (3) "Look Bob / Jane is waiting at preschool for mum. Mum's running late". These stories were selected to represent physical threat, social threat and separation anxiety respectively and were adapted from previous

research examining interpretation bias in older children (Barrett, Rapee, Dadds, & Ryan, 1996). To ensure that the stories were ambiguous, four experts in child anxiety rated the stories along with three threat-related stories used by Warren et al. (2000). A 7-point Likert scale was used for the rating with a score of +3 indicating threat and a score of -3 indicating no threat and a score of 0 indicating ambiguity. All three stories received a mean rating between 0 or 0.75, with an overall mean of 0.42, indicating that they were ambiguous. In comparison the threat-related stories from Warren et al. (2000) received mean scores of between 1.75 and 3, with an overall mean of 2.25.

Procedures

Macquarie University Human Ethics Committee approved the methods of the study. Following the initial screen using the parent-report STSC, children who met entry criteria were invited to take part in the full study. Mothers provided written informed consent for themselves and their children. The children provided assent to the study procedures. All participants visited the university for two 2-hour sessions during which the assessments outlined above, and additional assessments not reported here, were completed. Families were reimbursed $50 plus a small gift for their child.

Interpretation bias task.

To begin the interpretation bias task, the experimenter introduced the participant to four dolls, two that represented 'mum' and 'dad' and two children named 'Jane' and 'Susan' (for female participants) or 'Bob' and 'George' (for male participants). Before beginning the practice story, the experimenter ensured that the child could recall the names of the characters. The experimenter then told the participant that they were going to tell

some stories together using the dolls and that she would start each story and the child would finish them. A practice story was then completed to introduce the task to the participants. The practice story-stem was: "Mummy has baked this beautiful cake and she calls out come on Grandma, come on Dad, come on boys/girls, let's have a party". As with all the story-stems, the experimenter then handed the story over to the child by saying "Show me what happens now". After successful completion of the practice story stem the experimenter then proceeded to the three ambiguous story-stems outlined above.

To ensure that the methodology was standardised across participants, the experimenter followed a detailed procedure and script that were pre-prepared. If the participant did not respond to the practice story or had difficulty understanding the task, the experimenter modelled the story telling procedure for the child. For the ambiguous story-stems, additional props were used. In the 'rock' story, a piece of green felt was used to represent the park and a rock was placed in the park. In the 'friends' story, four additional dolls were used to represent the group of children playing. During the ambiguous story-stems, the experimenter did not provide any assistance to the child in telling the story.

Coding

The story-stem task was filmed and subsequently coded by a graduate student in psychology, who was unaware of the participants' diagnoses and temperament group status. Each story was coded according to whether the overall interpretation was that the situation represented danger or threat (threat interpretation). Specific examples of responses coded as threatening and non-threatening are given in appendix 1. Threat interpretation was coded in 497 stories (82%) out of a possible 606. Missing data were due to technical problems with recording equipment, child task refusal and ambiguity of child

responses. A total threat interpretation score (0, 1, 2 or 3) was computed for all participants

with complete data. In total, 131 (65%) participants had complete data. Stories from 25% of

the participants with complete data were coded by a second rater who was also blind to the

participants' diagnoses and temperament group status. Inter-rater reliability for total threat

interpretations was ICC (2,1)= .818. There were no significant differences between

participants with complete data and incomplete data on temperament group based on STSC

score, χ^2 (1, N = 202) = .12, p = .74, ф = .002, temperament group based on observation, χ^2 (1,

N = 202) = .24, p = .62, ф = .003, sex, χ^2 (1, N = 202) = .54, p = .46, ф = .05, age, t (200) = .73, p

= .47, ф = .06, anxiety symptoms, t (196) = .63, p = .53, ф = .06, anxiety diagnoses, χ^2 (1, N =

202) = 0.36, p = .55, ф = .04, or ethnicity, χ^2 (1, N = 201) = 8.31, p = .14, ф = .20.

