Title: **Ghosts in the nursery: An experimental investigation of a parent's own maltreatment experience, attention to infant faces, and dyadic reciprocity.**

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Abstract

Previous studies have shown that the experience of childhood maltreatment can influence recognition and processing of emotional cues and that these effects can extend into adulthood. Such alterations in cognitive processing may have important implications for processing of infant affect and parenting behaviour. This study investigated whether the experience of childhood maltreatment altered attentional processing of infant faces in a community sample of mothers, using an established visual search task. Increased scores on a measure of childhood maltreatment were associated with decreased preferential "bias" towards infant faces (indexed by slower RTs to infant as compared to adult faces). Exploratory analysis of the relationship between attentional processing and actual 'own child' parenting behaviour (as measured by a video-recorded mother-child interaction) found that lower attentional bias to infant faces mediated the relationship between higher levels of childhood maltreatment and lower levels of mother-infant dyadic reciprocity. This suggests that childhood maltreatment may have enduring effects on the preferential processing of infant cues as well as parenting behaviour.

Keywords

Attention; face processing; maltreatment; mothers; parenting.

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No conflict of interest.

Introduction

The experience of maltreatment during childhood is associated with a range of enduring developmental consequences, across behavioural, emotional, and social domains (e.g. Cicchetti & Toth, 2005; Gilbert et al., 2009; McCrory, De Brito & Viding, 2010). The deleterious effects associated with childhood maltreatment can also be seen in adulthood, including an impact on adult parenting (Bailey et al., 2012; Belsky, 1984). Parents who experienced maltreatment during childhood show lower parental competence, less effective parenting styles, lack of emotional availability, and respond less sensitively towards their children (e.g. Bailey et al., 2012; Barrett, 2009; Fraiberg, Adelson & Shapiro, 1975; Moehler, Biringen, & Poustka, 2007; Newcomb & Locke, 2001; Newcomb & Locke, 2001). There is a small but reliable intergenerational pattern of risk, such that a minority of parents who have experienced maltreatment go on to maltreat their own children (e.g. Berlin, Appleyard, & Dodge, 2011; Egeland, 1993; Pears & Capaldi, 2001). What is less clear is how maltreatment experience impacts specific cognitive mechanisms that underpin adaptive parenting behaviour.

It is well established that maltreatment in childhood can alter the processing of affective cues, although much of the research has focused on negative emotions, particularly anger (da Silva Ferreira, Crippa, de Lima Osório, 2014; Pollak, 2012). For example, maltreated children are more likely to interpret ambiguous facial expressions as angry (Pollak & Kistler, 2002), and show attentional biases (rapid orientation and delayed disengagement) for angry faces (Pine et al., 2005; Pollak & Tolley-Schell, 2003). It has also been found that maltreated children detect anger on the basis of less sensory input than non-abused children, but struggle to identify sadness compared to non-abused children (Pollak, Cicchetti, Hornung & Reed, 2000;

Pollak & Sinha, 2002). Pollak and colleagues (2000) found that neglected children had more difficulty than controls and physically abused children in discriminating between different a range of different emotional expressions, but in particular were less accurate in recognising anger and were more sensitive to identifying sadness. Converging electrophysiological and neuroimaging studies have found that maltreated children exhibit greater neural responses in reaction to negative emotions, especially anger (da Silva Ferreira et al., 2014; McLaughlin et al., 2015).

These alterations in basic affective processes have also been shown in adults who have experienced childhood maltreatment (Dannlowski et al., 2012; Dannlowski et al., 2013; Grant et al., 2011). Dannlowski and colleagues (2013) found a strong association between scores on a measure of childhood trauma and amygdala responsiveness to sad but not happy facial expressions. However, Fani and colleagues (2011) found that adults with a history of childhood maltreatment demonstrated attentional biases to happy faces but not threatening faces (Fani et al., 2011). Another study found that mothers with a history of physical abuse in childhood showed increases in skin conductance while viewing video clips of a smiling infant but not while viewing a crying infant, whereas mothers without a history of abuse showed the opposite pattern of results (Casanova, Domanic, McCanne, & Milner, 1994). These authors suggest that women with a history of abuse may be less sensitive to infant negative emotional states, while happy expressions cause physiological arousal.

Alterations in processing negative emotions may be adaptive for children who grow up in threatening environments to develop increased sensitivity to negative emotional cues, as this may facilitate appropriate avoidance responses, while biases towards positive information may help increase salience of environmental resources (Fani, Bradley-Davino, Ressler, & McClure-Tone, 2011; Pollak, 2012). Conversely,

Fani and colleagues (2011) suggest that individuals who have experienced maltreatment may interpret happy or neutral faces as masks for more malevolent emotions and so allocate more attention towards them (Pollak, 2000). However, any biases towards or away from particular emotional stimuli may become maladaptive if they are regularly applied in non-adverse environments that do not necessitate such processing biases (McCrory & Viding, 2015). In particular, it remains unclear whether alterations in processing emotional facial cues generalise to adults with childhood experiences of maltreatment who have become parents, when they process infant cues. Allocation of attention to infant facial cues is an important prerequisite for sensitive parenting, which involves the ability to recognise, discriminate between, and then respond appropriately to infant cues (Ainsworth, Blehar, Waters, & Wall, 1978; Ferrey et al., 2016).

