UNIVERSITY OF SOUTHAMPTON

FACULTY OF ENVIRONMENTAL AND LIFE SCIENCES

School of Psychology

Exploring Emotional Functioning in Preschoolers: The Role of the Mother-Child Relationship, Maternal Emotional Functioning and Neural Markers of Emotion Processing Concurrently and Over Time

by

Ella Louisa Beth Chadwick

Thesis for the degree of Doctor of Philosophy

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ABSTRACT

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The role and importance of parents on children's emotional development is well documented. Within this literature, theoretical models focus on the ways in which parents socialise their children, highlighting processes such as observational learning, discussion of emotion, and parenting practices related to the management of children's emotion. Family relationships and, specifically, the parent-child relationship have been emphasised as important contexts for development. Until recently, theoretical models of parental socialisation of emotion generally have not, however, accounted for the specific characteristics of the parent-child relationship. Further, limited research has considered what factors may influence parental socialisation, with emerging research arguing that parental emotional functioning may be a key factor in this.

This thesis proposed a theoretical model of emotion development in which maternal emotional functioning predicted child adjustment via the quality of the parent-child relationship and children's emotional functioning. Emotional functioning was defined as emotion regulation, understanding and neural processing of cross-modal emotion, and in

mothers included the related constructs of anxiety and depression symptoms. The parent-child relationship quality was characterised as being negative or positive, and children's adjustment was operationalised as internalising and externalising symptoms, and prosocial behaviour.

This thesis first systematically reviewed the available evidence for a direct relationship between parental and child emotional functioning at both the behavioural and neural level. Second, to test the proposed model, this thesis explored the associations between parental and child emotional functioning, the parent-child relationship and child adjustment concurrently and over time in mothers and their preschool children (i.e. three-to-five-years-old). A multimethod approach was used, including questionnaires, interactive tasks, observations and event-related potentials (ERPs). This thesis also aimed to identify a novel neural marker of cross-modal emotion processing in children.

The systematic review indicated considerable heterogeneity across studies in terms of sample characteristics (e.g. ages of children) and methods (e.g., whether questionnaires, observations, or experimental). The findings from these studies reported consistent empirical support for the direct association between emotion regulation in parents and children, and provided inconsistent evidence for associations between parents' and children's recognition of emotion. This review also highlighted a lack of neuroscientific and longitudinal studies; two aspects the subsequent papers of the current thesis aimed to address.

In the first empirical study of this thesis, analyses considering concurrent associations at Time 1 highlighted key maternal factors, in particular maternal use of suppression and neural processing of emotion, associated with children's emotional functioning and adjustment. In support of the theoretical model, maternal negativity was found to mediate the relationship between maternal P2 amplitudes to fear and children's emotion knowledge. Few other associations were observed between maternal emotional

functioning and child outcome. Maternal positivity was observed as a predictor of children's externalising symptoms, via children's emotion lability. The LPP was identified as a marker of children's cross-modal emotion processing, finding LPP amplitudes to happy faces to be negatively associated with children's prosocial behaviour concurrently and across time.

The second empirical study was longitudinal in design, and reviewed evidence for the proposed theoretical model from the same study cohort at Time 2. Few significant associations were found in support of the model for the concurrent Time 2 data. Furthermore, there was limited support for the proposed model from the longitudinal analyses. Maternal anxiety at Time 1 was identified as a key predictor of later adjustment, predicting later school adjustment over and above concurrent anxiety. Across time points, child emotion regulation and lability were observed as a key factors in determining children's psychosocial and academic adjustment.

Taken as a whole, this thesis provides evidence that maternal anxiety and child emotion regulation are strongly linked to children's adjustment in this age group. It is therefore suggested that to deliver successful and impactful support, maternal anxiety and child emotion regulation are key targets for intervention prior to the transition into primary school. Further larger scale replication of this work is needed.

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Academic Thesis: Declaration of Authorship

Title of thesis: Exploring Emotional Functioning in Preschoolers: The Role of the Mother-Child Relationship, Maternal Emotional Functioning and Neural Markers of Emotion Processing Concurrently and Over Time

I, Ella Louisa Beth Chadwick, declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. None of this work has been published before submission

Signed: .....

Date:.....

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Abbreviations

ADHD	Attention Deficit Hyperactivity Disorder
AEU	Adult Emotion Understanding
AKT	Affective Knowledge test
ANOVA	Analysis of variance
ANXDOS	Anxiety Dimensional Observation Scale
EE	Expressed Emotion
ERC	Emotion Regulation Checklist
ERP	Event-Related Potentials
ERQ	Emotion Regulation Questionnaire
fMRI	Functional Magnetic Resonance Imaging
fNIRs	Functional Near-infrared Spectroscopy
HADS	Hospital Anxiety and Depression Scale
Hz	Hertz
IAPS	International Affective Picture System
IQ	Intelligence Quotient
LPP	Late positive potential
MS	Milliseconds
Mv	Microvolts
PFMSS	Preschool five minute speech sample
SDQ	Strengths and Difficulties Questionnaire
SES	Socioeconomic status
STEU	Situational Test of Emotion Understanding
T1	Time 1
T2	Time 2

TRSSA	Teacher Rating Scale of School Adjustment
WPPSI	Weschler Preschool and Primary Scale of Intelligence

Chapter 1 The Development and Correlates of Emotional functioning: A Review of the Neurobehavioural Theory and Literature

Researchers recognise that there are an innate set of basic emotions (e.g. anger, fear, sadness, happiness, disgust and surprise) that have evolved that allow infants early in development to communicate and interact with the environment (Cole, Martin, & Dennis, 2004; Ekman, 1992). In addition, complex or more socially determined secondary emotions, such as shame or pride, emerge later (Plutchik, 1991).

For example, early studies have shown that infants can differentiate basic facial emotional expressions of joy and anger from as young as four-months-old (LaBarbera, Izard, Vietze, & Parisi, 1976). At approximately seven months of age, infants can also discern the difference between fear and joy (Nelson & Dolgin, 1985). Differentiation of emotions has been found to have some impact on behaviour through social referencing (i.e., using another person's expression to guide behaviour; Cole, et al., 2004; Feinman, 1982). In the seminal visual cliff study, for example, infants modulated their behaviour based on emotional cues from their mother (they were significantly more likely to cross a visual cliff if their mother looked happy versus fearful; Sorce, Emde, Campos, & Klinnert, 1985). Further studies into novel object presentation have extended this work to show that maternal emotion cues are more salient for 14-month-old infants compared with that of a stranger (Zarbatany & Lamb, 1985), and replicated this in both the laboratory and home setting (Schieler, Koenig, & Buttelmann, 2018). Emotion recognition continues to rapidly develop in the toddler years, and by age three children are able to identify happy, fearful and angry facial expressions at above chance levels, even when the stimuli were morphed to 60% intensity (Bayet, Behrendt, Cataldo, Westerlund, & Nelson, 2018). By age four-to-

five, children are typically able to recognise the six basic emotions (Parker, Mathis, & Kupersmidt, 2013). Emotion recognition continues to develop over middle childhood, with children reaching adult levels of facial emotion recognition at approximately 11 years of age, whilst recognition from voices continues to develop until approximately 14 years of age (Chronaki, Hadwin, Garner, Maurage, & Sonuga-Barke, 2015; Grosbras, Ross, & Belin, 2018).

In addition to recognising the emotional expressions of others, research has focused on the development of emotion expressions in infants. There is much debate between theorists concerning the development of emotion expression, but there is consensus that certain basic expressions such as disgust and distress are evident at birth due to an innate adaptive need for social communication (Darwin, 1872/1965). Some theorists believe that over time these facial expressions and communications differentiate and develop, for example when social smiling emerges at approximately six weeks after birth, usually in response to their primary caregiver (Sroufe, 1996; Wörmann, Holodynski, Kärtner, & Keller, 2012). Others argue that there are a larger number of basic emotions evident at birth, such as joy, surprise, sadness, fear and anger, citing cross-cultural work showing commonalities across infant expressions in support (Izard, 1994). Nonetheless, the use of emotion expressions changes across childhood, with research finding that infants more commonly displayed the appropriate emotional expression (joy for being tickled, anger at having their arm restrained and disgust at a sour taste) at twelve months of age compared to four months (Bennett, Bendersky, & Lewis, 2005). In addition to increased specialisation, children are able to display emotions via more mediums as they age. For example, observational research has found children to display increased vocal emotion at age three compared to age two (Malatesta-Magai et al., 1994).

Emotion understanding has often been explored through language (Wellman, Harris, Banerjee, & Sinclair, 1995). For example, children are asked to identify the effects

of feelings on mental states and behaviour (Stein & Levine, 1999) and to link emotions to situations (Denham, 1986; Thompson, 1987). The ability to do so, requires a combination of affective and cognitive skills, and thus demonstrating understanding of emotion is evident later than for recognition or regulation of emotion (Grazzani, Ornaghi, Conte, Pepe, & Caprin, 2018; Lemerise & Arsenio, 2000).

Emotion terms such as happy and sad become a common part of a child's vocabulary by the age of two (Wellman et al., 1995). However, this early usage can often reflect children's understanding of emotional valence, rather than the individual emotion. The ability to understand distinctions between different emotions is more evident at four-to-five years (Widen & Russell, 2008). In addition to improved differentiation of emotion, at age five children also become more adept at understanding external causes of emotion (Pons, Harris, & de Rosnay, 2004). Children's understanding of emotion continues to develop across middle childhood, reflected, for example, in the developing knowledge that multiple or mixed emotions can occur at the same time (Dunn, 1995; Southam-Gerow & Kendall, 2002).

Alongside emotion understanding, infants and young children are learning to regulate their own emotional states. In infancy, the use of attention (i.e. shifting attention away from an arousing stimuli) has been found to be important in regulating emotion in novel or ambiguous situations (e.g. Bridges & Grolnick, 1995). Similarly, Stifter and Braungart (1995) elicited anger in infants aged five months (using arm restraints) or ten months (by removing a desired toy) and found evidence of regulatory self-comforting behaviours, such as rocking or thumb sucking, which decreased negative arousal across ages. Buss and Goldsmith (1998) also found support for the effectiveness of anger regulation (as evident in attention shifts to the mother or experimenter), but not for fear, in infants of six, 12 and 18 months of age. During the toddler and preschool years, children shift away from using primarily self-comforting behaviours to regulate emotion and

towards strategies such as active engagement or support seeking (Cole et al., 2004; Diener, 1999). As children's understanding of emotion increases, they begin to regulate their emotions based on "display rules" or guidelines about appropriate expression of emotion in contexts (Garner & Hinton, 2010). For example, in middle childhood children may begin to smile when they feel unhappy.

Research has highlighted that young children become increasingly more competent with age at recognising and understanding emotions, as well as regulating their own feelings. Together these skills are often conceptualised as being associated with each other, with research supporting links between them (Denham et al., 2003). Despite consensus that there is a general concept of emotional competence, research has varied by the construct name used, and the specific skills assessed under that construct. Emotional competence has been commonly used to reflect behavioural indices such as emotion knowledge (Denham et al., 2003; Mirabile, 2010), although more recent research involving neural indices of emotion processing has termed it emotional functioning (Turpyn, Poon, Ross, Thompson, & Chaplin, 2018). Due to the focus of the thesis on broader elements of emotional experience, including neural emotional processing and parental anxiety and depression, this thesis will use the term emotional functioning throughout to capture the related constructs of emotional experience. Despite often strong correlation between emotional functioning and measures of social competence and wellbeing, researchers recognise a conceptual distinction between both measures (Barblett & Maloney, 2010; Denham et al., 2003). These related constructs such as social competence and wellbeing are often assessed together as an index of children's adjustment (Cunningham, Kliewer & Garner, 2009; Mirabile, 2010).

Further research has aimed to understand the importance of emotional functioning across development, focusing on its link with related adjustment outcomes such as social functioning, wellbeing and school adjustment, including attainment. Increasingly, this

research has begun to utilise a wider range of methodologies to explore this, in particular the use of neuroscientific assessments.

1.1 Event-related potentials and emotion

This thesis aims to integrate the findings of both behavioural and neuroscientific studies to characterise emotional development, with a specific focus on data gained from event-related potentials (ERPs). ERPs represent patterns of brain electrical activity in response to a stimulus or event. These electrical charges summate to a sufficient quantity in order to be measured using electrodes placed on the scalp (Banaschewski & Brandeis, 2007). ERPs, unlike the continuously recorded electroencephalograms (EEGs) from which they derive, are portioned into time windows called epochs. These epochs contain a series of positive and negative deflections known as 'components.' Components are conceptualised by their properties i.e. their polarity, latency (timing), and topography (distribution on the scalp). These components reflect underlying cognitive mechanisms behind phenomena (Luck, 2014; Teplan, 2002). For example, the P1 component has a positive peak with an approximate latency of 100ms post stimulus onset, originating predominantly from parieto-occipital sites. The magnitude or amplitude of a component in response to a specific stimulus is measured in microvolts. Early components are typically conceptualised as reflecting a sensory or perceptual process such as recognising a stimulus as a face, and later components as reflecting cognitive processes for example processing the emotional content of a word (Nelson & McCleery, 2008).

ERPs have a number of advantages over other behavioural and neuroimaging techniques. Firstly, ERPs have very good temporal resolution of one millisecond or better and thus can detect very rapid changes in brain activity (Luck, 2014). This high temporal resolution can be very informative as many studies report significant differences between the processing of emotional faces as soon as 100ms after presentation (e.g. Vlamings,

Jonkman, & Kemner, 2010). Secondly, they are non-invasive and do not require a behavioural response, making them an appropriate choice for research using young children or infants as participants (e.g. Grossmann, Striano, & Friederici, 2006). Neuroscientific methods, such as ERPs, also allow for the study of more implicit forms of emotion recognition, not captured by self-reports or emotion labels (Telzer et al., 2014). Finally, they are inexpensive compared to functional magnetic resonance imaging (fMRI) techniques (Light et al., 2010; Luck, 2014).

However, limitations of ERP should be considered, both compared to other neuroscientific and behavioural methodologies. ERPs excel at providing high temporal resolution data exploring cognitive processes, but are limited at providing data on other aspects. Although ERPs are able to provide some spatial data, for example the topography of a certain component, they are unable to provide the high spatial resolution of other techniques such as fMRIs (Banaschewski & Brandeis, 2007).

