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Attention Bias in Youth in Response to Maternal Behaviors: A Mobile Eye Tracking Study

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Abstract

Maternal behaviors often predict child behaviors, particularly anxious behaviors. Our study used mobile eye tracking technology to monitor the interactions between parent-child dyads during the preparation phase of a stressful, lab-based speech task. During this task, we coded for maternal warmth, intrusiveness, and quality of relationship. We hypothesized that children with mothers exhibiting low warmth, high intrusiveness, and low quality of relationship would spend a greater proportion of time fixating on the neutral judge versus the positive judge when proportions are compared out of total fixation time. Unexpectedly, children did not exhibit attention bias in response to exhibited maternal behaviors. However, the incorporation of eye tracking technology in this study was a novel approach to examine children's automatic responses to real-world situations involving potential threat and should be utilized in future research.

Attention Bias in Youth in Response to Maternal Behaviors: A Mobile Eye Tracking Study

Maternal behaviors have been shown to predict child behaviors, particularly anxious behaviors, during parent-child interactions. In a parent child task, warmth is defined as overall positive behaviors (i.e., smiling) and a general sense of affection (McLeod et al., 2007). When a mother exhibits high levels of warmth it comforts the child, encouraging feelings of safety (McLeod et al., 2006). The quality of relationship between mother and child is defined as positive interactions (i.e., smiling, joking, and active conversation) between dyad members (Creswell et al., 2013). A high-quality relationship between dyad members signifies that the mother does not induce stress in the child and therefore promotes a feeling of comfort and additionally offsets the effects of over control (McLeod et al., 2006). A strong relationship also inspires confidence in the planning process. Intrusiveness is considered a negative behavior consisting of verbal or physical interference in the completion of the task, appearing as the mother attempting to control the “agenda (McLeod et al., 2006).” High levels of intrusiveness cause a child to feel that her autonomy has been removed and she is no longer able to cope in stressful situations (McLeod et al., 2006; Rork et al., 2009). State anxiety is defined as anxiety induced during a certain activity as opposed to a clinical diagnosis of an anxiety disorder or chronically high levels of anxiety, also known as trait anxiety (Endler et al., 2001). Anxiety can be expressed by the mother in subtle ways throughout the lab-based tasks. Parental anxiety can be exhibited through fearful expressions or body movements such as fidgeting movements or lip biting (Murray et al., 2011). A mother with high state anxiety often models anxious behaviors. This modeling can lead the child to also view the situation as stressful, feeling that she is not able to succeed in the task on her own (van der Bruggen et al., 2008).

Specifically, research has shown that characteristics such as high levels of intrusiveness and a low-quality mother-child relationship leads to greater transference of negative emotions, such as fear, in a lab-based task (Creswell et al., 2013). Other researchers have found support for the role of maternal warmth in the transfer of negative emotions (i.e., anxiety) between mother and child, although this only accounts for a small percentage of the variance in child anxious behaviors (McLeod et al., 2006; Moore et al., 2004). There is also evidence that anxious parents predict that their children will display higher levels of anxious behaviors and avoidance in a stressful lab-based task (Cobham et al., 1999). Indeed, despite the likelihood of other influences on anxious child behaviors, maternal behaviors during parent-child interactions have been found in some studies to be the most salient predictor of anxious child behaviors (Whaley et al., 1999).

The impact of maternal behavior also extends into the visual attention of children. Social referencing studies have demonstrated that infants use positive parent cues, such as smiling, as encouragement to engage with novel toys (Walden et al., 1988). Other studies have shown that when infants are faced with a stranger, they are more likely to react fearfully if their mother initially acted fearfully toward the stranger (De Rosnay et al., 2006). These particular studies suggest that positive behaviors from parents increase the probability that a child will engage in a novel situation, while negative parenting behaviors may dissuade a child from comfortably engaging in novel tasks, which together could lead to fear and/or avoidance of ambiguous situations.