Longitudinal Follow-up

In addition to the baseline assessment in which participants completed all tasks,

participants were also assessed 12-months, two years and five years later. At two year

follow-up and five year follow-up, participants returned to the University for a 2-hour

research session during which the ADIS-P and symptom measures (PAS / SCAS) were

completed along with other assessments not reported here. At 12-month follow-up, the PAS

was completed by mail. Full assessments were not completed at 12-month follow-up to

ensure participants were not over-burdened and to keep attrition as low as possible across

the course of the study. Of the 131 participants who had complete data on the

interpretation bias task, 103 participated at 12-month follow-up (79%), 110 participated at

two-year follow-up (84%), and 104 participated at five-year follow-up (79%). There were no

significant differences between those who completed the follow-up at each stage and those

who did not on temperament group, child anxiety status, ethnicity or gender (p > 0.05), with

the exception of the 5-year follow-up when participants classified as behaviourally inhibited

at baseline were less likely to participate.

Results

Data preparation and preliminary analyses

Participants were divided into two anxiety groups according to whether or not they

met criteria for an anxiety diagnosis at baseline. Of the final sample of 131 participants, 74

met criteria for an anxiety diagnosis and 57 did not. Temperament group assignment was

based on the classifications made using baseline STSC score and observed temperament. Of

the sample of 131 participants, 46 were classified as inhibited on both parent-report and

observation and 54 were classified as uninhibited on both parent-report and observation.

Analyses involving temperament group were based on this subset of 100 participants; the

classifications for the remaining 31 participants were not consistent across parent-report

and observation.[1] Scores on the PAS and SCAS were positively skewed and were

transformed to approximate normality using a square root transformation. For all

regression analyses, the data were checked for multicollinearity. No evidence of

multicollinearity was found between the interpretation bias score and either baseline

anxiety measure or between temperament and baseline anxiety groups using the following

criteria; correlations < .65; tolerance >.6; VIF <2.

Based on the sample of 100 participants with complete data at baseline and a

consistent temperament group classification, 74% of the inhibited group and 17% of the

uninhibited group met criteria for an anxiety diagnosis at baseline. This represents a

significant between-group difference, χ^2 (1, N = 100) = 33.21, $p < .001$, $\phi = .58$. A significant

difference was also found between temperament groups on total PAS score, t (96) = 10.34, *p* < .001, *d* = 2.10.

Baseline analyses

Table 1 shows the percentage of participants in each group (anxiety group and temperament group) who made zero, one, two or three threat interpretations on the story-stem task. These figures suggest that participants who met criteria for an anxiety disorder were more likely to make threat interpretations than those who did not. There is also some suggestion for differences between temperament groups in number of threat interpretations made.

[Insert Table 1 here]

T-tests were conducted to examine differences between temperament groups and anxiety groups on interpretation bias. For temperament group, the between-group difference approached significance, t (98) = 1.72, *p* = .09, *d* = .34, with inhibited participants interpreting more stories in a negative way. The difference between anxiety groups was significant, t (129) = .004, *p* = .004, *d* = .51, with participants who met criteria for an anxiety disorder making significantly more threat interpretations than participants who did not. To examine the relationship between parent-reported anxiety symptoms and interpretation bias, bivariate correlations were calculated. No significant correlation was found between total PAS score at baseline and threat interpretation score, *r* = .13, *p* = .13.

A general linear model analysis using Type III Sums of Squares was used to examine the relative importance of temperament group and anxiety group as predictors of threat interpretation score at baseline. With threat interpretation score as the dependent variable

and anxiety group and temperament group as independent variables, there was a significant

effect of anxiety group, $F(1, 97) = 4.51$, MSE = 3.56, $p = .04$, partial $\eta^2 = .04$, but no significant

effect of temperament group, $F(1, 97) = .04$, MSE = .03, $p = .84$, partial $\eta^2 < .001$.

To examine whether interpretation bias was related to a specific anxiety disorder, a

series of t-tests were conducted. Participants who met criteria for social anxiety disorder

(N=27) were more likely to interpret the stories in a threat-related way than those who did

not but this difference was not statistically significant, $t(129) = 1.28$, $p = .20$, $d = .29$.