Additionally, ERPs are very small in nature, which causes two distinct problems in obtaining a reliable signal-noise ratio, both of which are particularly relevant to preschool aged participants (Luck, 2014). In order to obtain this ratio, experiments are designed with a large number of trials per condition, with research with five-to-seven-year-olds commonly using 60 trials per emotion (e.g. Chronaki et al., 2018; O'Toole, Decicco, Berthod, & Dennis, 2013), placing attentional demands on the child. Although difficult to operationalise due to large study heterogeneity, a review of ERPs with infants up until the age of two, estimated a 25-75% attrition rate (Hoehl & Wahl, 2012). Additionally, individual ERPs are very biased by noise in the data such as blinks or movement, which are particularly difficult to control in child populations (Luck, 2014). Both the large number of trials needed, and susceptibly to noise, lead to data loss above what would be expected in behavioural research.

There is a vast behavioural literature exploring emotion recognition across ages, emotions, and different modes of presentation-modality (i.e. faces, voices, body postures and cross-modal conditions). Emotion recognition improves with age, with older children able to more accurately recognise and match emotions from faces (Herba, Landau, Russell, Ecker, & Phillips, 2006) and voices (as reviewed by Morningstar, Nelson, & Dirks, 2018). Emotion in faces is argued to be more accurately recognised than vocal emotion in preschoolers (Nelson & Russell, 2011) and to reach adult levels of recognition earlier in development. Facial cues have been argued to be more distinctive, and provide more effective cues for rapid recognition (Little, Jones, & DeBruine, 2011; Pell, 2002). Despite the argument that emotion portrayed in multiple modalities is more ecologically valid (Ding, Li, Wang, & Luo, 2017; Gross & Ballif, 1991; Klasen, Chen, & Mathiak, 2012; Niznikiewicz, 2013) the majority of studies focus on facial expressions, with relatively few studies combining modalities (Maurage, Campanella, Philippot, Pham, & Joassin, 2007; Schirmer & Adolphs, 2017). Those that do often find a 'facilitation effect' in which multiple modalities lead to more rapid and accurate recognition of emotion in adults (Hunter, Phillips, & MacPherson, 2010). Some studies have replicated this finding in children, finding that nine-year-old children benefited from multimodal information when identifying whether the person felt more happy or sad (Gil, Hattouti, & Laval, 2016), however the younger children aged between five-and-seven were no more accurate from one or multiple modes. Consistently, in a sample of three-to-five-year olds, there was no significant difference in participant's ability to label emotions from the face-only, or the face-voice-body condition. The authors argued that this may reflect a developmental change in which children younger than six process emotional stimuli by individual features, and integrate cues less successfully than older children, and thus the addition of extra information is of no benefit for recognition (Nelson & Russell, 2011).

In addition to the modality, and age of the participants, studies into emotion recognition vary by the emotions presented. Across childhood, happiness is found to be one of the earliest and most accurately recognised emotion (Nelson & Russell, 2011; Nowicki & Duke, 1994). However, researchers have highlighted a negativity bias in which studies tend to present multiple negative emotions alongside happiness, and thus it cannot be disentangled whether happiness is more distinctive compared to positive vs negative valence more generally (Sauter, 2010; Sauter, Panattoni, & Happé, 2013). In support of this argument, research with two-to-five-year-old children found that children use more broad categories of positively and negatively valenced emotions (i.e. putting all negative faces in the box when asked to collect all the scared faces) before they begin to develop more fine-tuned differentiations (Widen & Russell, 2008).

In summary, the behavioural literature has illuminated the developmental trajectory of emotion recognition, and the effect of modality and emotions on this. Broadly, these have found that recognition improves with age, allowing for more distinctions to be seen between emotions, and that this trajectory is earlier for facial than vocal emotion. The wide range of stimuli and methods allow for a comprehensive assessment of emotion recognition however, this also limits synthesis of findings. Additionally, many studies (e.g. Widen & Russell, 2008) require the verbal ability to label and express emotions, potentially limiting the validity of this research in young children. Increasingly, researchers are recognising the need to explore neural and behavioural measures together in order to garner a better understanding of emotional development (e.g. Bennett, 2013). Thus, the following section will review the contribution of ERP studies to understanding of the processing and recognition of emotion, with a particular focus on different modalities. Although other components have been observed in relation to emotion processing, only those components observed in the empirical work for this thesis will be reviewed.

1.1.1 Components implicated in facial emotion recognition

1.1.1.1 P1.

The P1 is a positive component that is maximal in parieto-occipital sites in response to black and white faces across adults and children (Batty & Taylor, 2003, 2006), and is argued to index early visual processing of facial stimuli, specifically the physical characteristics such as facial features. In adults, the P1 can be seen between 80 and 160ms post stimulus onset and has a positive peak typically between 90 and 110ms (Batty & Taylor, 2003; Liu et al., 2012a). These peaks are often observed at later latencies in children, for example in a study of three-year-olds Curtis and Cicchetti (2011) found the P1 to peak at 130ms, in response to angry, happy and neutral Ekman faces (Ekman & Friesen, 1976). The longer latencies observed in children for the P1, and indeed some other components, are argued to reflect less automisation of the visual system and thus longer time taken to process the individual physical characteristics of a face (Batty & Taylor, 2006), supporting the argument of feature-based processing in younger children (Nelson & Russell, 2011). In addition to longer latencies in children, amplitudes of the P1 have been found to decrease with age (Batty & Taylor, 2006). These larger amplitudes seen in children are argued to reflect less automatic processing, and thus more cognitive effort being required to process emotional stimuli (Batty & Taylor, 2006; Vlamings et al., 2010). However, as very few studies have explored the trajectory of the P1 in typically developing preschool and school-aged children, any conclusions can so far be only tentative (Wauthia & Rossignol, 2016).

The P1 has been shown to be sensitive to emotion in faces in adults. A sample of 26 young adults were presented with black and white photographs portraying anger, happiness, sadness, fear, surprise, disgust and neutral and asked to respond when a non-face object was presented. The P1 was found to have larger amplitudes for emotional faces compared to neutral, with the exception of surprise (Batty & Taylor, 2003). Differences

between specific emotions for the P1 have also been observed in adults. For example, Nomi, Nguyen, Bastidas, Troup, and Frances (2013) asked adult participants to passively view faces and respond when the face was scrambled and found significantly larger amplitudes for angry compared to happy faces.

Similarly, in children aged between three and eight the amplitudes of the P1 have been found to have larger amplitudes for fearful compared to neutral NimStim faces, and for faces with high spatial frequency (Vlamings et al., 2010). This effect has also been observed in seven-month-old infants with fearful eyes eliciting larger P1 amplitudes than non-fearful eyes (Jessen & Grossmann, 2016).

P1 amplitudes have also been linked to maternal-reports of emotion regulation and task performance in five-to-nine-year-olds. Dennis, Malone, and Chen (2009) presented children with a modified attention network task in which fearful, sad and neutral faces were briefly presented as distractors prior to the main tasks of indicating which direction the target stimulus pointed. Children who showed higher P1 amplitudes to fearful and sad faces were found to show greater task alertness following negative emotional distractors, and also to show less maternal-reported child emotion dysregulation. Thus, in addition to reflecting the processing of faces, the P1 in children may index the use of different emotion regulation strategies.

The latencies of the P1 have also been found to vary by age and emotion in children (Batty & Taylor, 2006; Vlamings et al., 2010). For example, four-to-nine-year-old children were found to have significantly longer latencies in response to emotional faces, than ten-to-fifteen-year-olds (Batty & Taylor, 2006). Although the overall latencies tend to be longer in young children, emotion specific effects can still be observed. For example, Dennis et al. (2009) found significantly shorter P1 latencies for fearful compared to sad faces in a sample of five-to-nine-year-old children, possibly reflecting the adaptive significance of fear cues for recognising the presence of threats.

1.1.1.2 N170.

The N170 is a negative component typically observed maximally in parieto-occipital regions across both adults and children. In adult samples, this is usually between 140 and 230ms post stimulus onset with a peak at approximately 140ms (Batty & Taylor, 2003; Liu et al., 2012a), and in children it is observed up to 300ms after stimulus onset with a negative peak between 190 and 210ms (Dennis et al., 2009; O'Toole et al., 2013; Vlamings et al., 2010). The N170 is consistently linked to the structural encoding of faces (Eimer & Holmes, 2002; Liu et al., 2012a).

In adults, larger N170 mean amplitudes have been found for fearful and happy faces, compared to angry and neutral faces (Nomi et al., 2013). A meta-analysis of 57 ERP adult studies on the N170 found that some emotional faces elicited larger N170 amplitudes than neutral faces, across a variety of active and passive viewing tasks (Hinojosa, Mercado, & Carretié, 2015). Specifically, amplitudes to angry faces were found to differ the most from neutral, followed by fear and happiness, with sadness and disgust showing no significant difference to neutral. This pattern of findings would suggest facilitated processing of socially relevant cues, i.e. of threat followed by successful social interaction, which are necessary for survival.

In childhood, the N170 appears less sensitive to emotion in faces. One study measuring facial affect and familiarity in children aged between four and six years found no differential N170 amplitudes to angry and happy faces, although the N170 did differentiate processing of mothers and strangers faces (Todd, Lewis, Meusel, & Zelazo, 2008). In support, no amplitude or latency differences were found in a sample of three-year-olds when passively viewing angry, happy and neutral black and white Ekman faces (Curtis & Cicchetti, 2011). In addition, no amplitude differences were found to the same emotions shown on coloured photographs (NimStim- Tottenham et al., 2009) in a flanker task with a sample of five-to-seven-year-olds (O'Toole et al., 2013). However, one study

with five-year-old-children found that the N170 was modulated by emotion. Specifically, that fearful faces showed a shorter latency than angry or happy faces (de Haan, Nelson, Gunnar, & Tout, 1998). This difference could in part be due to the different task paradigms in the studies. Work by de Haan et al. (1998), was notably the only study finding emotion specific effects of the N170, and were also the only study which asked the children to respond specifically to the emotion as opposed to a distractor task such as the flanker task. This increased focus on the emotional content may therefore have affected the N170 response. However, a recent study asking six-to-eleven-year-old children to view angry, happy and neutral faces and label the emotion found no significant differences in N170 amplitudes (Chronaki et al., 2018). Alternatively, it could be the case that the N170 develops across childhood. Consistent with this, a cross-sectional study testing children aged between four and 15 found emotion specific effects of N170 only for the oldest age group of 14-15-year-olds (Batty & Taylor, 2006), again suggesting a shift with age away from global sensory recognition towards more fine grained processing of faces including the specific emotions.

1.1.1.3 LPP.

The late positive potential (LPP) can be seen from 200ms after stimulus onset and is maximal over centro-parietal sites in adults (Schupp, 2000) and midline parieto-occipital sites in children (Chronaki et al., 2018; Hajcak & Dennis, 2009). The LPP indexes evaluative processing and attention to emotional stimuli (Chronaki et al., 2018; Kujawa, Klein, & Hajcak, 2012a), as well as emotion regulation (Desatnik et al., 2017; Van Cauwenberge, Van Leeuwen, Hoppenbrouwers, & Wiersema, 2017).

Many of the studies measuring the LPP have used affective stimuli such as the International Affective Picture System (IAPS: Lang, Bradley, & Cuthbert, 2008) to elicit rather than portray emotion. Two studies presented undergraduate students with images from the IAPS and asked participants to rate them as pleasant, unpleasant or neutral

(Cuthbert, Schupp, Bradley, Birbaumer, & Lang, 2000; Schupp, 2000). Both studies found LPP amplitudes to be larger for emotional compared to neutral images. This was most evident in high intensity images (e.g. of violent content), suggesting that more attentional resources are dedicated to salient and intense cues. Similar research has shown the effect to persist for 800ms following the end of the stimulus presentation for pleasant images and 1000ms for unpleasant images (Hajcak & Olvet, 2008).

Similar to research with adults, many studies in children observe the LPP in response to affective as opposed to emotional stimuli. Collectively these studies in middle childhood (five-to-ten-year-olds) have found the LPP to be larger to unpleasant compared to neutral stimuli (DeCicco, Solomon, & Dennis, 2012; Dennis & Hajcak, 2009; Solomon, DeCicco, & Dennis, 2012) and larger for pleasant compared to neutral stimuli (Solomon et al., 2012). In support, research with four-to-five-year-olds found larger LPP amplitudes for passively viewed pleasant and unpleasant compared to neutral images (Hua et al., 2014).

Studies using affective stimuli have also proposed the LPP as a marker of emotion regulation. In young children aged five-to-seven, this was not supported. DeCicco et al. (2012) presented negative stories before half the unpleasant images, and reappraisal stories before the other half, but found no significant difference in LPP amplitudes between the two conditions. The same design was utilised with older children, finding no differences in amplitude for the younger age group (eight-to-eleven-year-olds) but significantly reduced LPP amplitudes in the older age group following reappraisal (twelve-to-fifteen-year-olds, Van Cauwenberge et al., 2017). Consistently, research in adolescents found that emotion suppression significantly affected LPP amplitudes albeit in different ways. Specifically, amplitudes were reduced in occipital and increased in parietal electrodes in the suppression condition (Desatnik et al., 2017). However, it has been argued that the task demands, understanding and retaining the interpretation in their working memory, was too high for the younger children. Research using simplified stories with four-to-five-year-olds found

larger amplitudes for negative compared to neutral interpretations (Hua, Han, & Zhou, 2015), suggesting that the LPP may be a useful marker for emotion regulation across childhood, provided the tasks used are developmentally appropriate.

Research has also considered the LPP directly in response to emotional faces. For example, one study asked eight-to-thirteen-year-old participants to passively view emotional faces and found significantly larger amplitudes for sad compared to neutral faces, but no significant differences for happy compared to neutral faces (Kujawa et al., 2012a). In a further study, emotional faces (sad, angry, fearful and happy) elicited larger LPP amplitudes compared to neutral faces, which was evident at earlier latencies in occipital sites (200-600ms) than in parietal sites (600-1000ms; (Kujawa, Hajcak, Torpey, Kim, & Klein, 2012b)).

In summary, several components are implicated in facial emotion recognition. Earlier components, the P1 and N170, reflecting more sensory based processing, show emotion specific effects from 100ms after stimulus presentation. Later, more evaluative components, such as the LPP show a pattern of larger amplitudes in response to emotive compared to neutral stimuli, although findings are predominantly focused on affective as opposed to emotional stimuli. Developmental changes are also evident, such that children tend to have larger amplitudes and longer latencies for components implicated in facial emotion processing, argued to reflect an overreliance of global processing to detect emotion and less automisation of their visual systems. Further developmental changes in emotion processing are evident in the N170, for which only the oldest group of children showed clear modulation by emotion (Batty & Taylor, 2006). Additionally, there is the suggestion that both adults and children may attend to salient, threat-relevant cues such as anger more, thus creating larger amplitudes.