Attention bias is the propensity to selectively attend to negative or threatening information (Everaert et al., 2013). Theoretical work has suggested a link between this information processing bias and risk for anxiety disorders (Beck et al., 1997). Anxiety in adolescents is linked to a decreased ability to learn language and take part in social interactions

(National Scientific Council on the Developing Child, 2010). As anxious children transition to adulthood, they are less likely to have jobs or be enrolled in school, but more likely to exhibit psychological problems such as depression (Last et al., 2010). Therefore, it is important to investigate the link between maternal behaviors and attention bias.

The current study uses behavioral coding to evaluate the interactions between parent-child dyads as they prepare for a stressful, lab-based speech task. During this task, a trained team of coders rated maternal warmth, intrusiveness, quality of relationship, and adult state anxiety. We also use mobile eye tracking glasses in order to examine whether our parenting behaviors of interest were related to attention bias toward a potential threatening stimulus during an in vivo speech task. We hypothesized that children with mothers exhibiting high intrusiveness and anxiety, low warmth, and with whom they had a low-quality relationship would spend a greater proportion of time fixating on a potentially threatening judge during the speech task.

Methods

Participants

Participants were 92 mothers and their daughters that had been recruited through community and online announcements describing participation requirements with the goal of having a greater proportion of participants rating highly on fear and shyness scales. Child participants were recruited solely based on birth assigned gender as reported by parents; gender identity was not taken into account. Girls were chosen to fully compose the sample because they have an increased risk of presenting heightened emotional and social sensitivity (Rudolph et al., 2016; Guyer et al., 2008). Additionally, adolescent girls are at a higher risk for anxiety (Mcrikangas et al., 2010). Prior to the lab tasks, children were given the Early Adolescent Temperament Questionnaire- revised (EATQ-R) which was created to measure the level of

reactivity and temperament traits that a child possessed (Ellis et al., 2001). Children scoring .75 SD's above the mean or more on the shyness (3.16 for child-report, 2.99 for parent report) or fear scale (3.48 for child report, 3.12 for parent report) were considered high risk. Participants scoring below .75 SD's from the mean were considered as part of the low-risk participant group (Muris et al., 2009). From child scores it was determined that the group consisted of 30 low risk participants and 62 high risk participants. Inclusion criteria were that children had to be between the ages of 11 and 14 years, have an IQ greater than 70 (as assessed via the Wechsler Abbreviated Scale of Intelligence), have no serious medical problems, no diagnoses of an anxiety disorder as determined by the DSM-5, or previous diagnosis of a psychotic or autism spectrum disorder, not be pregnant, and able to pass a drug test. Additionally, children were excluded if they took medication that affected their nervous system or had conditions that affected their ocular abilities and prevented proper use of the eye tracking glasses. Child participants were all female with a mean age of 12.3 (SD= .8). Out of the 92 participants, 22.8% identified as Black, 1.1% identified as Asian, 68.5% identified as White, and 7.6% identified as Biracial. The mean income, as reported by parents through an 11-point interval scale, was \$105,740.30 (SD= \$62,080.10).

Attention Speech Task

There are two phases of the attention speech task, a discussion or preparation phase and a speech phase. The discussion phase has a duration of 2 minutes, and it allows the child to prepare for a 2-minute speech that will take place in front of two trained judges (study confederates). The participants were instructed to prepare to present a speech talking about why they should be chosen to participate in a reality TV show for teenagers. During the 2 minutes the mother is

allowed to assist the child in preparing, but she is told to only help if her daughter needs it, and she is not given any instructions on how to help.

In the speech task portion of the attention speech task, child participants are asked to give a 2 minute speech in front of two judges, unbeknownst to them, the judges are study confederates trained to deliver certain behaviors based on their assigned role: the positive judge smiles and nods her head at regular intervals and one ambiguous judge keeps a neutral expression throughout and looks around the room and shuffles her feet at designated intervals. The judges, all adult females, were seated side-by-side, 8 feet from the participant during the delivery of the speech. The positions of the judges (left vs. right) were counterbalanced. Mothers remained in the room during the speech but were set behind their child's line of sight. They were told to help if their child needed it, but that the task was for their child to complete. Following the completion of the speech, judges gave participants scripted positive feedback to minimize any potential participant discomfort.