Similarly, participants who met criteria for separation anxiety disorder (N=22) made more

threat interpretations than those who did not but this did not reach significance, $t(129) =$

1.71, $p = .09$. A significant difference was found between participants who met criteria for a

specific phobia (N=39), with phobic participants making more threat interpretations, $t(129)$

$= 2.89$, $p = .005$, $d = .57$. Comparisons for other diagnoses were not possible due to the small

number of participants meeting criteria for a diagnoses (N<10).[2]

Longitudinal follow-up

To examine the longitudinal relationship between interpretation bias and anxiety,

after controlling for baseline anxiety, a series of multiple regressions and logistic regressions

were conducted with anxiety symptoms and anxiety diagnostic group as the respective

dependent variables. The corresponding measure of baseline anxiety was entered first into

each regression and interpretation bias score was then entered as a second step. Across all

analyses, a significant effect of baseline anxiety was found ($p < 0.05$); the results for

interpretation bias are reported below.

Although the response rate for each follow-up was good, there was some missing longitudinal data. Multiple imputation (Rubin, 1987; Sinharay, Stern, & Russell, 2001) was utilised to create 20 complete data sets (N=131). Baseline measures (child temperament group, PAS score, child anxiety and interpretation bias score) were used as independent variables only. PAS scores at 12-month and two-year follow-up, SCAS scores at five-year follow-up and child anxiety group at two-year and five-year follow-up were used as both independent and imputed variables. The analyses were run with both the original data and the imputed data (by examining the pooled results). No differences in patterns of significance were found. The results for the original data are reported here.

Clinical anxiety diagnosis.

To examine the relationship between interpretation bias and clinical anxiety diagnoses, two logistic regression analyses were conducted with anxiety status at two-year and five-year follow-up as dependent variables respectively. After controlling for the significant effect of anxiety status at baseline, there was no significant effect of interpretation bias on anxiety status at two-year, b = -.28, SE = .24, Wald = 1.30, df = 1, p = .26, OR = .76, or five-year, b = -.26, SE = .27, Wald = .94, df = 1, p = .33, OR = .77 follow-up.

Anxiety symptoms.

To assess the relationship between interpretation bias and anxiety symptoms, three multiple regression analyses were conducted with PAS score at 12-month and two-year follow-up and SCAS score at five-year follow-up as the dependent variables. After controlling for the significant effect of baseline anxiety, a significant effect of interpretation bias was found for anxiety symptoms at 12-month follow-up, F (1, 99) = 5.43, MSE = 4.80, p

= .02, partial η^2 = .05, but not at two-year, F (1, 113) = .05, MSE = .06, p = .82, partial η^2 < .001

or five-year, F (1, 95) = .02, MSE = .03, p = .89, partial η^2 < .001, follow-up. Examination of

parameter estimates showed that participants with higher PAS scores, b = .61, SE = .05, and

higher interpretation bias scores, b = .25, SE = .11, at baseline, had higher PAS scores at 12-

month follow-up..

To further explore the longitudinal relationship between interpretation bias and

anxiety at 12-month follow-up, Figure 1 shows PAS scores at baseline and 12-month follow-

up for participants who made: no threat interpretations, one threat interpretation and two

or more threat interpretations. Figure 1a shows the pattern for those participants who met

criteria for a clinical anxiety diagnosis at baseline and Figure 1b shows the pattern for

participants who did not meet criteria for an anxiety diagnosis at baseline. The pattern of

results suggests that participants who made no threat interpretations consistently showed a

decrease in anxiety from baseline to 12-month follow-up, whereas those who made one or

more threat interpretations remained stable or showed a slower rate of decrease. There is

no indication that anxiety increased in participants who made more threat interpretations,

regardless of their anxiety status at baseline.

[Insert Figure 1 here]

Discussion

The present research uses a novel methodology to assess interpretation bias in

preschool children and to explore the relationship between interpretation bias and anxiety

over time. There were four principal aims. The findings relevant to each aim will be

discussed in turn. The first aim was to pilot a new method of assessing interpretation bias in

preschool children. Whilst there is increasing evidence that anxious adults and school-aged

children are biased to resolve ambiguity in a threat-related way, there is a dearth of

research examining interpretation bias in young children. One of the primary reasons for

this is that the methodologies employed to assess interpretation bias in older children and

adults typically rely on self-report of reasoning, or priming paradigms that are not suitable

for young children (Field, et al., 2008). In the present research the story-stem paradigm,

initially developed to assess children's internal working models of their attachment

relationships (Bretherton, et al., 1990), was adapted to assess children's interpretation of

ambiguous stories. Three stories were used that were related to physical threat, social

threat or separation anxiety.