1.1.2 Components implicated in vocal emotion recognition

1.1.2.1 N1.

In adult auditory and cross-modal studies, the N1 is maximally observed in central locations, between 70 and 160ms with a negative peak at approximately 130ms (Jessen & Kotz, 2011; Joassin, Maurage, Bruyer, Crommelinck, & Campanella, 2004; Liu et al., 2012a). In contrast, studies using vocal stimuli with children have observed the N1 most strongly in temporal sites, and even to have an initial positive peak in four-to-eight-year-olds (Bruneau, Roux, Guérin, Barthélémy, & Lelord, 1997; Chronaki et al., 2012). The N1 is most commonly associated with the processing of auditory stimuli, although it has also been observed in studies using only emotional facial stimuli in children (Dennis et al., 2009). Consistent with Schirmer and Kotz (2006)'s theoretical model, the N1 has often been linked to sensory processing, i.e. sound detection and attention orienting towards a stimulus and is proposed as the earliest point at which vocal emotion can begin to be processed (Liu et al., 2012a; Näätänen & Picton, 1987).

The latency and amplitude of the N1 has been found to be modulated by emotion in adults. For example, angry vocalisations (such as the sound 'ah') were found to have shorter latencies and smaller amplitudes compared to neutral and fearful vocalisations (Jessen & Kotz, 2011). Additionally, the authors also found smaller amplitudes for fearful compared to neutral voices. Further work by these authors found a smaller N1 amplitude to fearful voices compared to angry and neutral voices, and no differences in latency for the different emotions (Jessen, Kotz, & Obleser, 2012). Smaller N1 amplitudes to anger compared to neutral voices have been replicated in a further adult study by Kokinous, Kotz, Tavano, and Schröger (2014). Further research has found that the N1 peaks significantly earlier for angry compared to fearful voices (Yeh, Geangu, & Reid, 2016). Taken together, these findings suggest facilitated processing of emotional voices compared to neutral, which is particularly evident for anger.

There is a comparative lack of research into vocal emotion processing generally compared to other modalities, which is particularly evident in the child literature (Chronaki, 2016). The N1 in children has shown some evidence of reduced amplitudes to angry compared to happy and neutral vocal expressions, however this effect did not persist after controlling for multiple comparisons (Chronaki et al., 2012). The use of non-verbal expressions is a strength of this study as semantic content has been found to bias emotion recognition in children (Morton & Trehub, 2001).

1.1.2.2 P2.

The P2 is typically observed at fronto-central sites, between 150 and 240ms post stimulus onset (Curtis & Cicchetti, 2011; Liu et al., 2012a), with a positive peak at approximately 200ms (Balconi & Carrera, 2007). In children, the auditory P2 has been observed in posterior sites (Čeponien, Rinne, & Näätänen, 2002). The P2 is most consistently linked with the integration of cross-modal emotional stimuli in adults (Balconi & Carrera, 2007; Jessen & Kotz, 2011; Kokinous et al., 2014; Yeh et al., 2016).

Research using non-verbal vocalisations (e.g. 'ah') in adults found larger P2 amplitudes for emotional (angry and happy) compared to neutral stimuli (Liu et al., 2012b). There is also the suggestion of regional specific effects, with a study finding maximal emotion differentiations in amplitudes in the right frontal electrode sites in adults (Paulmann, Bleichner, & Kotz, 2013).

In summary, the N1 and P2 are observed in response to vocal emotional stimuli, which reflect different stages of vocal emotion processing (Schirmer & Kotz, 2006). In adults, larger N1 amplitudes and shorter latencies are typically found for negative emotions compared to neutral. For the P2, amplitudes are found to be larger for neutral compared to emotional stimuli. There is a comparative lack of research into vocal emotion processing compared to facial, which is particularly evident for children. One study which has

explored vocal processing in children found some evidence for attenuated amplitudes to angry stimuli (Chronaki et al., 2012).

1.1.3 Components implicated in cross-modal emotion recognition

1.1.3.1 N1.

Research has found the N1 to be modulated by modality of the stimulus. Specifically, smaller amplitudes and shorter latencies are consistently found for cross-modal compared to unimodal conditions (Jessen et al., 2012; Kokinous et al., 2014; Yeh et al., 2016). Taken together, these findings support the facilitation effect evident in the behavioural literature. Thus, it has been argued that cross-modal emotion recognition does not therefore occur after the individual emotional stimuli have been processed, but instead emotion from multiple modes leads to faster and less effortful recognition (Schirmer & Adolphs, 2017).

The N1 to cross-modal stimuli have been found to be sensitive to emotion in adults. For example, Jessen and Kotz (2011) also found shorter N1 latencies for angry compared to fear and neutral cross-modal stimuli, mirroring the findings of their auditory only condition. In this study, the cross-modal stimuli consisted of an actor displaying an emotion using their body posture, face and non-verbal vocalisation. Central N1 amplitudes were smaller for angry and fear compared to neutral, however the smaller amplitudes to fear compared to angry were not replicated in the cross-modal condition. This could be due to the fact that the auditory condition was presented with a static neutral body, thus introducing an element of incongruence to this condition (i.e. a neutral body position paired with a non-neutral emotional vocalisation). However, as this incongruence was true for both the angry and fearful condition, it is also possible that anger and fear have more similar patterns of processing in cross-modal stimuli. In their further work, for which no facial expressions were presented, smaller amplitudes were found for fearful compared to

angry and neutral stimuli (Jessen et al., 2012). Additionally, shorter N1 latencies were found for the emotional compared to the neutral stimuli. However, as happy or other positive emotions were not included in these studies it cannot be determined if this facilitated processing is specific to negative threat cues (i.e. angry or fearful) or emotional content more generally.

Infants as young as seven months have been found to be able to integrate cross-modal emotional information (e.g. Grossmann et al., 2006) with differential amplitudes for congruent (angry-angry, and happy-happy) compared to incongruent face-voice pairs. However, to the authors' knowledge no studies exist which explore emotion processing differences in congruent cross-modal stimuli in children.

1.1.3.2 P2.

Studies into cross-modal emotion recognition have consistently found a fronto-central P2 component, argued to index the integration of emotional cues (Schirmer & Kotz, 2006). For example, P2 amplitudes in university students were found to be larger for emotionally congruous (the face and voice conveying the same emotion) than incongruous conditions (the face and voice displaying different emotions), argued to reflect successful integration of multisensory information (Balconi & Carrera, 2007).

The P2 varies as a function of emotion, and has been found to have a larger amplitude for angry and happy cross-modal stimuli compared to neutral in adults (Liu et al., 2012a). This finding is supported by a further adult cross-modal study using angry, fearful and neutral stimuli (Jessen & Kotz, 2011). Differentiation between specific emotions have also been observed in adults, finding shorter latencies and smaller amplitudes for angry compared to fearful face-voice pairs (Kokinous et al., 2014).

Further latency differences in cross-modal studies have also been observed for the P2. For example, neutral face-voice pairs were found to have shorter latencies than angry face-voice pairs in a sample of adults (Kokinous et al., 2014). The authors also observed

amplitude differences within the negative emotions, with shorter latencies for angry compared to fearful face-voice pairs. As was the case with the N1, there are no cross-modal emotion recognition ERP studies in children from which to draw any comparisons or conclusions.

As was seen with the N1, there is some evidence to suggest a facilitation effect in the P2 cross-modally. For example, Kokinous et al. (2014) found smaller amplitudes to audio-visual compared to auditory emotional stimuli. In contrast, other research with adults has found that audio-visual conditions had larger amplitudes than the auditory condition, which may suggest an increased allocation of cognitive resources in emotion processing (Jessen & Kotz, 2011). These discrepant findings could be due to methodological differences as the study by Jessen and Kotz (2011) also included body movements in their cross-modal condition which may be harder to process than their voice only condition, or face-voice stimuli.

In conclusion, there is evidence of neural components which are emotion sensitive from as soon as 100ms post stimulus onset. The majority of the studies focused on unimodal processing, typically of facial expressions, but less is known about the neural underpinnings of cross-modal emotion processing (Liu et al., 2012a). Furthermore, there are no known cross-modal studies in children using ERPs. As research on unimodal processing has found that neural responding to emotional stimuli varies across development, understanding the neural underpinnings of cross-modal emotion processing in childhood would provide important and novel developmental data (Batty & Taylor, 2006; O'Toole et al., 2013), as well as allow for the exploration of implicit forms of emotion recognition (Telzer et al., 2014).

1.2 Theoretical models of the development and correlates of emotional functioning

Theoretical models have highlighted that the development of emotional functioning in children is influenced by a number of biological and environmental factors and their interaction (e.g. Eisenberg, Cumberland, & Spinrad, 1998). The influence of parents has received particular attention, especially the ways in which they socialise their children. Eisenberg et al. (1998) suggested that parent socialisation of emotion development reflects a parent's (i) own emotional expressions, (ii) reactions to their child's expressions, and (iii) their discourse about emotions (Figure 1.1). Consistent with this perspective, Mirabile (2010) predicted that "direct" (i.e. discussion of emotion and parental reactions) and "indirect" socialisation (i.e. the parent's general expressiveness) would influence the development of emotional functioning and psychosocial adjustment in children (see Figure 1.2). Extending this, Spinrad and Gal (2018) proposed that parental warmth and sensitivity would also play a role in emotion development in their child, and their subsequent prosocial behaviours. A growing body of research supports the role of parent socialisation in emotional development.

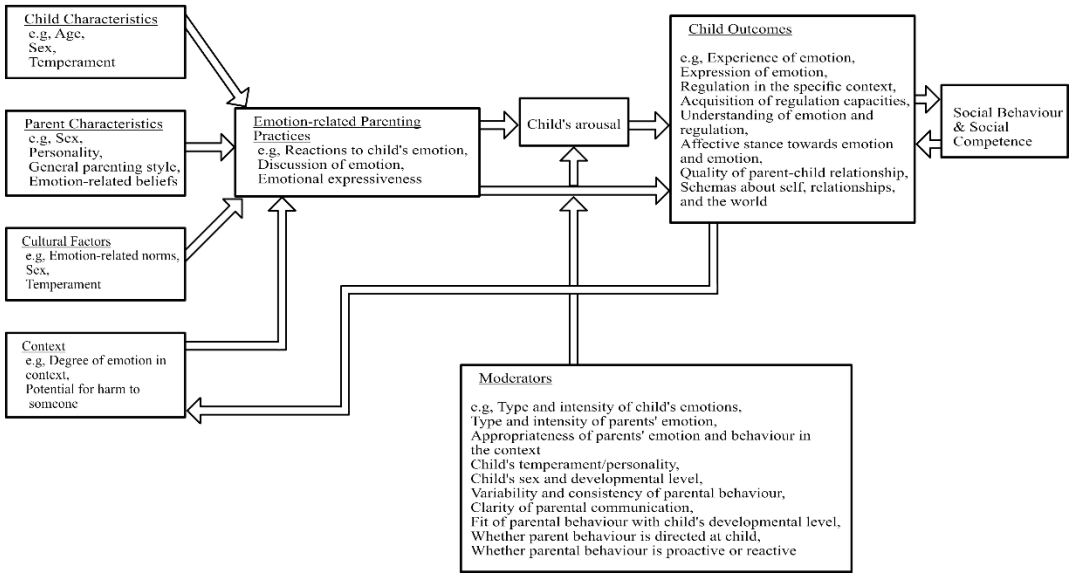

Figure 1.1. Eisenberg, Cumberland and Spinrad's (1998) model of parental socialisation of emotion.

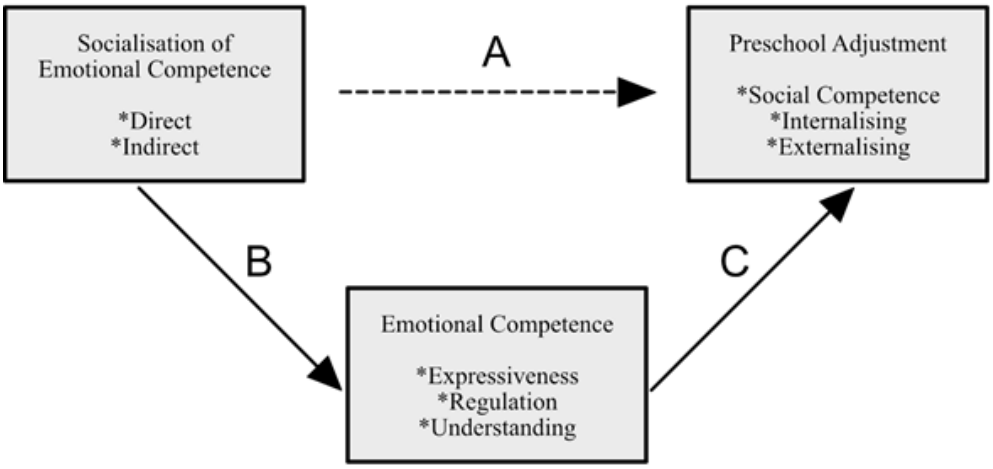

Figure 1.2. Mirabile's (2010) mediation model of the effects of parental socialisation of emotion.

Dunn, Brown, and Beardsall (1991), for example, observed three-year-old children during conversations with their mother and sibling and coded the interactions for emotional content. The results showed that a greater frequency and diversity of emotion language in families when children were three-years-old was associated with better recognition of emotion when children were six-years-old. Similar effects were reported with even younger children, where mothers were asked to describe a picture book (containing emotional and control pictures) to their 15 month old child, as though they were reading to their child at home (Taumoepea & Ruffman, 2006). Maternal use of desire language at 15 months (e.g. "hope" and "want") predicted children's emotion situation knowledge (understanding of emotion vignettes and emotion body language) at 24 months. The authors also measured maternal emotion recognition at time one (T1; e.g. to match facial expressions to vocalisations and written words), but did not explore the correlation with child emotion understanding. A further study that followed up the same children at 33 months showed that maternal mental state language (e.g. "think" and "know") at time two (T2) predicted children's emotion knowledge at this time (Taumoepeau & Ruffman, 2008). Garner, Jones, Gaddy, and Rennie (1997) similarly found a correlation between mothers' explanations of causes and consequences of emotion, measured using a picture book

methodology, with their three-to-five year olds' emotional role-taking, operationalised as the ability to understand the protagonist's facial emotion during an incongruent vignette. Taken together, the studies demonstrate the importance of emotion and mental state words used in maternal discourse on the development of emotion understanding in children.