Previous studies of typical parents have found that compared to non-parents, attention is more engaged by infant faces compared to adult, adolescent, and pre-adolescent faces, particularly when the infant faces display emotional expressions (Pearson et al., 2010; 2013; Thompson-Booth et al., 2014a,b). However, it has also been found that symptoms of depression are associated with a reduction in attentional allocation to infant faces (Pearson et al, 2010; 2013; although see Thompson-Booth et al., 2014a). An enhanced allocation of attention to infant faces has been interpreted as an adaptive cognitive mechanism that contributes to sensitive parenting behaviour by ensuring that parental attention is preferentially allocated to those individuals most in need of care and nurturance. Such findings are also in line with interventions that focus on promoting sensitive parenting by training parents how to accurately perceive, interpret, and respond to their child's emotional and behavioural signals (Bakermans-Kranenburg, van IJzendoorn, & Juffer, 2003; Juffer, Bakermans-

Kranenburg, & van IJzendoorn, 2008; 2014). It follows then that if attentional processing of infant cues is impaired, parents may not be able to appropriately and sensitively interpret and respond to such cues, which in turn may adversely impact parenting behaviour.

To date no behavioural study has investigated whether mothers with maltreatment histories show the typical pattern of preferential attentional processing of infant faces. Furthermore, it is not known whether any alterations in attentional processing influence observable parenting behaviour. In order to address these questions, the current study recruited a group of mothers and using an established visual search paradigm (Hodsoll, Viding & Lavie, 2011; Thompson-Booth et al., 2014a,b) and a standardised measure of dyadic parenting behaviour (Feldman, 1998) investigated the impact of childhood maltreatment on: (i) the attentional processing of infant and adult faces, and (ii) the relationship between attentional processing of infant faces and 'own child' dyadic parenting behaviour. It was hypothesised that higher levels of childhood maltreatment would be associated with reduced attentional bias to infant faces. This was expected given the existing literature indicating that adults who have experienced childhood maltreatment have altered processing of emotional cues, which we theorise may extend to non-affective cues indexing vulnerability including infant status. Current symptoms of depression were also measured, as previous studies have shown that depression may impact on attentional processing of infant faces (Pearson et al., 2010; 2013). Secondly, in view of the importance of cue detection in dyadic interaction (Ainsworth et al., 1978; Bakermans-Kranenburg et al., 2003; Kalinauskiene et al., 2009) it was hypothesised that a failure to preferentially attend to infant faces would be associated with compromised parenting responses when mothers interacted with their own infants.

Methods

Ethical considerations

Ethical approval was obtained from Yale University Human Investigation Committee and written consent was obtained from all participants.

Participants

Forty-seven women with a child aged 3 years old or under were recruited from a participant database and from flyers distributed in the New Haven community. Participants were compensated $40 for participation. Five women were excluded from task analysis due to incomplete data or high error rates (>40%). All women were right-handed, reported normal or corrected-to-normal vision, and screened negative for recent drug use. The sample was racially diverse (61.9% White, 31.0% African American, 2.4% Hispanic, 4.8% mixed race). Participants were aged between 17 and 41 years old (M=29.10, SD=5.67). The sample included first time mothers (52.4%) and those with more than one child (42.9%). Participant demographics can be found in the appendix.

Questionnaire Measures

Assessment of history of childhood maltreatment

Participants were asked to complete the Childhood Trauma Questionnaire (CTQ; Bernstein & Fink, 1998). This 28-item self-report questionnaire measures five subscales of maltreatment on a scale from 1 (never true) to 5 (very often true); Physical abuse, Sexual abuse, Emotional abuse, Physical neglect, and Emotional neglect. Scores on each subscale range from 5-25, with higher scores indicating more severe maltreatment. A total score can be calculated by summing scores from the five

subscales. The CTQ is psychometrically sound in community and clinical samples, has good internal and test-retest reliability, as well as convergent and divergent validity with other measures of trauma (Bernstein et al., 2003; Paivio & Cramer, 2004). In the current study, Cronbach alpha across all items in the CTQ was .85 (for each subscale: Emotional abuse α=.88; Physical abuse α=.88; Sexual abuse α=.96; Emotional neglect α=.88, Physical neglect α=.78).