As a method for assessing interpretation bias in young children, the paradigm was

reasonably successful. The participants engaged with the task, willingly took part in the

story-telling process and responses could be reliably coded as indicating a threat or non-

threat interpretation. The main difficulty with the task was the number of stories that could

not be coded (18%). Although some of this missing data was due to technical problems with

recording equipment, it was more common for data to be missing because the child's

response was ambiguous. This was due, in most cases, to the child either not telling the

story out-loud or the child telling a story that appeared to be unrelated to the story-stem.

An example of the latter would be a child who ended the rock story by saying "then the rock

turned into a spaceship and flew off into outer-space". In this example, the child has not

resolved what would happen should the child doll want to climb the rock, which is the

premise of the story-stem. Any stories such as this could not clearly be coded as threat-

related or non-threat related and were, therefore, not given a code. Of the three stories, the

separation story caused the most confusion and resulted in the most missing data. This story-stem requires the participant to understand that, although they can see both the child and mother doll, the characters in the story are in different places and cannot see each other. This is a complex premise for preschool aged children and an alternative story-stem might be more appropriate in future research. Other recommendations for improvements to the task to minimise missing data in future research are: for the experimenter to tell the child initially that they are to tell the story out-loud using words as well as using the dolls; for this to be reinforced during the practice story; for the experimenter to remind the child of the task and encourage them to try the story-stem again if the child gives an irrelevant ending.

Behavioural Inhibition (BI) is one of the most consistently supported risk factors for child anxiety. Although recent research has begun to consider the role of cognitive biases in BI, there is a lack of research examining the relationship between BI and interpretation bias. Waters, Craske et al. (2008) argue that, if cognitive biases play a causal role in the development of anxiety, they might also be expected in at-risk populations. Consequently, the second aim of the present research was to examine whether behaviourally inhibited and uninhibited preschool children differed on interpretation bias. It was hypothesised that children classified as behaviourally inhibited would be more likely to end the ambiguous stories in a threat-related way than those who were classified as behaviourally uninhibited. The results provided only partial support for this hypothesis; although the BI group were more likely to interpret the stories in a threat-related way, the difference between temperament groups on interpretation bias did not reach statistical significance. This finding is consistent with previous research that has failed to find evidence of an interpretation bias

in other at-risk populations (Waters, Craske et al., 2008) but is somewhat inconsistent with recent findings of threat-related attention biases in adolescents classified as BI during childhood (Perez-Edgar, et al., 2010). Cognitive theories of anxiety propose that a common mechanism underpins attentional and interpretation biases (Mathews et al., 1997). Therefore it was anticipated that an interpretation bias would also be present in BI children. It is important to consider, however, that Perez-Edgar et al. (2010) assessed participants as adolescents. It is not clear, therefore, whether an attentional bias would have been present if the participants has been assessed at a younger age. Furthermore, Perez-Edgar et al. (2010) examined BI at multiple points during childhood and the *average* BI rating was associated with attentional bias. In the present study BI status was assessed at a single time point and at the same time as the interpretation bias assessment. It remains possible therefore, that interpretation bias might be related to the stability of BI across childhood. That is, those children classified as BI who also exhibited an interpretation bias may have been more likely to remain inhibited throughout childhood. This is an interesting question that could be explored in future research.