As well as parental use of language, parental reactions to their child's emotional displays are also related to emotion understanding. Denham, Mitchell-Copeland, Strandberg, Auerbach, and Blair (1997) found poorer emotion understanding in two-to-five-year-old children whose parents showed more negative reinforcement (e.g. using phrases like "stop that crying") when they displayed negative emotions. In a further study, Denham (1997) investigated children's perception of their parent's emotional reactions and child emotional functioning. Denham (1997) asked four-to-five-year-old children to act out how their parents would react to a series of eight emotional stories using dolls. It was found that children who acted out more comforting actions, displayed better emotional functioning (e.g., more empathy and cooperation) with their peers as rated by their teachers. Denham (1997) proposed that children who experience more comforting strategies from their parents gradually internalise these as mental scripts, which they then use to interact more successfully with peers. Mirabile (2010) extended this work to show that optimal levels of parent displays of emotion were linked to an increased understanding of emotion in a sample of 64 three-to-five-year-olds and argued that these moderate levels of emotional displays allowed children to better access the underlying meaning and significance of them. Further work has demonstrated that age plays a key role in the effect of parental reactions to negative emotions. In a study of 81 children, parent's supportiveness (a combination of emotion and problem-focused coping strategies) was related to better emotion regulation and lower symptoms of anxiety only in the three-to-four-year-olds, and to worse emotion regulation and higher symptoms of anxiety in the five-to-six year olds (Mirabile, Oertwig, & Halberstadt, 2018).

In line with Mirabile (2010), Eisenberg et al. (1998) reported, in their study of children aged four-to-twelve-years old, that child emotion suppression and avoidance (argued to be a maladaptive emotion regulation strategy, see J. Gross & John, 2003) were linked to parents who displayed more punitive reactions towards their child when they expressed negative emotions. A different study assessed the relationship between maternal supportiveness during a frustration task, operationalised as levels of attentiveness, sympathy and physical affection, and emotion regulation in a sample of three-to-four-year-old children (Cole, Dennis, Smith-Simon, & Cohen, 2009). The authors reported that children of mothers who were more emotionally supportive used some maladaptive strategies to manage the situation (e.g., misbehaviour) less frequently, but they also used some adaptive strategies (e.g., seeking support) less often compared to peers whose mothers were less supportive. In the same study, children of mothers who were more supportive were more able to recognise anger reducing regulation strategies, but were also less likely to generate their own management strategies compared to their peers who had less supportive mothers. Taken together, these findings suggest that there is an optimal level of parental support and emotional expressiveness, which is developmentally appropriate and exposes children to a wide range of regulatory strategies whilst also allowing them to independently manage emotions.

Further studies have explored parental socialisation in terms of the related construct of "meta-emotion" (Gottman, Katz, & Hooven, 1996). Meta-emotion refers to the way in which parents think and feel about emotions in themselves and their child. Although related to emotion understanding, meta-emotion is conceptualised more broadly in the awareness of all aspects of emotion and their approach towards the experience of these (termed 'meta-emotion philosophy'). Gottman et al. (1996) distinguished two forms of meta-emotion philosophy, awareness of different emotions in the parent and child, and the extent to which parents coached their children about emotion, such as discussing emotion

and teaching the child strategies to deal with it (see Figure 1.3). Better meta-emotion in parents was found to be associated with their parenting behaviours (the inhibition of parental derogation of the child and increased scaffolding), child physiology and other outcomes (peer relations and illness).

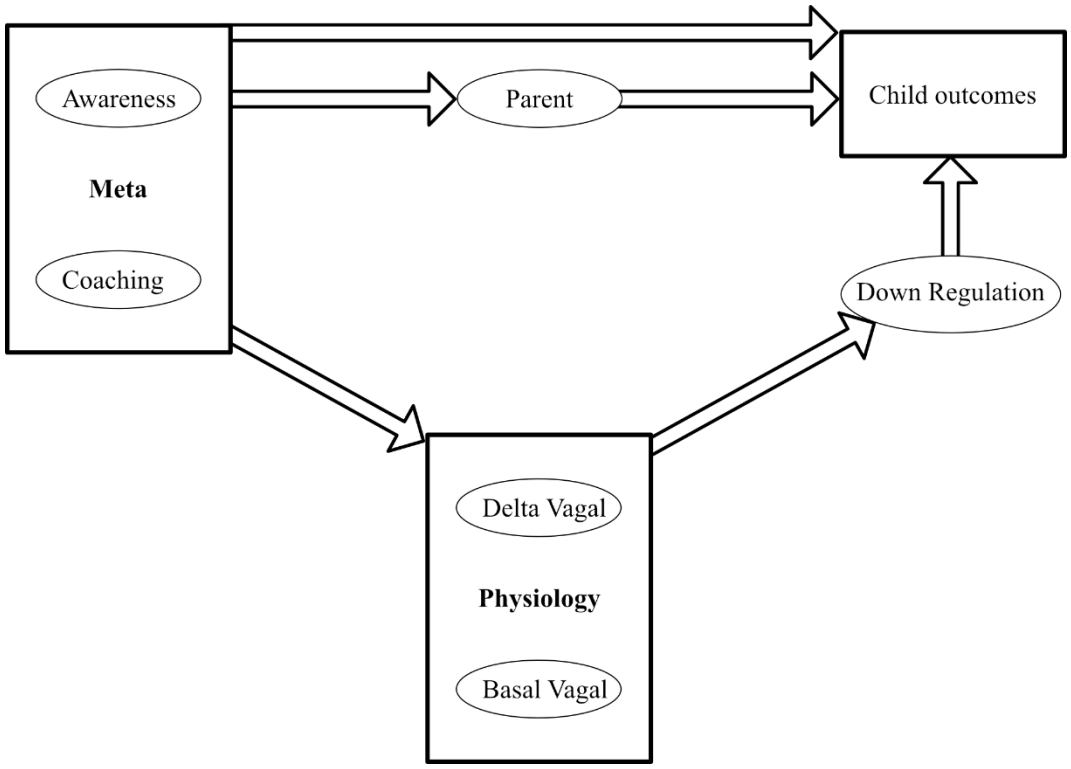

Figure 1.3. Gottman et al., (1996) model of parent meta-emotion and behaviours, and child outcomes, physiological arousal and emotion regulation.

Cunningham et al., (2009) proposed a related theoretical model between parental meta-emotion philosophy, child emotional functioning and child outcomes, which was argued to be moderated by gender. Cunningham et al. (2009) reported that in a sample of 69 nine-to-thirteen-year-olds, parental meta-emotion philosophy was mediated by children's emotion understanding for internalising problems in boys, and social skills in girls (see Figure 1.4). Furthermore, emotion regulation mediated the associated between parental meta-emotion philosophy and child outcomes (internalising and externalising behaviour, social skills and grades) in boys. Taken together, these findings provide some evidence for the influence of parents' meta-emotion philosophy, both directly and indirectly, on child emotional functioning and adjustment.

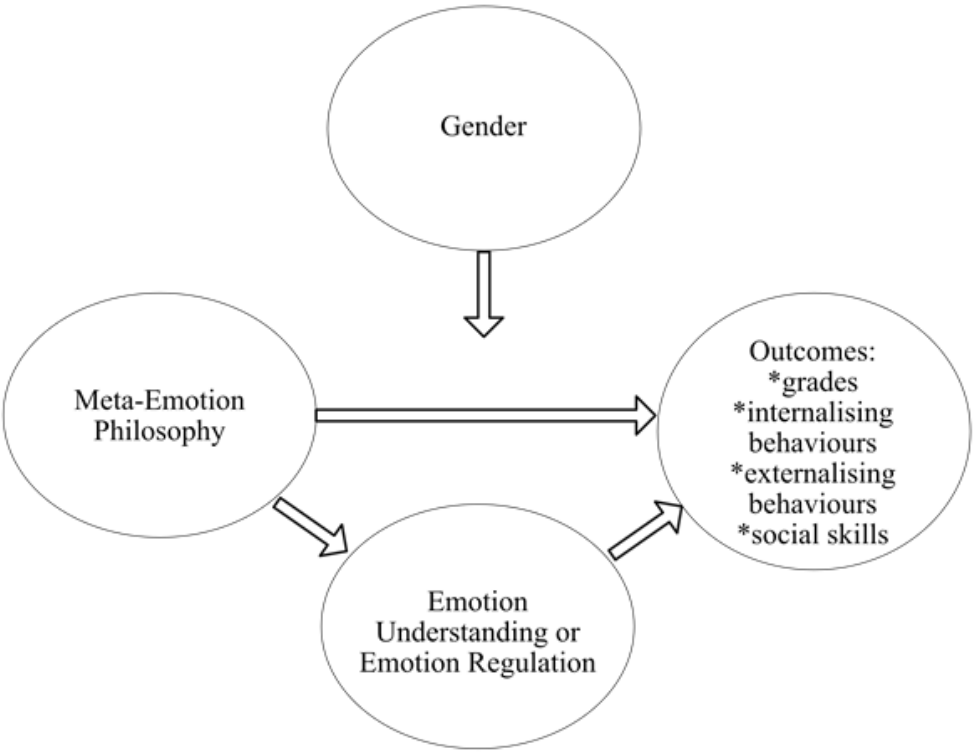

Figure 1.4. Cunningham et al., (2009) model of the relationship between parent meta-emotion philosophy and child outcomes, mediated by child functioning, moderated by gender.

In summary, there is strong evidence for the role of parental socialisation in the development of children's emotional functioning. However, less is known about the factors which guide parental socialisation i.e. what makes one parent a more effective socialiser of emotion compared to another (Belsky, 1984; Cumberland-Li, Eisenberg, Champion, Gershoff, & Fabes, 2003; Eisenberg et al., 2003). An emerging body of research has argued that the parental beliefs and behaviours that make up socialisation, may themselves be affected by the parent's own emotional functioning and in turn relate to emotional functioning in their children (Bariola, Gullone, & Hughes, 2011; Buckholdt, Parra, & Jobe-Shields, 2014; Castro, Halberstadt, Lozada, & Craig, 2015). Although theoretical models (see Figure 1.5) have proposed that parental emotional functioning would exert an influence on child emotion development, (Morris, Silk, Steinberg, Myers, & Robinson, 2007), research exploring this is in its infancy (Kehoe, Havighurst, & Harley, 2014). Recent research has provided support for this model finding that parental emotion

regulation was correlated with emotion regulation in their child, which was mediated by their reactions to their child's negative emotions (Li, Li, Wu, & Wang, 2019).

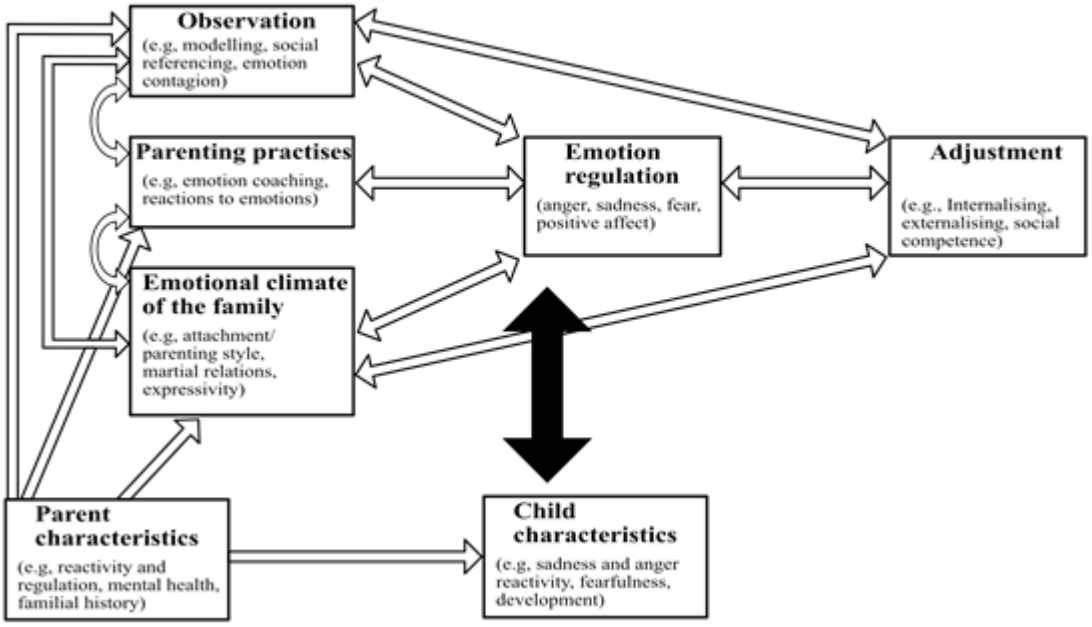

Figure 1.5. Tripartite model of the influence of the family on children's emotional regulation and adjustment.

Additionally, none of the presented theoretical models considers the influence of the quality of the parent-child relationship, but instead focus on specific parenting practices (e.g. Eisenberg et al., 1998; Gottman et al., 1996). There is growing evidence that parenting practices are influenced by child characteristics (Belsky, 1984; De Mol & Buysse, 2008; Reitz, Deković, & Meijer, 2006; Zahn-Waxler, 2010). Accordingly, theoretical models of children's emotional development need to take into account the transactional nature of the parent child relationship. A recent model extending Eisenberg et al. (1998), did so by proposing that the parent-child relationship and family context more broadly would contribute to emotion regulation development in children, see Figure 1.6 (Raval & Walker, 2019).