Behavioral Coding

Coders trained to reliability followed an established protocol to assess maternal behavior (warmth, intrusiveness, and quality of relationship) during the discussion task (Murray et al., 2011). All behaviors were rated on a 5-point Likert scale (1 = none, 5 = pervasive/strong). All scales were rated for each of the 2 minutes and an average was then calculated. The coding team consisted of undergraduate research assistants in the laboratory who were trained by a graduate student to within 80% reliability before beginning to code independently. A random sample of 33% of the discussions and speeches were double coded in order to ensure reliability. Inter-rater reliability was assessed for each of the behavior scales. Koo et al. (2016) found good reliability to be between the values of 0.75 and 0.90 and poor reliability to be values less than 0.50 (Koo et

al., 2016). Reliability was found to be good for the majority of variables with scores of .80 for Warmth, .81 for Quality of Relationship, and .78 for Intrusiveness. Maternal Anxiety was found to have poor reliability with a value of 0.44. The distribution of scores on each scale was then reviewed for normalcy and tested for skewness and kurtosis. The scale for trait anxiety was found to have values of 2.61 for skewness and 5.84 for kurtosis. It was then removed based on 77 out of 92 mothers reporting a score of 1 on the Likert scale. The other scales were found to be within the acceptable range for skewness and kurtosis. Warmth had a skewness of -.78 and a kurtosis of -.11. Intrusiveness had a skewness of 2.64 and a kurtosis of 8.15. Quality of Relationship had a skewness of -1.08 and a kurtosis of .65.

Eye Tracking

Each participant is wearing Tobii Pro Glasses 2 to continuously measure their eye gaze during the speech phase of the Attention Speech Task. Accuracy tests were completed in order to certify that the average distance between the measured gaze location and target location is 0.62° (Tobii 2017). Data received from the eye tracking glasses was processed with the Tobii Pro Glasses Analyzer with the addition of a filter to classify eye movements into fixations. A fixation was defined as a set of consecutive raw data points with a velocity below $30^\circ/s$ that had a duration of 100ms or more. The fixations to areas of interest (AOI's) were mapped through Tobii's real-world mapping function by using algorithms that take into account slippage and parallax error. AOI's were drawn around the body and face of each judge, and Tobii software was able to distinguish whether each fixation was on the positive judge, ambiguous judge, or elsewhere. In order to achieve accurate mapping, the raw gaze data was superimposed by the automated mapping procedure into a still photo of the two judges. This image is made by utilizing a representative frame from each participant's glasses camera. In order to ensure

accuracy, a research assistant evaluated, frame-by-frame, the accuracy of the automatically mapped data and the actual captured data. Any discrepancies due to participant movement were manually corrected by the research assistants. The calculated proportion Neutral/Total signifies the time the child participant spent fixated on the neutral judge divided by the total time the child spent with her gaze fixated on both the positive and neutral judge.

Results

The mean of warmth was 3.6 (SD= 1.1), Intrusiveness yielded a mean of 1.4 (SD= 0.8), and Quality of Relationship had a mean of 4.2 (SD=1.0). All correlations with regards to the variables of interest and controls are depicted in Table 1. Controls were chosen due to the supported influence of income on mental health (Bøe et al., 2011) and the age of children was accounted for due to its impacts on maternal behavior (Dix et al., 1986).

Table 1: *Correlations for Variables of Interest*

	Warmth	Intrusiveness	Quality	Neutral/Total	Age
Warmth					
Intrusiveness	.02				
Quality	.65**	-.08			
Neutral/Total	.02	.01	-.07		
Age	0	-.12	-.16	-.08	
Income	.18	.02	0	.20	.07

** Signifies significance at the .01 level.

Quality refers to the variable Quality of Relationship. The calculated proportion Neutral/Total signifies the time the child participant spent fixated on the neutral judge divided by the total time the child spent with her gaze fixated on both the positive and neutral judge. Age describes the baseline age of the child participants and income is the total household income for the family.