Assessment of symptoms of depression

Participants completed the Beck Depression Inventory (BDI-II; Beck et al., 1996), a 21-item self-report questionnaire designed to assess the intensity of symptoms of depression. The BDI has been shown to have high internal consistency, excellent internal reliability, good test–retest reliability, and correlates with other measures of depression (Beck et al., 1996; Beck, Steer & Garbin, 1988). In the current study, Cronbach alpha across all items for the BDI was .89.

Measure of parenting behaviour

A ten-minute free play interaction between each mother and their infant was recorded. These interactions were coded according to the Coding Interactive Behaviour Manual (CIB; Feldman, 1998). The CIB is a rating system that consists of 45 codes (22 for parents, 16 for infants, 5 for dyads, and 2 overall), each rated on a 5-point scale ranging from 1 (*low*) to 5 (*high*). Codes are averaged into six composites. The CIB has been validated in normative and at-risk samples from birth to adolescence (Feldman, Greenbaum, Mayes, & Erlich, 1997; Keren, Feldman, & Tyano, 2001).

A coder trained to 90% reliability by the CIB author coded all the interactions, and 31 (66%) of these interactions were additionally coded by a second coder trained

to 90% reliability and unaware of participant grouping. Inter-rater reliability ranged from intraclass r=.72 – r=.93. The composite measures of interest in this study were Sensitivity (internal consistency α=.95) and Dyadic Reciprocity (internal consistency α=.90), as two measures of maternal sensitivity. Codes that make up the Sensitivity composite are characterised by: acknowledgement of child signals, visual contact, positive affect, resourcefulness in handling the interaction, and consistency. The codes that make up the Dyadic Reciprocity composite are: mother and child engaging in a give-and-take play/conversation, a synchronous interaction, and an atmosphere that is not tense.

Computer task

An established visual search task (Hodsoll et al., 2011; Thompson-Booth et al., 2014a, b) was used. Participants were asked to select one "odd" face out among three faces according to eye color. This task has been previously shown to enable a reliable indexing of enhanced attention to facial affect and infant status (Thompson-Booth et al., 2014a, b). It is hypothesised that facial affect and infant faces are sufficiently salient to involuntarily engage attention, slowing reaction time in the visual search task.

Stimuli in this task were color images of **White** male and female infant and adult faces. There were images of each identity showing neutral, sad, and happy facial expressions. In a preliminary study, 14 individuals who did not take part in the main study rated all images for age, valence, arousal, and vulnerability on a scale of 1–5 (see Thompson-Booth et al., 2014b). Images were edited so that each identity displayed blue eyes on some trials (when target) and brown eyes on other trials (when non-target), and eye-size (measured in pixels) was matched across stimuli. The

dimensions of the stimuli and arrangement on screen were identical to that previously reported in Thompson-Booth et al. (2014b).

Procedure

Questionnaire measures were administered first, followed by the computerised task and ten-minute video-taped free-play interaction session. The computer task was conducted using a Sony Vaio Windows 7 PC laptop with 2.4-GHz Intel Core Duo processor and 13" wide screen monitor (60 Hz, 1366 x 768 resolution). Stimuli were presented and RTs recorded using Psytools software (Delosis Limited).

Trials were blocked by face age and emotion, with the order counterbalanced across participants. Each block consisted of 96 trials; within each block one half of the trials were neutral conditions (no emotional faces present). On the other half of the trials an emotional expression was present; in half of these (24 trials) the emotional expression was present on a non-target face and in the other half the emotional expression was present on the target face. Taking all the conditions together, a 2 (Face Age: Infant and Adult) x 2 (Emotional condition: Happy and Sad) x 3 (Search condition: Emotional target, emotional non-target, and all neutral) repeated-measures design was employed, resulting in 12 experimental conditions. Randomisation criteria of conditions, face identities, task timings, and task instructions were the same as those reported in Thompson-Booth et al. (2014a,b). Anticipatory (<150 ms) responses (.02%) and incorrect responses (5.5% of total trials) were excluded from the reaction time (RT) analysis. Outliers (2.5 SDs from mean) were calculated for each participant's range of RTs and removed from analysis (2.5% of total trials), and mean correct RTs for each experimental condition were then calculated for analysis.

Results

A repeated-measures 2x2x3 ANCOVA was conducted on the RT data, in relation to Age (infant vs. adult), Emotion (happy and sad) and Search condition (emotional target, emotional non-target, all neutral), exploring all main effects and interactions among variables. CTQ total maltreatment score was mean centred and then entered as a covariate in the model. Effect sizes are reported as partial eta squared (η_p^2) and significant effects are followed up with post-hoc pairwise comparisons with Bonferroni correction applied. Means and standard errors of reaction times are presented in Table 1. Descriptive statistics for questionnaire measures can be found in Table 2.