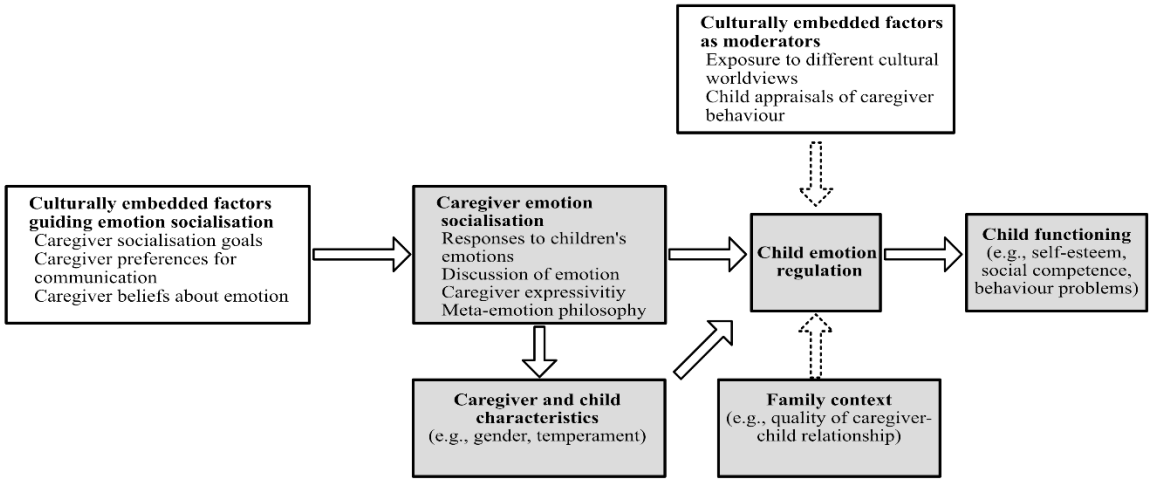

Figure 1.6. Raval's extension of Eisenberg's 1998 model. Boxes in grey represent aspects of existing models, and dotted lines represent associations where more empirical support is needed.

The present thesis has developed a theoretical framework adapted from the above theoretical models (see Figure 1.7). The model extends the previous focus on parental socialisation in two key ways. Firstly, the inclusion of indices of maternal emotional functioning propose some factors which may underlie maternal socialisation of emotion, which is recognised to some extent by Morris et al. (2007). Secondly, the proposed model considers the dyadic relationship quality, and in doing so recognises the transactional nature of family relationships.

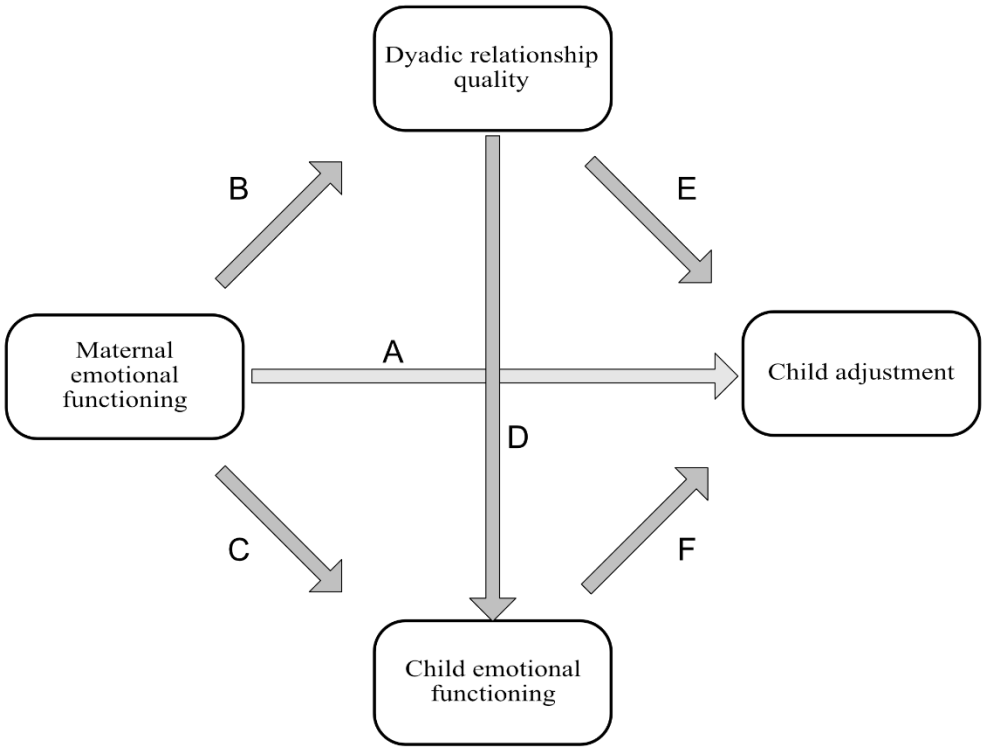

Figure 1.7. A theoretical model adapted from Mirabile (2010) and Gottman et al., (1996) for the present study.

The present model extends previous work by considering maternal emotional functioning in children's development of emotional functioning and their psychosocial and academic adjustment. The dyadic relationship quality will be operationalised as levels of positivity and negativity. Child adjustment encompasses indicators of wellbeing (i.e. levels of internalising and externalising symptoms), social skills and school based achievement. Maternal emotional functioning encompasses the same skills as child emotional functioning, namely the neural processing of emotion, understanding and regulation of emotion, in addition to the related indicators of symptoms of anxiety and depression. As research assessing the impact of parents' emotion regulation, understanding and neural processing of emotion, on the family is still in its infancy, related constructs reflecting parental emotional functioning can be considered as proxies. Anxiety and depression are argued to be related to the ability to regulate emotions (Aldao, Nolen-Hoeksema, & Schweizer, 2010), and thus will be used in this work as indicators of emotional functioning

in mothers. The following sections will review evidence for the pathways in this model (Figure 1.7).

1.3 Empirical evidence for the proposed model

1.3.1 Parental and child emotional functioning

Researchers are beginning to argue that the effects of parental socialisation on emotional functioning in their children may in part be driven by the parents own emotional functioning (Bariola et al., 2011; Buckholdt et al., 2014; Castro et al., 2015). To explore this proposition, Castro et al. (2015) asked parents and their children, aged 8-11, to complete a problem solving task and each member of the dyad to label their own and the other member's feelings. The authors reported a positive correlation between emotion matching, i.e. the level of agreement in recognising the other's emotions compared to their self-reported feelings. Other research has taken this further by exploring direct links between recognition of emotion in unfamiliar others, as well as by using neuroimaging techniques (Telzer et al., 2014). Adolescents and their parents were asked to match facial expressions to the emotional label during an fMRI task, and adolescents were asked to self-report on their general emotional competence. Increased neural activation in parents during the emotion labelling task was linked to better adolescent emotional competence, even when controlling for parental warmth and expressivity. Furthermore, this relationship was mediated by the adolescents' own brain activation in response to the emotion matching task. The findings of Telzer et al. (2014) are important in providing novel insight into the correspondence between parent and child emotional competence (i.e. emotion recognition) at a neural level, and making a case for the value of understanding the mechanisms underlying emotion development. However, longitudinal research is needed to demonstrate the directionality of this association, as it could be the case that adolescents' emotional competence explained their neural activation.

Research has also considered associations between emotion regulation in parents and their children. For example, Bariola, Hughes, and Gullone (2012) measured emotion regulation use (reappraisal and suppression) in 358 9-19 year olds and both their parents. They found only one significant correlation between maternal and child use of suppression. The authors suggested that maternal influences on emotion regulation may be stronger than paternal influences in this age group. They also argued for the effects of parental modelling as suppression, more easily observed due to the mismatch between the emotional expression and the situation, was related in mothers and children but not reappraisal, a more internal cognitive strategy.

Child gender has been identified as a possible moderator in parent's socialisation of emotion, with the link being strong in mother-daughter dyads compared to mother-son dyads (Daughters, Gorka, Rutherford, & Mayes, 2014). Mothers and their adolescent children's ability to tolerate distress were studied using a computer task which increased in difficulty over time. Participants were required to add numbers continuously whilst receiving feedback in the form of either pleasant or aversive noises. Distress tolerance, operationalised as high or low based on task completion, was found to be significantly positively correlated for mothers and daughters but not sons. The authors proposed that this may be due to the effects of modelling being stronger for parents of the same gender. However, it is important to note that fathers were not included in this study. At this point, too little evidence is currently available to draw firm conclusions.

Considering maternal emotional functioning more broadly, Joormann, Gilbert, and Gotlib (2010) reported that higher levels of maternal depression were correlated with decreased emotion recognition in children aged 9-14. Emotion recognition was operationalised as the number of errors made, and the intensity threshold needed before the participant was able to recognise the emotion. Moreover, maternal depression has also been linked to less effective emotion regulation in children both currently and over time,

and across both maternal report and observational measures strengthening the reliability of this association (Hoffman, Crnic, & Baker, 2006; Silk, Shaw, Skuban, Oland, & Kovacs, 2006). However, whilst parental depression is a useful proxy when considering the scarcity of literature assessing direct links between parent and child emotional functioning, these associations should also be interpreted with caution. Specifically, it may be that other factors related to the depressive symptoms in the mother are in fact driving the relationship with child emotional regulation, for example a shared genetic vulnerability towards negative emotionality (Nobile et al., 2004).

1.3.2 Parental emotional functioning and the parent-child relationship

There is a scarcity of studies which assess the impact of parental emotional functioning (operationalised as emotion recognition, understanding and regulation) on the quality of the parent-child relationship. One such study found that mothers who were rated by observers as having better emotion regulation, self-reported being less likely to use unsupportive parenting strategies (e.g. telling the child that they are overreacting). Furthermore, mothers who rated themselves as having higher levels of emotion dysregulation rated themselves as more likely to use unsupportive parenting strategies (Morelen, Shaffer, & Suveg, 2016). Consistently, fathers of six-to-twelve-year-old children who rated themselves as more dysregulated, also self-reported more frequent use of unsupportive reactions to their child (Yan, Han, & Li, 2015).

Further support for this proposed theoretical pathway can be derived from research focusing on parental emotional functioning more generally, i.e. symptoms of anxiety and depression. A meta-analysis of 46 observational studies, including children from infancy to adolescence, reported a significant association between maternal depression and both positive (r =.08) and negative parenting (r =.20) behaviours in the dyad (Lovejoy, Graczyk, O'Hare, & Neuman, 2000). Specifically, mothers who were higher in depressive

symptoms displayed more negative (e.g. expressing more anger and negativity to the child) and fewer positive parenting behaviours (e.g. praising and being affectionate to the child) than their non-depressed counterparts, although the magnitude of the association between maternal depression and positivity was relatively small.

Parental anxiety has also been reported to affect the parent-child relationship. For example, mothers who are more anxious have been found to display less warmth and positivity, more criticism and less granting of autonomy in interactions with their child. Moreover, even when child anxiety was taken into account, maternal anxiety was still the strongest predictor of maternal displays of warmth in the dyad (Whaley, Pinto, & Sigman, 1999). Further, mothers with co-morbid anxiety and depression reported increased parenting hostility, and lower engagement, warmth and positivity when parenting their child in its first year of life (Seymour, Giallo, Cooklin, & Dunning, 2015), highlighting the need to consider the effects of multiple aspects of emotional functioning.

1.3.3 Parental emotional functioning and child adjustment

Parental emotional functioning has been consistently linked to indices of adjustment in their preschool child, both concurrently and across time. For example, mothers of three-year-olds with more depressive symptoms were more likely to have children with higher levels of behaviour problems at age four (internalising, externalising and total) compared to mothers with lower levels of depression (Hoffman et al., 2006). A study with three-to-five-year-olds and their parents found that mothers who rated themselves as more anxious, had children with higher levels of internalising and externalising behaviours (as rated by themselves and the child's father). Similar results were found for the father, with the only exception being that paternal anxiety was not significantly related to mother-reported child internalising behaviours (Hanetz Gamliel, Dollberg, & Levy, 2018).

Research has demonstrated that the relationship between parental emotional functioning and child adjustment is mediated by the quality of the parent-child relationship. In support, Brennan, Le Brocque, and Hammen (2003) reported a positive association between maternal history of depression and child internalising symptoms and social skills in a sample of 816 15-year-olds, which was mediated by maternal levels of warmth and acceptance. In a different study using the same sample as Brennan et al. (2003), the transmission of anxiety in the family was explored, also testing for the potential role of the parent-adolescent relationship as a mediator. The findings demonstrated that the presence of an anxiety disorder in mothers, but not fathers, was a significant predictor of the presence of an anxiety disorder in the child (McClure, Brennan, Hammen, & Le Brocque, 2001). In contrast to the findings of Brennan et al. (2003), no mediation was found for the transmission of anxiety via adolescent reports of the parent-child relationship. This discrepancy could be due to a reporting bias, in the ways in which adolescents with anxiety perceive and report on their parents' behaviours and parenting, for example perceiving parental behaviour as more threatening and controlling. Future research may benefit from more objective measures of parent-child relationships, such as observational tasks.

1.3.4 The parent-child relationship and child emotional functioning

Positive parent-child relationships, characterised by an acceptance of the child's feeling and an openness to discuss these, are associated with better understanding and regulation of emotion in children (Gross, 2014). For example, parents who were more responsive to their child's distress, had children who were better able to regulate negative emotions. Moreover, mothers who showed more warmth had children who were better able to regulate positive affect, further highlighting the need to consider multiple aspects of both parenting behaviours and child outcomes (Davidov & Grusec, 2006). A clear strength

of this study was the use of multiple methods to operationalise parenting behaviours including observations, questionnaires and linguistic coding. Furthermore, this finding has been replicated both concurrently and overtime. For example, maternal positivity in the dyad has been negatively linked to anger displays in boys and time taken to regulate emotions and calming down in girls (McDowell, Kim, O'Neil, & Parke, 2002). Maternal warmth at age one and a half has also been found to be a significant predictor of better observed emotion regulation in boys at age three and a half (Gilliom, Shaw, Beck, Schonberg, & Lukon, 2002).

Children's emotion understanding has also been linked to the parent-child relationship. For example, maternal negativity and particularly anger during parent-child interaction was negatively associated with preschoolers' emotion understanding (Denham, Zoller, & Couchoud, 1994). In addition to observed behaviour, five-year-old children who perceived their parents to be more comforting and positive in reaction to their emotional displays showed better general emotional competence (Denham et al., 1997).

Recent research has begun to explore the relationship between emotional functioning and the parent-child relationship at the neural level. One study assessed six-month-old infants neural processing of angry, happy and neutral non-verbal vocalisations (e.g. the word 'ah') using functional near-infrared spectroscopy (fNIRS) and mothers' level of sensitivity (i.e. appropriate meeting of their infant's needs) and directiveness (e.g. critical and controlling behaviours) in a free-play task with their infant. Infants who had larger responses to angry vocalisations were significantly more likely to experience more directiveness from their mother (Zhao, Chronaki, Schiessl, Wan, & Abel, 2019). Further research has found an association between observed maternal sensitivity and a larger negative central ERP amplitudes to happy faces in their seven-month-old infant (Taylor-Colls & Pasco Fearon, 2015). The authors suggest this may be due to the infants learning the significance of positive cues from their mother's sensitive parenting, and attaching

greater significance and attention to these. Taken together, these studies show the impact of parenting on infant brain development. Recent research has also demonstrated the effects of parent-child interaction on neural processing of emotion in their eight-year-old girl (Leventon, Merrill, & Bauer, 2019). Girls whose parents used more elaborative discussion of negative emotions, showed reduced LPP amplitudes to emotion-inducing IAPS images, argued to reflect less emotional reactivity.