As discussed, clinically anxious children and adults are significantly more likely to interpret ambiguous stimuli in a threat-related way than healthy children and adults (Amir, et al., 1998; Eysenck, et al., 1991; Hadwin, et al., 1997). The third aim of the present research was to examine whether clinical anxiety in preschool aged children is associated with an interpretation bias. This is the first study to address this question. The results clearly demonstrated that participants who met criteria for a current anxiety diagnosis were significantly more likely to end the ambiguous stories in a threat-related way than those who did not meet criteria. These results support cognitive models of anxiety that purport

dysfunctional cognitions lie at the core of anxiety disorders (e.g. Beck, et al., 1985). A

significant relationship between interpretation bias and current anxiety was found even

when BI was controlled for. However, once anxiety was controlled for, there was no

significant relationship between BI and interpretation bias. This suggests that, although BI is

associated with the development of anxiety disorders, interpretation bias does not appear

to play a role in this temperament – anxiety relationship.

To examine whether threat interpretations were related to specific anxiety

diagnoses, we compared participants who met criteria for social anxiety disorder,

separation anxiety disorder and specific phobia with those that did not meet criteria for

each respective diagnosis. A significant difference was found only between participants that

met criteria for a specific phobia and those that did not. This provides some initial evidence

that threat interpretations might be closely related to specific phobias. An association

between specific phobia and threat interpretation has also been reported in previous

research, although a similar association was also found for generalized anxiety disorder

(Barrett et al., 1996). It is important to note that, in the present study, the power to detect

differences between groups was greatest for specific phobia. The effect sizes suggest that

some differences in threat interpretations may also be apparent for other anxiety

diagnoses, although these were not statistically significant in the present sample. This

finding therefore requires replication and should be interpreted with caution.

The final aim of this research was to examine whether interpretation bias plays a

role in the *development* of anxiety over time. Anxiety was assessed not only at baseline but

also 12-months, two years and five years later. It was hypothesised that participants'

interpretation bias at baseline would significantly predict anxiety diagnoses and symptoms

over time, after controlling for baseline anxiety. Overall, the results did not support this hypothesis. After controlling for baseline anxiety, interpretation bias was not significantly associated with anxiety symptoms two-years or five-years later and no significant association was found between interpretation bias and the presence of a clinical anxiety diagnosis at two-year or five-year follow-up. However, interpretation bias was significantly associated with parent-reported anxiety symptoms at 12-month follow-up, which provides some tentative support for a longitudinal relationship between interpretation bias and child anxiety. To examine the nature of this longitudinal relationship, the baseline and 12-month follow-up anxiety scores were plotted against interpretation bias for both anxiety groups (Figure 1). The pattern of results shown in this figure provides no indication that interpretation bias acts as a risk factor for increased anxiety over time; in neither the clinically anxious or healthy participants was interpretation bias associated with an increase in anxiety between baseline and 12-month follow-up. Instead, participants who made no threat interpretations showed a decrease in anxiety symptoms over time that was more rapid than any decrease shown by participants who made one or more threat interpretations, suggesting that interpretation bias is related to the maintenance of anxiety over time.

Overall, the pattern of results provides little support for the hypothesis that interpretation bias plays a causal role in the development of anxiety. This is largely consistent with the findings of previous longitudinal studies examining the relationship between interpretation bias and anxiety over time (Creswell & O'Connor, 2011; Creswell, et al., in press; Muris, et al., 2004) but conflicts with the findings of Wilson et al. (2006). In their study Wilson et al. showed that individuals trained to make threat interpretations show

larger increases in anxiety symptoms after a stressor than those trained to make benign

interpretations, suggesting that interpretation bias can play a causal role in the onset of

anxiety. There are a number of possible explanations for the inconsistency of these findings.

First, the study by Wilson et al. examined changes in anxiety mood state over a single

experimental session. It is certainly possible that interpretation bias can cause increased

anxiety and mood in the short-term but that these effects do not translate into stable

changes in anxiety symptoms and/or diagnoses over time. Another important consideration

is that Wilson and colleagues assessed anxiety following a stressor. It is possible that

interpretation bias interacts with environmental stress to predict changes in anxiety over

time. Additionally, a methodological factor that might also be relevant is the limited number

of story-stems used in the present research. Given the age of participants and the

exploratory nature of the task, we chose to only administer three ambiguous story-stems,

which gave limited scope for detecting individual differences in interpretation bias. It

remains possible, therefore, that this task was not sensitive enough to show a relationship

with anxiety over long-term follow-up. It would be useful for future research to consider

using more story-stems. A third consideration is that the subjects in the Wilson et al. study

were adults; it is plausible that interpretation bias plays a different role in adult anxiety than

in child anxiety.