[Insert Table 1 here]

Main Effects

A main effect of face age was found ($F(1, 40) = 9.20$, $p<.01$, $\eta_p^2=.19$), with slower RTs to infant compared to adult faces. A main effect of emotion was also found ($F(1, 40) = 10.88$, $p<.01$, $\eta_p^2=.21$), with slower RTs to happy compared to sad faces. There was also a main effect of condition (Greenhouse-Geisser adjusted $F(1.56, 62.55) = 186.54$, $p<.001$, $\eta_p^2=.82$). Post-hoc pairwise comparisons indicated that RTs were slower in emotional target conditions than in emotional non-target conditions (mean RT difference=126 ms, $p<.001$, $d=2.52$, 95% CI for difference lower: 105ms, upper: 146ms) and neutral conditions (mean RT difference=120 ms, $p<.001$, $d=2.54$ 95% CI for difference lower: 99ms, upper: 141ms). There was no significant main effect of CTQ score ($F(1, 40) = 3.27$, $p=.08$, $\eta_p^2=.08$).

Interactions

There was a significant interaction between face age and maltreatment score ($F(1, 40) = 3.93$, $p=.05$, $\eta_p^2=.09$). Figure 1 shows that for lower CTQ scores, RTs are slower to infant faces than adult faces, but this RT difference appears to decrease as CTQ scores increase. This interaction was probed further by investigating the effect of face age at CTQ score values one standard deviation above and below the mean (see Aiken & West, 1991). At one standard deviation below the mean, the difference between infant and adult faces was significant (mean difference = 65.77, p<.001, 95% CI for difference lower: 28.25, upper: 103.30, d=-0.75). At one standard deviation above the mean, the difference between infant and adult faces was no longer significant (mean difference = 13.38, p=.48, 95% CI for difference lower: -24.15 upper: 50.90, d=-0.15). Tests of the simple slopes revealed that there was an effect of face age on RTs at the mean CTQ score (B=39.57, t=2.22, p<.05). There was also an effect of face age at one standard deviation below the mean CTQ score (B=65.47, t=2.59, p<.01), but no effect of face age at one standard deviation above the mean CTQ score (B=13.68, t=.54, p=.59). These results indicate that as CTQ score increases, the difference in RT between adult and infant faces decreases and is no longer statistically significant.

There was no significant interaction between face age and emotion ($F(1, 40) = .007$, $p=.934$, $\eta_p^2=.00$), nor between emotion and CTQ score ($F(1, 40) = 1.67$, $p=.20$, $\eta_p^2=.04$) and there was no significant three-way interaction between face age, emotion, and CTQ ($F(1, 40) = .003$, $p=.955$, $\eta_p^2=.00$).

There was a significant interaction between face age and condition ($F(2, 80) = 3.31$, $p<.05$, $\eta_p^2=.08$).Post-hoc comparisons with Bonferroni corrections revealed that

RTs were significantly slower to infant than adult faces in neutral conditions (mean RT difference=43.03 ms, p<.001, d=0.52, 95% CI for difference lower: 18.29ms, upper: 67.77ms) and emotional target conditions (mean RT difference=56.29 ms, p<.01, d=0.44, 95% CI for difference lower: 20.11ms, upper: 92.47ms), but RTs did not significantly differ by face age in emotional non-target conditions (mean difference=19.41 ms, p=.23, d=0.19, 95% CI for difference lower: -12.63ms, upper: 51.45ms).

There was also a significant interaction between condition and CTQ score (F(2, 80) = 5.22, p<.01, η_p^2=.12; see Figure 2). Simple slope analysis revealed that there was an effect of search condition at the mean CTQ score value (B=60.19, t=5.64, p<.001), at one standard deviation below the mean CTQ score value (B=54.24, t=3.57, p<.001), and at one standard deviation above the mean CTQ value (B=66.13, t=4.36, p<.001). This was probed further by investigating the effect of condition at CTQ score values one standard deviation above and below the mean (see Aiken & West, 1991). At one standard deviation below the mean, RTs were significantly slower in emotional target condition as compared to neutral conditions (mean difference = 108.47, p<.001, 95% CI for difference lower: 84.45, upper: 132.49, d=-2.44) and emotional non-target conditions (mean difference = 101.45, p<.001, 95% CI for difference lower: 77.92, upper: 124.97, d=-1.98). At one standard deviation above the mean, RTs were significantly slower in emotional target condition as compared to neutral conditions (mean difference = 132.27, p<.001, 95% CI for difference lower: 108.25, upper: 156.29, d=2.97) and emotional non-target conditions (mean difference = 149.56, p<.001, 95% CI for difference lower: 126.03, upper: 173.08, d=-2.92). RTs were also slower in neutral conditions than in emotional

non-target conditions (mean difference = 17.29, p<.05, 95% CI for difference lower: 2.75, upper: 31.83, d=0.51).

There was no significant three way interaction between face age, condition and CTQ score ($F(2, 80) = .04$, $p=.96$, $\eta_p^2=.001$).