1.3.5 The parent-child relationship and child adjustment

The evidence for the effects of the parent-child relationship and child adjustment are well documented, particularly for the early school years. Children of parent-child dyads characterised as more positive in their interaction have been found to show higher levels of academic achievement across both normative (Pianta & Harbers, 1996) and high risk low socioeconomic status (SES) samples (Connell & Prinz, 2002). In addition to academic achievement, the quality of the dyadic relationship has also been linked to wider aspects of school adjustment. For example, five-to-six-year-old-children with more positive maternal-reported mother-child relationships, were rated by their teachers as being more co-operative, self-directed and well-adjusted to school (Nur, Aktaş-Arnas, Abbak, & Kale, 2018). Further research has supported this finding, demonstrating that the mother-child relationship was a stronger predictor of school adjustment than the teacher-child relationship (Pianta, Nimetz, & Bennett, 1997). Such finding underscores the unique influence on school adjustment of the parent-child relationship compared to relationships with other significant adults.

The quality of the parent-child relationship has also been linked to children's broader adjustment. Maternal warmth was associated with greater peer acceptance in boys, which was mediated by their regulation of positive affect, supporting Morris et al.'s (2007) theory. However, research has extended theory by providing evidence of direct links

between the parent-child relationship and child adjustment. For example, in five-year-olds, maternal expressed emotion, comprised of warmth, criticism and positivity, was found to be associated with antisocial behaviour in a study of monozygotic twins (Caspi et al., 2004). Specifically, the twin rated as receiving more maternal negativity and less warmth had higher rates of antisocial behaviour problems. The use of monozygotic twins in the present study is an important strength as it allows for the assessment of non-shared environmental influences on antisocial behaviour, specifically the unique relationship a mother has with each of their children. In a different study the quality of the mother-child relationship has been linked to prosocial behaviour. In a cross-sectional sample of six-to-eight-year-old children, maternal responsiveness to distress was found to be correlated with increased prosocial behaviour (Davidov & Grusec, 2006).

1.3.6 Child emotional functioning and adjustment

1.3.6.1 Emotional and social functioning and emotional well-being

Halberstadt, Denham, and Dunsmore (2001) defined affective social competence as the ability to effectively and appropriately communicate and regulate emotion, as well as understand and respond to another's affective communications. Eisenberg et al. (1998) proposed that emotional competence, amongst other skills, is bi-directionally related to social functioning (see Figure 1.1), as well as synthesising many studies showing a positive link between emotional and social competence. For example, four-to-five-year-olds with better emotion recognition and emotion situation knowledge reported feeling less lonely and received fewer negative peer nominations (Heinze, Miller, Seifer, Dickstein, & Locke, 2015). In support, emotional competence (measured via the child's understanding of ambiguous negative situations) was found to be associated with concurrent social competence (as rated by peers and teachers) in a sample of three-to-four-year-olds (Denham et al., 2003). This study also showed that poorer emotion regulation was linked

to lower peer popularity and more teacher-rated oppositional behaviour. Furthermore, emotion knowledge and regulation at age three-to-four was found to predict social competence at six-years-old (Denham et al., 2003).

While most research supports the proposition that emotional and social functioning are strongly linked across development, Bennett (2013) did not find this in their ERP study. Bennett (2013) assessed emotion knowledge using ERPs by presenting six-year-old children with a series of pictures portraying a sequence, such as a child dropping an ice-cream, ending with either a congruent or incongruent facial expression for the story. The LPP was identified as a neural marker of emotion understanding, demonstrating significant amplitude differences between emotionally congruent and incongruent stories. The results showed no correlation between LPP amplitudes and parent-reported social competence, which the author posited may in part be due to the novel use of a neural emotion understanding measure focused on emotional congruence and incongruence. The results of this study suggest that further work is needed to more effectively utilise diverse methodologies this area of research.

While a body of research has considered associations between emotional and social competence, further work has looked at links with wellbeing and behavioural difficulties more generally. Increased emotional functioning has also been found to be positively associated with fewer internalising (e.g. anxiety and depression) and externalising problems (e.g. hyperactivity and conduct problems) in preschool aged children. For example, Heinze et al. (2015) reported negative associations between four-to-five-year-olds' behavioural emotion knowledge and parent-reported internalising problems (i.e. loneliness and peer victimisation). Emotion recognition was also negatively associated with loneliness in boys. In addition, Mirabile (2010) reported that children's emotion knowledge (emotion naming and situational knowledge) was significantly negatively correlated to parent-reported internalising behaviours. Consistently, a meta-

analysis combining the results of 19 studies, estimated the effect size of the correlation between emotion knowledge and internalising behaviour to be small to medium (r = -.17) in children aged between three and five (Trentacosta & Fine, 2010).

Further studies have found that emotional functioning predicts later internalising problems. Izard et al. (2001), for example, found that emotion knowledge (recognition and labelling) at age five predicted teacher rated internalising problems (loneliness, sadness and depression) at age nine. Similarly, Gaffrey, Barch, and Luby (2016) found links between amygdala reactivity to sad faces in four-to-six-year-olds and dysregulated negative affect (i.e. rapid emotional changes, increased anger and intensity of emotion) both at baseline and in the same sample 12 months later. This effect persisted even when controlling for baseline negativity, leading the authors to argue that emotional functioning was a unique predictor of internalising problems. An ERP study found high anxiety at age five-to-seven to be predictive of high anxiety two years later, only for those children who showed larger N170 amplitudes to angry faces, and even when controlling for baseline anxiety (O'Toole et al., 2013). However, no concurrent effect of angry face processing on anxiety was found, possibly suggesting that a neural hypervigilance to threat manifests itself slowly over time or that other factors are influencing this relationship. The authors recommended that future research combine neural measures with measures of social context, such as parenting.

Further research recognises the bidirectional relationship between internalising symptoms and emotional functioning. McClure and Nowicki (2001), for example, found a correlation between symptoms of social anxiety in eight-to-ten-year-olds and the ability to recognise emotion from facial expressions and verbal tone. They argued that the social anxiety could be driving the poorer emotion skills because more anxious children are more prone to misinterpreting environmental cues, and have less opportunity to develop social skills due to their withdrawing from social experiences. The recognition and description of

these bidirectional influences on complex developmental phenomena such as children's emotional functioning are often referred to as "cascade models" (Blandon, Calkins, Grimm, Keane, & O'Brien, 2010).

Emotional functioning has also been found to be correlated with externalising problems. Trentacosta and Fine's (2010) meta-analysis reported a small to moderate effect size of -.15 for the association between emotion knowledge and externalising problems at age three-to-five. Other research has found a significant positive correlation between maladaptive emotion regulation and externalising behaviour (Mirabile, 2010). Furthermore, impaired emotion recognition was found to be associated with a diagnosis of attention-deficit-hyperactivity-disorder (ADHD) in a sample of six-to-11-year-old children (Chronaki, Benikos, Fairchild, & Sonuga-Barke, 2015). This difference was also evident at a neural level. Compared to controls, children with ADHD had larger N1 and smaller P300 amplitudes to angry compared to neutral voices, even when comorbid conduct disorder (CD) and medication use were controlled for. Children with a diagnosis of ADHD also showed larger N400 amplitudes compared to controls, particularly for emotive voices. Taken together, these findings suggest that there is a pattern of hypervigilance to anger followed by attentional reduction in ADHD, which may relate to the patterns of behaviour observed.

Emotional functioning appears to have less predictive power explaining externalising behaviour, than internalising problems. For example, research has found that emotion knowledge at age three-to-four-years was predictive of aggression 12 months later, which was particularly evident for boys (Denham et al., 2002), and emotion knowledge at age five was predictive of later hyperactivity at age nine (Izard et al., 2001). However, Izard et al. (2001) did not find a correlation between emotion knowledge and conduct problems at follow up, of which aggression is a feature. The disparity between these could in part be due to the differing lengths of follow up and that with a longer

follow up period other factors than emotional functioning are more influential in the development of conduct problems, for example previous behaviour problems (White, Moffitt, Earls, Robins, & Silva, 1990). It is also possible that other aspects of emotional functioning are more important in delineating specific developmental pathways than knowledge of emotion, for example emotion regulation. Hill, Degnan, Calkins, and Keane (2006) measured emotion regulation at age two, and externalising behaviour at yearly intervals between two and five. They found that better emotion regulation was associated with high decreasing symptoms of externalising behaviour in girls (and not boys). The results showed that for boys, stable and elevated levels of externalising behaviour was associated with SES. Blandon et al. (2010) tested a bidirectional cascade model of the influences of emotion regulation and externalising behaviour between ages two and seven. They found only a unidirectional pathway in that better emotion regulation predicted fewer externalising problems over time. Current evidence on the predictive power of emotional functioning on externalising behaviour indicate that further longitudinal research is needed.

1.3.6.2 School adjustment and attainment

There is a wealth of literature exploring the effects of emotional functioning on school adjustment, where starting school is recognised to be a major transition and developmental challenge for young children. Researchers have argued that children who show better recognition, understanding and regulation of emotion perform better academically (e.g. Raver & Knitzer, 2002). Consistently, Graziano, Reavis, Keane, and Calkins (2007) found that parent–reported emotion regulation at age five was positively correlated with teacher reported concurrent maths and literacy scores. The results of this study are particularly compelling as the effect persisted even when controlling for IQ, parent-reported behaviour problems and the teacher reports of the quality of their relationship with the child. Further research has explored similar relationships over time, highlighting that parent-reported emotion regulation and understanding in the first term of

school uniquely predicted teacher-reported measure of global school adjustment (social, regulatory and academic outcomes) at the end of the year (controlling for verbal ability and disruptive classroom behaviour; Shields et al., 2001). Moreover, children with a higher understanding of emotion at 40 months were found to have a more positive perception of school by the end of the kindergarten year at age six (Dunn, 1995).

In summary, emotional functioning early in childhood has been shown to impact school adjustment, including academic and social outcomes. It has also been consistently linked to more general aspects of functioning, such as social and wellbeing outcomes. Although there is an emerging literature which combines both behavioural and neural indicators, more work is needed to integrate these whilst embedding them in the social and emotional context of the family.

1.4 Summary

Emotional functioning is an important and complex developmental construct on which much research has been focused, particularly on its antecedents and correlates. Research into the neural underpinnings of emotional functioning has found several components which are implicated in the processing of emotion, and which observe differences based on the specific emotions presented. Behavioural studies into emotional functioning have found it to be an important construct associated with a wide range of social, wellbeing and academic outcomes. Emotional functioning in children is also consistently linked with parents, with varying influences from parental socialisation and parenting behaviours. However, there is an emerging literature focused on the effects of parental functioning itself, and a call to develop this knowledge further (Bariola et al., 2011; Castro et al., 2015). When considering this scarcity of literature, parental emotional functioning more generally (i.e. symptoms of anxiety and depression) can be looked to as proxies. Additionally, there is evidence to support the transactional nature of relationships

in the family, and thus the need to further the study of parenting behaviour in this context to include the dyadic relationship. Finally, researchers are increasingly recognising the benefit of combining a wide variety of methodologies to comprehensively measure a construct, specifically utilising both behavioural and neuroscientific methods (e.g. Bennett, 2013).

Thus, the present thesis aims to assess emotional functioning in young children and explore relations with child adjustment, the dyadic relationship and maternal emotional functioning. This will involve the use of multiple methods, i.e. questionnaires, interactive tasks, observations and ERPs. In order to extend the literature and also to increase the ecological validity of the study, the ERP measure will use cross-modal face and voice stimuli. All the research in this thesis is embedded in the proposed theoretical framework presented in Figure 1.7.

Chapter 2 Exploring Associations in Emotional Functioning in Parents and Children. A Systematic Review of Behavioural and Neuroscientific Studies

2.1 Abstract

Little research to-date has considered the direct influence of parental emotional functioning (EF) on its development in children. In this review, emotional functioning is defined as the ability to identify, understand and regulate emotions. This systematic review includes 16 studies that measured EF in both parent and child and assessed their association. It considered the diverse methods used to investigate EF and the specific contribution of neuroscientific methods. Associations were found between parental and child emotion regulation, which in some studies were specific to mothers and daughters. Results for emotion recognition were mixed. Whilst the addition of neuroscientific measures allowed for the exploration of more implicit forms of emotion, overall study heterogeneity made it difficult to draw firm conclusions regarding links between EF in parents and children at the neural level. Although a limited literature, findings highlight associations between parents and children's EF across different methodologies. Limitations and future directions for research are discussed.

2.2 Introduction

Emotional functioning involves the ability to recognise, understand and regulate feelings in oneself and others. The ability to recognise and differentiate between basic facial expressions of emotion is evident in infants as young as four months (LaBarbera et al., 1976). Emotion recognition is a fundamental component of emotion understanding,

which is often defined as the ability to identify the antecedents and consequences of emotions (Stein & Levine, 1999; Thompson, 1987). Emotion regulation is defined as the strategies used to change emotions, e.g. via emotional suppression (Southam-Gerow & Kendall, 2002), and where better emotion regulation strategies enhance social functioning (Cole, Hall, & Hajal, 2008). Emotion regulation emerges in infancy, with infants as young as five months showing some skill in regulating themselves from both positive and negative affect, using gaze aversion (Stifter & Moyer, 1991) and self-soothing behaviours such as thumb sucking (Stifter & Braungart, 1995).

Emotional functioning has been consistently linked to developmental outcomes in childhood, both concurrently and across time. Emotion understanding, for example, is argued to be one of the core components of social competence (Halberstadt et al., 2001). Empirical evidence supports both contemporaneous and longitudinal associations between emotion understanding and social adaptation over time (Denham et al., 2003). Greater emotion knowledge at age five has also been associated with better teacher-rated social skills and academic achievement when children were followed up aged nine (Izard et al., 2001). In preschoolers attending Head Start centres, poorer emotion knowledge has been linked to higher incidences of internalising problems (Heinze et al., 2015). Poorer emotion knowledge has also been linked to externalising difficulties across different ages groups (see review by Trentacosta & Fine, 2010). Further research has found that children with better emotion regulation scored more highly in tests of academic achievement on entering primary school (Graziano et al., 2007), and showed better teacher-reported school adjustment at the end of the school year (Shields et al., 2001).