Strengths and limitations

        A significant strength of the present research is the use of a method designed to

assess interpretation bias in preschool-aged children specifically, rather than relying on

existing measures that have been developed for older children or adults. However, the use

of a novel measure also raises a number of questions. For example, although the story-stem

paradigm has been used extensively to assess children's attachment relationships, we do not have data on the test-retest reliability or the construct validity of the story-stem paradigm for assessing interpretation bias. Importantly, however, the significant difference between anxiety groups on the interpretation bias tasks provides some initial support for the construct validity of the task. Other strengths of the present study include the lengthy longitudinal follow-up and the good retention rate for participants. In order to not over-burden participants, the 12-month follow-up was limited to questionnaire measures conducted by mail. As a result of this it is not clear whether the significant association between interpretation bias and anxiety symptoms at 12-month follow-up would have been supported by an association with clinical anxiety at this stage. Finally, by assessing interpretation bias in behaviourally inhibited and uninhibited children we were able to examine the relationship between interpretation bias and BI. However, by only including these two groups of participants the sample was not representative of the wider population. It will be important, therefore, for future research to replicate these findings with other samples.

Implications and future research

Overall the results suggest that, even in preschool children, anxiety is associated with an interpretation bias. There was some evidence that interpretation bias may play a role in the maintenance of anxiety symptoms over relatively short periods of time, but little evidence that interpretation bias plays a causal role in the onset of child anxiety. The findings are somewhat consistent with those of Warren et al. (2000) who used a story-stem paradigm with unambiguous stories and found a significant relationship between negative story endings and anxiety symptoms over 12-month follow-up. This raises the question of

whether interpretation bias for ambiguous stimuli can be distinguished from a general negative response style in preschool age children and, indeed, whether it is useful to make this distinction. An assessment that incorporates both ambiguous and non-ambiguous story stems would allow the discriminant validity of these measures to be assessed.

Although the present findings do not support the hypothesis that interpretation bias plays a role in the onset of anxiety, it remains possible that interpretation bias may interact with other risk-factors such as adverse parenting or life events, to affect anxiety over time. It will be important, therefore, for future research to include the interaction between cognitive bias and environmental stressors in longitudinal studies of anxiety development. Other important areas for consideration in future research are to further validate the use of the story-stem paradigm as a method for assessing interpretation bias in preschool children and to replicate the present findings in a sample representative of the typically developing population. As they stand, the present findings have preliminary implications for early intervention. Given that children who made fewer threat interpretations showed decreases in anxiety over time, it may be possible to use bias modification procedures to affect anxiety risk in young children. The story-stem paradigm itself might provide a useful context for this type of bias modification work in young children.

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Table 1

The percentage of participants in each anxiety group and each temperament group making

threat interpretations to story-stems

Number of threat interpretations	Anxiety group		Temperament group	
	No anxiety (N = 74)	Anxiety * (N = 57)	BI (N = 46)	BUI (N = 54)
0	20%	11%	15%	20%
1	42%	26%	22%	39%
2	31%	47%	50%	31%
3	7%	11%	13%	9%%

* significant between group difference in threat interpretations, $p < 0.05$

Footnotes

[1] The analyses were also conducted with the full sample of 131 participants using only parent-report groups. The results were consistent with those reported.