There was a significant interaction between emotion and condition (Greenhouse-Geisser adjusted $F(1.72, 68.96) = 29.23$, $p<.001$, $\eta_p^2=.42$). Post-hoc pairwise comparisons with Bonferroni corrections applied found that RTs were slower to happy than sad faces for emotional target conditions (mean RT difference=92.43 ms, $p<.001$, $d=0.94$, CI for difference lower: 63.04ms, CI for difference upper: 121.81ms). However, RTs did not significantly differ between happy and sad faces for either emotional non-target (mean RT difference=7.09 ms, $p=.56$, $d=0.09$, CI for difference lower: -17.42ms, CI for difference upper: 31.61ms) or neutral search conditions (mean RT difference=17.54 ms, $p=.23$, $d=0.20$, CI for difference lower: -11.72ms, CI for difference upper: 46.80 ms).

There was no three way interaction between emotion, condition and CTQ score (Greenhouse-Geisser adjusted $F(1.72, 68.96) = 1.91$, $p=.161$, $\eta_p^2=.05$), nor between face age, emotion and condition (Greenhouse-Geisser adjusted (1.72, 68.60) = .537, $p=.587$, $\eta_p^2=.013$). Finally, there was no four way interaction between face age, emotion, condition, and CTQ score (Greenhouse-Geisser adjusted $F(1.72, 68.60) = 2.570$, $p=.09$, $\eta_p^2=.06$).

Including depression as a covariate

The repeated measures ANOVA was re-run with total BDI score (mean centred) as a covariate. There was no main effect of BDI score on RTs ($F(1, 39) = 1.11$, $p=.30$), BDI score did not interact with any other variables.

Parent Sensitivity and Dyadic Reciprocity

Table 2 shows the scores on the Parent Sensitivity and Dyadic Reciprocity measures. Associations between these two measures, scores on the CTQ, and attention to infant faces were tested using two-tailed Pearson correlations. An "attentional bias to infant faces" index was created by subtracting RTs to adult faces from RTs for infant faces for each participant. The results of the correlation analysis are shown in Table 3. Because Parent Sensitivity did not significantly correlate with maltreatment score, analyses were only run to explore the potential factors mediating the association between childhood maltreatment and Dyadic Reciprocity.

[Insert Table 2 here]

[Insert Table 3 here]

Mediation analysis

A mediation analysis was conducted according to Hayes (2013) to estimate potential indirect effects of childhood maltreatment on observed parenting behaviour (Dyadic Reciprocity) via attentional capture. Indirect and direct effects were tested with the PROCESS toolbox for SPSS (http://www.afhayes.com/spss-sas-and-mplus-macros-and-code.html), entering **CTQ score** as independent variable (X), dyadic reciprocity as outcome variable (Y) and the index score for "attentional bias to infant faces" as a potential mediator (M1) in a mediation model. Mediation analyses were assessed using 1000 bootstrapping samples and 95% CI. Confidence intervals not covering 0 indicate a significant direct or indirect effect (Hayes, 2013).

A significant indirect effect was found for CTQ score on dyadic reciprocity via attentional bias (CI lower: -.02 CI upper: -.01). The total effect of CTQ score on dyadic reciprocity was also statistically significant (CI lower: -.04, CI upper: -.003). However, the direct effect of maltreatment experience on dyadic reciprocity was no longer statistically significant after including attentional bias in the model (CI lower: -.03, CI upper: .003). These results indicate that a higher score on the CTQ measure is associated with lower dyadic reciprocity via lower attentional bias. Including depression score (BDI) as a potential mediator in the model did not alter the pattern of results.

Discussion

This study investigated whether mothers with childhood experiences of maltreatment displayed altered attentional processing of infant faces. It also investigated whether individual differences in attention to infant faces mediated the relationship between maltreatment history and mothers' parenting behaviour. Childhood maltreatment experiences were associated with a decrease in the typical preferential "bias" for infant faces (indexed by slower RTs to infant as compared to adult faces) that has been observed in mothers without maltreatment histories (see also Brosch et al., 2007, 2008; Pearson et al., 2010; Thompson-Booth et al., 2014a,b,). Furthermore, lesser attentional bias to infant faces partly accounted for the association between higher levels of childhood maltreatment and lower levels of mother-infant dyadic reciprocity, suggesting that information processing biases associated with maltreatment experience may in part explain less than optimal mother-child interaction between mothers who have experienced maltreatment and their children (e.g. Bailey et al., 2012; Ferrey et al., 2016*;* Newcomb & Locke, 2001).Our primary