2.2.1 Measuring emotional functioning

The measurement of knowledge of emotions in context is typically assessed using interactive tasks such as the Affective Knowledge Test (AKT; Denham, 1986). In this task,

young children are shown puppet faces and asked to label the emotion shown, and subsequently to identify the emotion that the puppet portrayed in a series of situations. Emotion recognition tasks are often computer based, asking children and adults to label or match the emotions presented to them (e.g. Montirosso, Peverelli, Frigerio, Crespi, & Borgatti, 2010; Nelson & Russell, 2011). Emotion regulation is commonly measured using questionnaires in both children (e.g. Shields & Cicchetti, 1997) and adults (e.g. Gross & John, 2003). Observational methods of emotion regulation in development typically involve the elicitation of a negative emotion such as frustration, for example through delaying gratification for the child (e.g. Shoda, Mischel, & Peake, 1990) or by having the parent and child complete a challenging or impossible task or discuss a controversial issue that potentially causes conflict (e.g. Han & Shaffer, 2013).

In recent years, neuroscientific measures of emotion processing in infants and children provided new insights in a number of ways. Neuroimaging methods have been argued to measure more implicit forms of emotion processing that cannot be explored behaviourally. For example, as some neuroimaging methods such as EEGs do not require a behavioural response, researchers have been able to study the development of emotion recognition in infants as young as 7 months (Grossmann et al., 2006), finding a larger negative component to angry compared to happy faces. Moreover, in a different study of 7-months-old infants, sensitive parenting was related to increased amplitudes in the negative central (Nc) component in response to positive facial expressions (Taylor-Colls & Pasco Fearon, 2015).

Other studies using neuroimaging methods were able to identify potential neural markers predictive of risk for later psychopathology. O'Toole et al. (2013), for example, presented five-to-seven-year-old children with angry, happy and neutral faces in an event-related potential (ERP) task and parents reported on child anxiety symptoms concurrently, and at a two year follow up. Anxiety at Time 1 was only predictive of later anxiety for

those children who showed an increased N170 amplitude to angry faces. The authors argued that this N170 response reflected an increased sensitivity to threat which is indicative of anxiety risk. Biomarkers have also been found using fMRI (functional magnetic resonance imaging) studies that have highlighted correlations between increased amygdala activity in preschoolers in response to emotional faces and parent-reported child negativity (as rated on the Emotion Regulation Checklist; ERC) both concurrently and at a follow up one year later (Gaffrey et al., 2016).

Taken together, we anticipated that the recent increase in studies employing neuroimaging methods will provide new insights into the development of emotional functioning in childhood and adolescence.

2.2.2 The role of Parenting

Psychological research and theory has highlighted that parental socialisation impacts children's development of emotional functioning. Theoretical models have posited several ways in which parents exert an influence on emotion development and emotion regulation; through (1) through modelling emotion expressions, (2) via their own reactions to situations and to their child's emotional reactions and (3) through discussion of emotion with their children (Eisenberg et al., 1998; Mirabile, 2010). Studies have shown, for example, that parents who react negatively to their child's display of emotion (e.g. with more punitive or minimising responses) rated their child as having poorer emotion regulation (Shewark & Blandon, 2015). Conversely, parents who engage in "emotion coaching" (Gottman, Katz, & Hooven, 1997) to utilise opportunities to support and discuss emotions typically have children who show higher levels of emotion understanding on the AKT (Denham et al., 1997) and parent-rated emotion regulation (Cunningham et al., 2009).

Further evidence suggests that parents who have more discussions with their 15-month-old children that focus on emotions and mental states (e.g., beliefs and desires) have children who go on to display better understanding of emotion at age two (Taumoepea & Ruffman, 2006). This association is supported by early research showing that more frequent discussions about emotions, which included focus on conflict resolution and causality of feelings, at age three were associated with a better ability to understand the emotions of a story character at age six (Dunn et al., 1991).

Theoretical models have also considered that parent emotional functioning may be a key contributor to child emotional functioning. For example, a theoretical model by Morris et al. (2007) proposed parental emotion regulation as one predictor of both parenting and family environment, and child characteristics which in turn would influence child emotion regulation. In support, Bariola et al. (2011) proposed that in order for parents to be effective socialisers of emotions, parents themselves must have good emotion understanding and regulation. Bariola et al. (2012) examined the link between maternal and paternal emotion regulation strategies with their children's emotion regulation strategies. The results showed an association between mothers' and children's use of suppression (i.e. inhibiting emotional expressions). Importantly, the authors were only able to identify two other studies assessing emotion regulation in families, both where the mother was diagnosed with depression, finding support for the influence of maternal characteristics on child regulation skills (Garber, Braafladt, & Zeman, 1991; Silk et al., 2006). The available evidence suggests that the importance of parent emotional functioning on the development of emotion understanding in children is not currently well understood (Bridgett, Burt, Edwards, & Deater-Deckard, 2015). Given the importance of emotional functioning in children on academic, social and mental wellbeing, parental factors that play a role in emotional development could be a target for potential

interventions and prevention. However, to date, no systematic review has been conducted to draw this evidence base together.

The primary aim of the present review was to collate and synthesise the findings of studies that have explored the direct association between emotional functioning in parents and children. These findings will be reviewed in the context of moderating factors, including age and gender. In line with recent research developments, the secondary aim of this review was to assess the specific contribution of neuroscientific methodologies to our understanding of the direct association between emotional functioning in parents and children

2.3 Method

2.3.1 Search Strategy and Study Selection

Four databases were searched (ERIC, MEDLINE, PsycINFO, and Web of Science Core Collection) for published journal articles. Databases were selected following a scoping search to identify key references, and were checked with the subject librarian. PsycINFO and MEDLINE were accessed via the EBSCO host platform and ERIC via proquest. The same search terms were entered into all four databases, specifying journal articles published in English only[1] and with no limit applied to the year of publication (see Appendix A for specific search terms). Search terms and inclusion and exclusion criteria were checked with all authors, an experienced doctoral student and a trained librarian for systematic reviews. Searches are up-to-date as of 08/08/2017. An updated search was run up until the 11/10/2019, with the results discussed in section 2.5.2. The protocol for this review can be seen at https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=41683.

[1] Articles were limited to English due to funding limitations preventing the use of a translation service.

Following initial scoping searches, books and dissertations were excluded to focus on peer-reviewed research. After removal of these, and of duplicates, 1838 records were screened by title and abstract.

Studies were included if the child participant's age was between 0-to-18 years. Two papers were identified for which the upper age of the child was over 18 (19 and 20-years-old, respectively: Bariola et al., 2012; Kim, Pears, Capaldi, & Owen, 2009). It was not possible to extract the data for only the younger children, therefore, it was decided to include any studies for which the majority of participants were under 18. In addition, and in order to allow for the assessment of the association between parental and child emotional functioning, papers were only included in this review if they considered at least one measure of emotional functioning for both the child and the parent (defined as an index of emotion regulation, recognition or understanding). Specifically, papers were only included if they directly measured the participants' skill with regards to their own emotion (e.g. parents' ability to regulate their own emotions, and not solely their ability to regulate their child's emotions). Studies were excluded if participants were reported to have a diagnosed neurodevelopmental disorder (e.g. an Autism Spectrum Disorder), a neurological disorder (e.g. epilepsy), severe developmental delay or attention deficit hyperactivity disorder.

Of the 1838 records screened by title and abstract, 1586 of the abstracts were excluded for reasons such as including populations with neurodevelopmental disorders, or not reporting a parent and child measure. Following full-text assessment of the remaining 252 articles, 190 were excluded, leaving 62 records. Figure 2.1 outlines the reason for exclusion, and following AMSTAR recommendations (Shea et al., 2017), all papers excluded from reading of the full-text are summarised in Appendix B. Reference lists of the 62 retained papers were checked resulting in the identification of a further eight relevant articles. The 70 records were discussed with all authors.

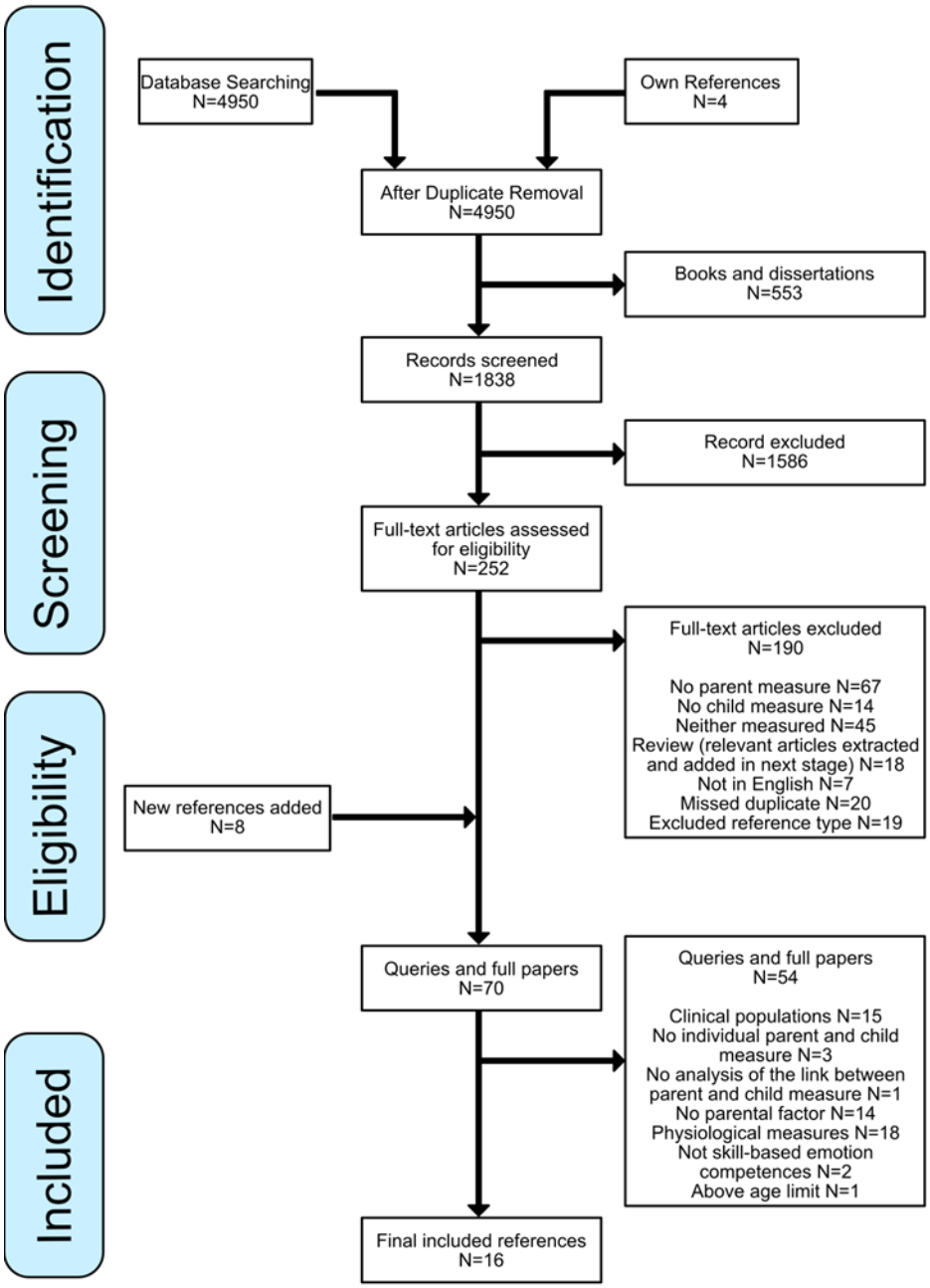

Figure 2.1. A PRISMA flowchart of the study selection process. Preferred Reporting Items for Systematic Reviews and Meta-Analyses, from Moher, Liberati, Tetzlaff, and Altman (2009)

An update was made to the original protocol (23/06/2018) registered on PROSPERO specifying that data on at risk or clinical populations should also be excluded due to the altered emotional trajectories in these groups (Pears & Fisher, 2005; Pollak, Cicchetti, Hornung, & Reed, 2000). In addition, reading of these papers highlighted that some used physiological measures of emotion, and where the focus was on general arousal

and not emotion specific competency, therefore, these papers were also excluded (Mauss & Robinson, 2009). Data from control groups in relevant papers (N=1; Kluczniok et al., 2016) were included. Additionally, for intervention studies (N=1; Havighurst, Wilson, Harley, Prior, & Kehoe, 2010), only pre-intervention data was considered. The 70 papers were reviewed again and these exclusion criteria were applied.

Study authors were also contacted by email twice, if necessary, for missing information: N=3 for participant gender (Buckholdt et al., 2014; Chen, 2015; John & DiLalla, 2013) and N=3 for analysis of the relationship between parent and child emotional functioning (Ferrer, Green, Oh, Hennessy, & Dwyer, 2017; Havighurst et al., 2010; Sreekrishnan et al., 2014). All but one author (Sreekrishnan et al., 2014) provided the necessary information for inclusion. Following this process, a final sample of 16 studies were included in the review.

Data extraction was carried out by the primary author, see Table 2.1 for details. All paper selection and screening was carried out by the primary author. An undergraduate student carried out reliability checks on each stage of the process. Due to time constraints, with only four hours a week available, the student screened two databases (ERIC and MEDLINE, 108 records, 5.88% of the full sample), finding the same three papers for inclusion as the primary author. Data extraction was also conducted on four of the included papers (25%), and any disagreements were discussed and clarified. Agreement on the quality assessment ratings were substantial (83.75%, $\kappa = .74$), and any discrepancies were discussed and clarified with the other authors.

2.3.2 Quality Assessment

The 16 included studies were assessed by the first author using the AXIS (Downes, Brennan, Williams, & Dean, 2016) tool for cross-sectional studies. The scale comprises 20 items pertaining to quality of reporting and risk of bias, see Appendix C for specific items.

Numerical values were attached to the items such that a 'yes' was scored as a 1 and a 'no' as 0 so that overall classifications could be derived. Items 13 "does the response rate raise concern about non-response bias," and 19 "were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?" were reverse scored. As one longitudinal study was identified (Gunzenhauser, Fasche, Friedlmeier, & von Suchodoletz, 2014), five additional longitudinal items from Croxford et al. (2018) were assessed[2]. Quality assessment for each paper are presented as proportional scores and where higher scores indicate increased quality. Studies that presented cross-sectional data from a wider longitudinal study were treated as cross-sectional (N=4, i.e. Bariola et al., 2012; Castro et al., 2015; John & DiLalla, 2013; Kluczniok et al., 2016). Following Sacolo, Chimbari, and Kalinda (2018), overall quality classifications were created following the thresholds: low (0-.44), moderate (45-.79) and high (.8-1).