[2] To clarify the overlap between these diagnostic groups, the following patterns of comorbidity were observed: nine participants met criteria for Separation Anxiety Disorder, Social Phobia and Specific Phobia, two participants met criteria for both Separation Anxiety Disorder and Specific Phobia, four met criteria for Separation Anxiety Disorder and Social Phobia and eight met criteria for Social Anxiety Disorder and Specific Phobia. All remaining participants met criteria for just one anxiety disorder.
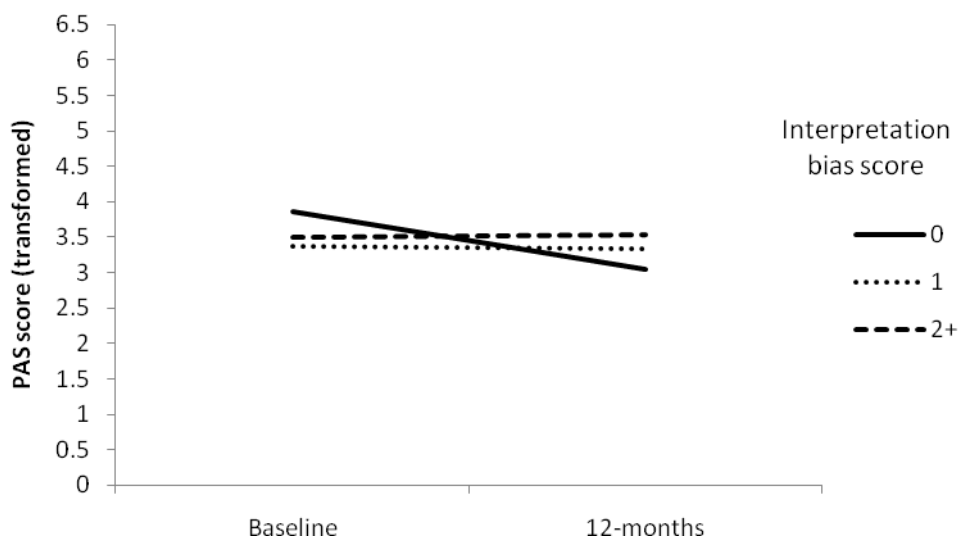
Figures

Figure 1: Change in PAS score between baseline and 12-month follow-up by interpretation bias group. A: Clinically anxious participants only. B: Non-clinically anxious participants only.

A
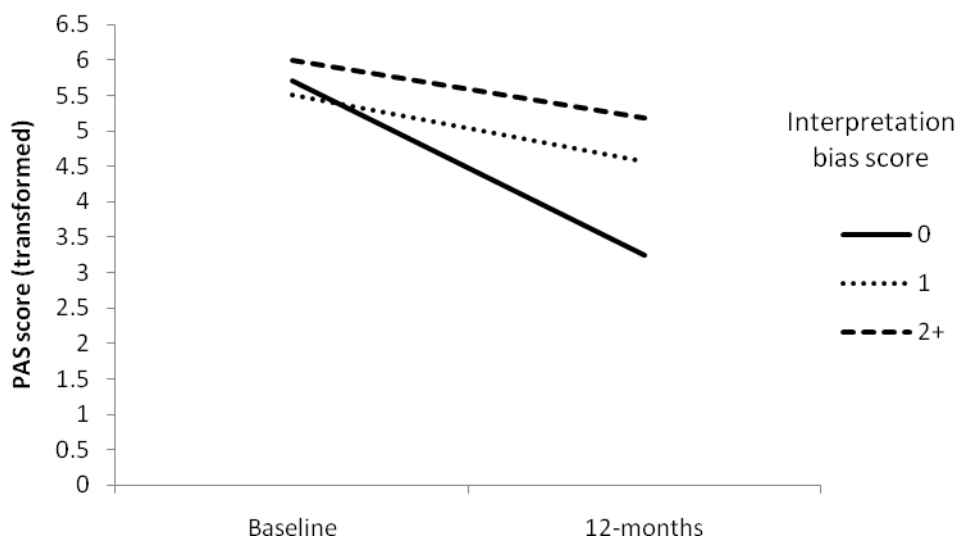
B

Appendix 1 - Examples responses and coding categories.

Threat examples:

- Rock – someone could get hurt, someone does get hurt, someone falls off, someone gets stuck at the top.

- Group of kids – the children laugh at the characters, physically hurt them or exclude them.

- Separation – mum has been hurt, mum has had an accident, mum has forgotten child.

Non-threat examples

- Rock –the rock is portrayed as something to climb up, have fun with, play on.

- Group of kids – the children are laughing together, telling a joke, having fun and are welcoming to characters.

- Separation – mum is stuck in traffic, left work late, has been busy and is running late.