finding indicates that infant faces may not elicit preferential attentional processing in women who have experienced maltreatment in childhood. This finding suggests that the general tendency seen in parents to prefer and orient toward infant faces (Thompson-Booth et al., 2014a,b) may be disrupted in those who have received poorer parenting themselves. Correlation analysis suggested that this response may be driven by an increase in RTs to adult faces as CTQ score increases, indicating that decreased attentional bias to infant faces may in part be driven by increased salience of adult faces. One possibility is that adult faces are of increased relevance in signaling potential threat. An absence of enhanced attentional allocation towards infant faces may have implications for parenting behaviour, as this may reduce the detection by a parent of an infant's communicative signals, which may result in inappropriate or missed caregiving responses (McElwain & Booth-LaForce, 2006; Pearson et al., 2011; Swain, 2011). However, it is also possible that participants who experienced maltreatment were slower in processing speed, as research has shown than childhood maltreatment is associated with altered executive functioning (e.g. Cross, Fani, Powers & Bradley, 2017; Navalta, Polcari, Webster, Boghossian, & Teicher, 2006; Nikulina & Widom, 2013). If this is the case, then it is possible that slower processing speed (but equal attention) may result in longer RTs to adult faces, whereas slower processing speed (but lesser attention) would result in similar RTs to infant faces as to adult faces. Although a main effect of CTQ score on overall RT was not found, future studies should measure and control for general processing speed to exclude the impact of possible individual differences in this domain.

Our second question investigated the effect of childhood maltreatment and attention to infant faces on observed parenting behaviour. Correlation analysis showed that a measure of mother-infant dyadic reciprocity correlated with both

attentional bias to infant faces and CTQ score, whereas a measure of parental sensitivity only correlated with attentional bias to infant faces. It is possible that the dyadic reciprocity scale of the CIB, which assess mutuality, synchronicity, and non-tense interactions better captures sensitive parenting behaviour than the sensitivity subscale of the CIB which focuses more on noticing and acknowledging child signals and positive affect. This is supported by a recent analysis of the operationalisation of parental sensitivity, which found that measures that assess attuned and co-operative interactive behaviour are more strongly associated with attachment security than measures that assess positivity or responsiveness (Bailey, Bernier Bouvette-Turcot, Tarabulsy, Pederson, & Becker-Stoll, 2017). An exploratory mediation analysis indicated that experience of childhood maltreatment had a small but significant negative indirect effect on mother-infant dyadic reciprocity via attentional capture, such that maltreatment was associated with a reduced "bias" to infant faces and in turn, lower observed dyadic reciprocity during a mother-infant interaction. This suggests that the experience of maltreatment may compromise the preferential attentional processing of infant faces, which in turn compromises the quality of interactions with one's own child. This is consistent with the proposal that the parenting difficulties observed in women with a history of maltreatment may, at least in part, be attributable to dysfunctional calibration of attentional mechanisms. Taken together, these findings provide preliminary experimental evidence that disruption in basic cognitive processes in individuals who have experienced childhood maltreatment may compromise parenting.

It was also found that RTs were slower to happy faces than sad faces, in contrast to a previous study using the same paradigm which found no main effect of emotion (Thompson-Booth et al., 2014a). There was also an interaction between

emotion and condition, such that RTs were slower to happy faces only in emotional target conditions. This may be because the demands of the visual search task (searching for eye color) possibly reduce holistic processing of emotional non-target faces, minimising the processing of facial affect (for further discussion, see Thompson-Booth et al., 2014a) Although many studies show negative emotions capture attention more effectively (e.g. Eastwood et al., 2001, 2003), others have shown that positive emotions also capture attention (Williams et al., 2005; Preston & Stansfield, 2008). Furthermore, it has been found that adults with maltreatment histories show attentional biases (Fani et al., 2011) and physiological reactivity (Casanova et al., 1994) to happy faces but not threatening faces (Fani et al., 2011). It is possible that those who have experienced maltreatment may interpret happiness as a mask for more malevolent emotions, and so allocate more attention towards them (Pollak et al., 2000). Another interpretation is that individuals allocate more attention towards happy faces than sad faces in an effort to avoid negativity (Fani et al., 2011). Finally, it may be the case that those with histories of maltreatment do not consistently recognise sad faces as showing sadness (Pollak et al., 2000). However, it should be noted that there was no three-way interaction between emotion, condition, and CTQ score nor between emotion and CTQ score, therefore the effect of slower RTs to happy faces applied to all participants, not just those who scored higher on the CTQ.