Contrary to our hypothesis, the correlations lacked significance when related to the proportion of time the child spent with their gaze fixated on the neutral judge. However, Quality of Relationship and Warmth were positively correlated. Below, Tables 2, 3, and 4 depict the regression analyses with the control variables and each of the parenting variables predicting proportion of time spent fixated on the neutral judge.

Table 2: *Regression Analysis: Warmth and Neutral/Total Fixation with Subject Controls*

Effect	Estimate	SE	95% CI		p
			LL	UL	
Constant	.97	.51			.059
Total Family Income at Baseline	.03	.01	6.38	7.71	.019
Subject Age at baseline	-.06	.04	12.16	12.50	.166
Warmth	.01	.03	3.40	3.87	.863

Table 3: *Regression Analysis: Intrusiveness and Neutral/Total Fixation with Subject Controls*

Effect	Estimate	SE	95% CI		p
			LL	UL	
Constant	.98	.52			.063
Total Family Income at Baseline	.03	.01	6.38	7.71	.017
Subject Age at baseline	-.06	.04	12.16	12.50	.175
Intrusiveness	0	.04	1.24	1.56	.924

Table 4: *Regression Analysis: Quality of Relationship and Neutral/Total Fixation with Subject Controls*

Effect	Estimate	SE	95% CI		p
			LL	UL	
Constant	1.19	.54			.031
Total Family Income at Baseline	.03	.01	6.38	7.71	.014
Subject Age at baseline	-.06	.04	12.16	12.50	.131
Quality of Relationship	-.03	.03	3.96	4.37	.348

Again, contrary to our hypothesis, the primary variables (i.e. Warmth, Intrusiveness, and Quality of Relationship) did not predict percentage of time spent looking at the neutral judge. However, family income did serve as a positive predictor for the proportion of time the children spent looking at the neutral judge.

Discussion

Additional research will help us better understand the impact of parenting behaviors and the development of risk factors for anxiety in their children. Results indicated that children with mothers exhibiting low warmth, high intrusiveness, and low quality of relationship did not spend a greater proportion of time fixating on the neutral judge versus the positive judge. That is, contrary to our hypothesis, children did not exhibit an attention bias in response to the maternal behaviors of interest. However, results indicated that children with a higher family income spent a greater proportion of time looking at the neutral judge when compared to children with a lower family income. Lower economic status is generally linked to poorer mental health outcomes (i.e., higher attention problems and increased emotional regulation issues), so these findings are unexpected (Bøe et al., 2011). The connection between income and attention bias has not undergone in depth research and should be studied in relation to children, as opposed to current research involving adults. Although, it is important to note that this research did find a positive relationship between anxiety and attention bias in low-income mothers (Finegood et al., 2017).

The lack of support for our hypotheses could be due to the amount of time it takes for maternal behaviors to manifest in gaze. Our study did not allow time for attention to be affected by maternal behaviors because the speech came directly after the discussion phase. The sample was also a partially low and partially high-risk group that excluded children with diagnosed anxiety disorders, so this would be considered a non-clinical sample. Attention bias is generally associated with higher levels of anxiety, so its lack of significance may correlate with low anxiety. Future research may want to reevaluate this study with a more anxious sample and examine the correlation between child anxiety, maternal behavior, and attention bias. Although attention bias is a risk factor for anxiety, a limitation of this study is that it did not directly

compare anxiety in children with the other measured variables. Future research should also further evaluate the relationship between mental health outcomes and income level. An upbringing in a low-income family with higher daily stress, could lead to a child more quickly needing to adapt and avoid situations and objects that could be threatening. In contrast, a higher income could lead children to not view the same situations as threatening, so future research may also want to evaluate the role of interpretation bias, the tendency to interpret ambiguous information as threatening (Quigley et al., 2012).

The incorporation of eye tracking technology in this study was a novel approach to examine children's attention to real-world situations involving potential threat. Also, novel was the examination of maternal behaviors in combination with child eye gaze. There is limited research examining the connection between behaviors exhibited by mothers and the resulting attention bias gaze fixation of their child. This eye tracking methodology may enhance future research exploring attention bias in anxious or fearful children and family risk factors.

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