An interaction between search condition and total maltreatment score was also found, such that as maltreatment score increased there was an increased difference in RTs between neutral and emotional non-target conditions, with RTs slower in neutral conditions. Although it is not immediately clear why RTs would be slower in conditions in which an emotional face is present as opposed to neutral faces only, it is

possible that those women with more experience of childhood maltreatment allocated more attention to neutral faces due to misinterpreting the neutral faces as negative or spending more time trying to identify an ambiguous emotional expression (Pollak et al., 2000). It is also possible that the slower response to neutral faces was due to carry-over effects from a previous emotional display. Future studies should systematically investigate potential carry-over effects from viewing emotion and also include a measure of interpretation of neutral faces. This study should be considered in light of its limitations. First, it is possible that there were other variables not measured in this study that differed according to severity of maltreatment, which could potentially account for some of the findings, such as low social support, ongoing trauma and victimisation, and deprivation (Coid et al., 2001, 2003). Second, only white face stimuli were used in this study; the use of stimuli that were not matched to participant race may have influenced performance, as previous research has shown that individuals are better at recognising and discriminating own- race faces (Meissner & Brigham, 2001), and own-race infant faces appear to preferentially attract attention, whereas other-race infant faces do not (Hodsoll et al., 2010). However, as race did not significantly differ according to level of maltreatment, it is unlikely to account for the differences seen as a function of maltreatment experience. Third, it should also be noted that maltreatment experience was determined based on self-report, which may be vulnerable to recall bias. In addition, while the CTQ asks questions about experiences of abuse and neglect "in my family" it does not specifically ask about who the perpetrator of the maltreatment was leaving open the possibility that the abuse was perpetrated by non-parental figures.

In summary, this study found that mothers who have experienced comparatively high levels of childhood maltreatment tend to show less preferential

allocation of attention to infant compared to adult faces. Furthermore, mediation analysis found that higher levels of childhood maltreatment are indirectly associated with lower dyadic reciprocity during mother-infant interactions via lower levels of attentional bias to infant faces. These results suggest that the experience of childhood maltreatment can disrupt the allocation of attentional resources to infant faces, which may in turn serve to compromise parenting behaviour.

Future studies may wish to investigate whether individuals with histories of maltreatment show different patterns of responding to other cues indexing vulnerability (e.g. children, infant animals, elderly people) as compared to people without such experiences. Such work may reveal whether the experience of maltreatment alters the allocation of attention specifically to infants or to cues indexing vulnerability more generally. Another option for future studies would be to investigate whether interventions that promote sensitive parenting by specifically focusing on paying attention to and interpreting child cues, such as video-feedback interventions (e.g. Bakermans-Kranenburg et al., 2003), can alter the processing of infant cues at a more basic cognitive level in women with histories of childhood maltreatment.

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Table 1.

Descriptive statistics for RTs (ms) for all trial conditions

	Infant Faces		Adult Faces	
	Mean	*SD*	Mean	*SD*
Happy Target RT	1249.03	229.37	1200.26	221.87
Happy Non-Target RT	1074.51	205.72	1048.9	195.34
Neutral trials with Happy blocks RT	1085.62	196.12	1037.61	186.31
Sad Target RT	1164.13	223.31	1100.32	203.14
Sad Non-Target RT	1050.77	165.44	1037.56	187.85
Neutral trials with Sad blocks RT	1073.55	177.68	1035.5	164.06

Table 2.

Descriptive statistics for scores on the CTQ, BDI, and the Parent Sensitivity and Dyadic Reciprocity subscales from the CIB..

	Mean	*SD*	Median	Range
CTQ Total	40.52	17.55	35	25 - 108
CTQ Emotional Abuse	8.76	4.86	7	5 - 25
CTQ Physical Abuse	7.45	4.32	5	5 - 25
CTQ Sexual Abuse	6.40	3.90	5	5 - 25
CTQ Emotional Neglect	10.10	5.25	8.5	5 - 25
CTQ Physical Neglect	7.81	3.85	5.5	5 - 25
BDI	6.10	6.79	3	0 - 26
Parent Sensitivity	3.74	0.68	3.8	2.25 - 4.90
Dyadic Reciprocity	3.33	1.02	3.33	1.33 - 4.83

Table 3.

Correlations between study variables

	Adult RT	Baby RT	Attentional Bias	BDI Score	CTQ score	Parent Sensitivity
Baby RT	*r* = .88**					
Attentional bias	*r* = -.24	*r* = .25				
BDI Score	*r* = -.07	*r* = -.13	*r* = -0.12			
CTQ Score	*r* = .34*	*r* = .19	*r* = -.30	*r* = .20		
Parent Sensitivity	*r* = -.36*	*r* = -.18	*r* = .39 *	*r* = -.04	*r* = -.29	
Dyadic Reciprocity	*r* = -.39**	*r* = -.18	*r* = .43 **	*r* = -.01	*r* = -.36*	*r* = .913**

** Significant at p<.05*

*** Significant at p<.01*

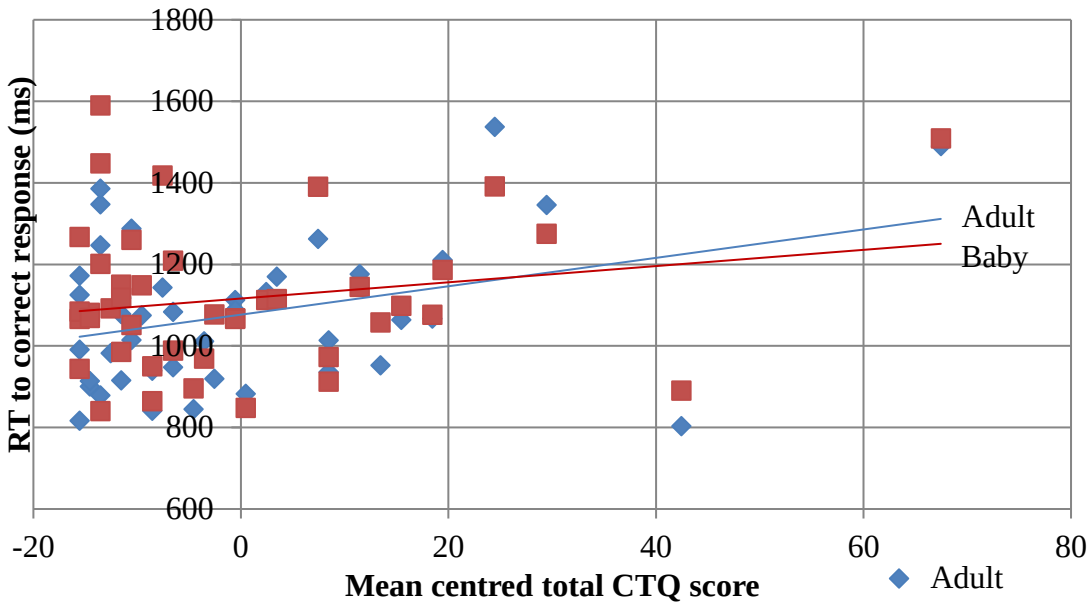

Figure 1. Interaction between face age and mean-centred CTQ score.

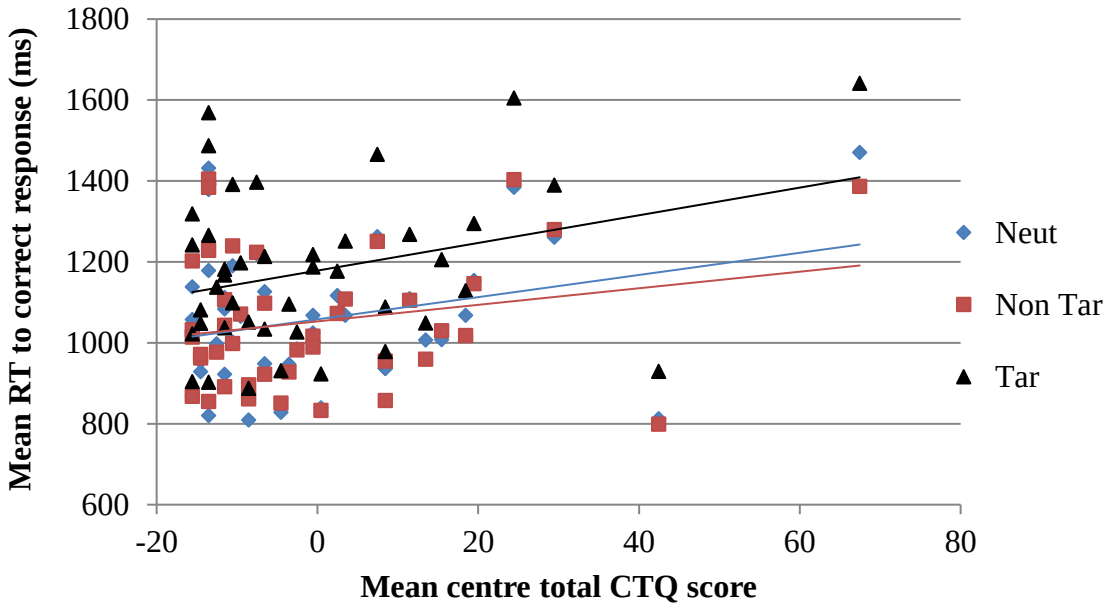

Figure 2. Interaction between search condition and mean-centred CTQ score.

Appendix
Participant demographics

	Mean	*SD*	Median	Range
Age	29.0976	5.66924	29.5	17-41
Years in education	14.2250	3.13367	13	8-20
Age of youngest child	1.5476	.50376	2	1-2

	n	%
Number of children		
Primiparous	21	50
Multiparous	19	45.2
Marital status		
Single	20	47.6
Married / Cohabiting	20	47.6
Household Income		
0-20,000	9	21.4
20,000-40,000	5	11.9
40,000-60,000	6	14.3
60,000-80,000	3	7.1
80,000+	10	23.8
Ethnicity		
White	25	59.5
Hispanic	1	4.8
African American	14	33.3
Mixed race	2	4.8