2.4 Results

Information on the study, number and demographics of the participants, measures and relevant results (i.e. those pertaining to the question of this review) for these 16 studies are presented in Table 2.1.

Emotional functioning was operationalised as emotion recognition, regulation and understanding. Data extraction and synthesis of the 16 studies are organised with reference to these three components. To address the secondary aim of assessing the contribution of neuroscientific methods to the literature, each section was organised around the methods used.

[2] One study involved the continuous collection of data over six months (Chen, 2015), but change over time was not considered, so this study was treated as cross-sectional.

Table 2.1
Data Extraction for the Included Studies

Paper details	Demographics	Study design	Parent measure of EC	Child measure of EC	Relevant results	QA score
1) Buckholdt et al. (2014)	80 parent-child (12-18 year olds, 25 boys) dyads. 79% African-American. 86% biological mothers	Cross-sectional	Difficulties in Emotion Regulation Scale (DERS, Gratsz & Roemer, 2004). 36 items with 6 subscales of clarity, awareness, acceptance, goals, strategies and impulse control. Scores on the items were averaged to create one dysregulation score	DERS	Parent and adolescent emotion dysregulation were significantly correlated (r =.26, p < .05)	Moderate
2) Saritas, Grusec, and Gencoz (2013)	365 school students and their mothers (14-17 year olds, M =15.16, 157 boys).	Cross-sectional	DERS	DERS	There was a significant correlation between mothers and daughters' ER difficulties (r = .27, p < .001) but not sons (r = .11, ns)	High
3) Bariola et al. (2012)	379 children (aged 9-19, 165 boys) and their 358 mothers and 207 fathers	Data from the 5th wave of a longitudinal project	Emotion regulation questionnaire (ERQ, Gross & John, 2003) 10 items assessing the subscales of	Modified ERQ-CA for children and adolescents. Same subscales as the parents	Only mother and child suppression use were significantly correlated (r = .21, p < .001) which	High

Paper details	Demographics	Study design	Parent measure of EC	Child measure of EC	Relevant results	QA score
			reappraisal and suppression		became non-significant after adding paternal emotion regulation to the model	
4) Ferrer et al. (2017)	1556 parent (75% mothers) - adolescent dyads (M =14.45, 50% boys) Matched to represent US population	Part of a larger study	The 4 item suppression subscale of the ERQ	The 4 item suppression subscale of the ERQ	Parent and adolescent suppression were significantly correlated ($r = .24$, $p < .001$). Mother and daughter's ($r = .27$, $p < .001$) and son's suppression ($r = .18$, $p < .001$) were significantly correlated as were fathers and sons ($r = .43$, $p < .001$) and daughters ($r = .25$, $p < .001$).	High
5) Crespo, Trentacosta, Aikins, and Wargo-Aikins (2017)	454 mother (18-54, M=33.38)-child dyads (aged 3-7 years 11 months, 236 boys, stratified by age and	Participants were taking part in a larger study of parenting stress	DERS. 1 subscale on awareness and the other 5 were collapsed into a difficulties in regulation subscale	Mothers completed the Emotion Regulation Checklist (ERC; Shields & Cicchetti). The regulation subscale	Child difficulties in regulation was significantly correlated to maternal lack of awareness of emotion ($r = .29$, p	High

Paper details	Demographics	Study design	Parent measure of EC	Child measure of EC	Relevant results	QA score
	gender across years). Operationalised as preschool (3-4) and school age (5-7) 75% Caucasian			was reverse scored to make it difficulties in regulation	< .01 overall; r = .26, p < .01 preschool, r = .31, p < .01, school) and maternal difficulties in regulation (r = .22, p < .01 overall; r = .22, p < .01 preschool, r = .26, p < .01, school). Child negativity was significantly correlated to both maternal difficulties in regulation (r = .37, p < .01 overall; r = .31, p < .01 preschool, r = .41, p < .01, school), and maternal lack of awareness of emotion (r = .16, p < .01 overall; r = .22, p < .01, preschool) but not for school aged	

Paper details	Demographics	Study design	Parent measure of EC	Child measure of EC	Relevant results	QA score
					children (r = .12 p > .05)	
6) Gunzenhauser et al. (2014)	118 children (58 boys) and their mothers (N=117) and fathers (102). M at Time 1= 5.11, M at Time 2= 6.63, boys were significantly older than girls	Part of a longitudinal study. T1=parental emotion regulation T2= children's emotion regulation	ERQ	Modified the German ERQ to be used for caregiver report (finding good psychometric properties).	Parent reappraisal was significantly correlated to child reappraisal (r = .34, p < .001) Parent suppression was significantly correlated to child suppression (r = .24, p < .001)	Moderate
7) Han and Shaffer (2013)	64 mother-child dyads (26 boys, aged 8-11, 50% African-American).	Cross-sectional	DERS	Mother-reported ERC Children completed the Children's Emotion Management Scales (CEMS, Zeman et al.) for sadness, anger and worry Observations of the child's negative expressions during the 4 interaction tasks with their mother, ("imaginary happening" of life	Maternal emotion dysregulation was only correlated to maternal report of child emotion regulation (r = .31, p < .001) and not child reports (r = .07, ns) or observer reports (r = .13, ns) Mothers of boys reported having significantly more difficulty managing their own emotions	High

Paper details	Demographics	Study design	Parent measure of EC	Child measure of EC	Relevant results	QA score
				50 years in the future, a conflict discussion task, an etch-a-sketch drawing task, a logic puzzle) on a scale of 1-7	Lower income mothers reported significantly more regulation problems in both themselves and their child African-American children reported having significantly more problems managing their own emotions	
8) Morelen et al. (2016)	64 mother-child dyads (8-11, M=9.5, 26 boys) Ethnically diverse	Cross-sectional	Emotion dysregulation: DERS ER: Behavioural observations in the conflict discussion task with their child. Rated from 1(extremely dysregulated) to 7 (extremely regulated)	ERC (2 items for the ER subscale were removed due to poor reliability). Children's Emotion Management Scales for Sadness (CSMS-12 items), anger (CAMS-11 items) and worry (CWMS-13 items) > Self-report. A composite dysregulation score	Mothers who were more dysregulated (DERS) rated their children as more dysregulated (negativity subscale, $r = .30$, $p = .02$) with lower regulation scores (ER subscale, $r = -.36$, $p = .004$) Observed maternal ER was marginally associated with child report of	High

Paper details	Demographics	Study design	Parent measure of EC	Child measure of EC	Relevant results	QA score
				from the 3 was created -Same behavioural rating	dysregulation (r = -.25, p = .05) When controlling for child sex, ethnicity and family income together, the relationship between mother reported maternal and child dysregulation (r = .28, p = .05) and ER (r = -.27, p = .05) became only marginally significant and non-significant between mother ER and child self-reported dysregulation (r = -.16, p =.24).	
9) Chen (2015)	4 families (mothers and fathers), with a total of 6 children (4 boys, M = 4, aged 3-6	Naturalistic study	Video data was collected over 6 months (48.25 in total). Some was filmed by the researcher and some by the parents. A series of emotionally charged interactions	Same process as the parents	5 types of emotionally charged interactions (desire-eliminating, joy-discontinuing, dislike-taking, interest-vanishing,	Moderate

Paper details	Demographics	Study design	Parent measure of EC	Child measure of EC	Relevant results	QA score
	Participants had a similar SES profile and number of children		were selected and analysed at the individual, family level and overall 12.75 hours of interviews		problem-solving) were identified Found 20 parent strategies and 5 child strategies There was a large overlap between the types of strategies parents and children used	
10) Daughters et al. (2014)	139 adolescents (aged 14-18) and their biological mothers (74 boys). Representative ethnicities	Cross-sectional	The computerised Paced Auditory Serial Addition Task (PASAT-C). Participants had to add a sequence of numbers and correctly select the answer before the next one appeared. Feedback was given in the form of winning/losing points and pleasant/aversive noises. 3 levels of increasing difficulty. In the stress phase, the time between numbers was set to exceed the skill level, and	Same as parent	Maternal DT was set as the predictor with adolescent DT as the outcome, and gender as the moderator. Covariates of maternal age and depressive symptoms were added. They found mothers with low DT were significantly more likely to have a daughter with low DT but the same was not true for their sons.	High

Paper details	Demographics	Study design	Parent measure of EC	Child measure of EC	Relevant results	QA score
			participants were told they could quit at any time but that it would affect their payment. DT (distress tolerance) was operationalised as quitting or completing the task			
11) Kluczniok et al. (2016)	Depressed mothers with or without a history of abuse and controls. There were 14 mother-child control dyads (M =8.4, range 5-12, 7 boys)	Participants were a subgroup of a larger research project	Computerised affect recognition task where faces were morphed from neutral (0%) to happy, sad, angry or fearful (100%) in 1% increments (10 per second) 16 trials of each emotion. Participants were asked to respond with a button press to one of the 4 emotions as soon as they could identify it	The same task except only for happy, sad and angry and only 12 trials of each Responses could be via button press or verbally	Mothers' and children's' accuracy at recognising sadness were not significantly correlated ($r = .23$, $p > .05$) Sadness bias (tendency to misinterpret a different emotion as sadness) was also not significantly correlated in mother-child dyads ($r = .24$, $p > .05$)	High
12) John and DiLalla (2013)	58 mother-child dyads (aged 6-10, M = 8.55, 50% male). 80% Caucasian	Cross-sectional but 52/58 families were part of	The DANVA2 (diagnostic analysis of nonverbal accuracy) Participants viewed 24 pictures of happy, sad,	The DANVA2	Children's fearful bias in the DANVA was not significantly correlated to parents	High

Paper details	Demographics	Study design	Parent measure of EC	Child measure of EC	Relevant results	QA score
	The target child was randomly selected for each family	a longitudinal twin study	angry and fearful children's faces for 2 seconds and were asked to identify the emotion presented Toronto Alexithymia Scale (TAS). 20 items measured on a 1-5 scale		fear bias (r = .10) or parents difficulty identifying feelings (r = -.23) But it was significantly related to parents difficulty reporting feelings (r = - .26, p < .05)	
13) Castro et al. (2015)	69 parent-child dyads Children aged 8-11 (33 boys), parents between 28 -53. 79% mothers. 34 were African, American, 5 European American and 30 Lumbee American Indian	Families were enrolled in a larger study	Parent and child engaged in a 7 minute problem solving discussion on a conflict eliciting topic e.g. bedtime which were used to create short clips. Participants were asked to label their own and other dyad members emotions. Scores were calculated based on matching own and other's rating from 0 (no agreement) to 1 (perfect agreement)	Same as parent	Parent and child emotion recognition were significantly correlated (r = .26, p < .05)	High
14) Minagawa-	18 mothers with 15 infants (9-13 months, 8 boys)	Cross-sectional	Neutral and smiling video clips were obtained of the mother	Same procedure as for the mothers	Significant differences between the two emotions	Moderate

Paper details	Demographics	Study design	Parent measure of EC	Child measure of EC	Relevant results	QA score
Kawai et al. (2008)			and the infant (presented without sound) Using NIRS (near-infrared spectroscopy) mothers were presented with the 2 emotions in her infant and an unfamiliar infant and vice versa with neutral as the baseline condition. Target area was the prefrontal region		was only found for the own dyad member condition and not when shown an unfamiliar person. In mothers this was maximal in the right anterior orbitofrontal cortex and in infants likely the anterior orbitofrontal cortex Despite this shared area, there were no significant correlations between the response for each channel in the mothers and her infant	
15) Telzer et al. (2014)	22 parent (19 mums, 3 dads)-adolescent dyads (M= 17.71 years, 8 boys). Parents were the primary caregiver	Cross-sectional	fMRI affect labelling task. Participants were presented with a negative emotional face (from the NimStim; Tottenham et al., 2009) and asked to select one of two	Emotional competence: reverse scored TAS so that higher scores indicated greater emotional competence Same fMRI task	No significant correlations between activation in the same areas (e.g. amygdala) in parent and child Parents with greater activation in the	Moderate

Paper details	Demographics	Study design	Parent measure of EC	Child measure of EC	Relevant results	QA score
	All Mexican ethnic background		written labels for the emotion (one correct and one same valence but incorrect). Approximating "putting feelings into words"		bilateral amygdala, bilateral VLPFC, bilateral STS, right TPJ, pSTS, DMPFC and precuneus had adolescents with higher emotional competence, even when controlling for parental expressivity and adolescent report of parental warmth and support. A significant mediation between parent's activation and adolescent emotional competence was mediated by the adolescent's brain activation, in both the TPJ and the temporal pole (areas commonly associated with mentalising)	

Paper details	Demographics	Study design	Parent measure of EC	Child measure of EC	Relevant results	QA score
16) Havighurst et al. (2010)	216 parent (primary caregivers, 207 mothers)-child dyads (113 boys) at T1. 106 intervention families, 110 control. Aged 46-68 months at T1 161 in the subsample with emotion understanding data (157 at T1) Low-middle class SES.	Longitudinal intervention study T1, pre-intervention data was analysed	DERS	Emotion knowledge: composite score of two subscales assessing causal knowledge (e.g. what made the puppet sad) and accuracy of emotion identification and situational resolution (e.g. pushed over by another child, how do they feel and what do they do?) using Denham's (1986) Affective Knowledge Test.	Parental difficulties in regulating emotions was unrelated to child emotion knowledge ($r = -.05$, $p = .57$).	High

Note. T1 = Time 1, T2 = Time 2, M = mean, ER = emotion regulation, EC= emotional competence, QA= quality assessment, ns = not significant, SES = socioeconomic status, fMRI = functional magnetic resonance imaging, VLPFC = ventrolateral prefrontal cortex, STS = superior temporal sulcus, TPJ = temporal parietal junction, pSTS= posterior superior temporal sulcus, DMPFC = dorsomedial prefrontal cortex.

2.4.1 Quality assessment

Eleven of the papers were classified as high quality and the remaining five as moderate quality (see Table 2.1). The most common limitation concerned sample size, with only one study providing a power analysis to justify their sample size (12). Most studies employed opt-in methods to recruit participants which were less likely to provide a representative sample (1, 2, 4, 5, 7 & 8). The use of a cross-sectional design when testing mediation models to specify directionality of effects was a further limitation in several studies (1, 3, 6, 8, 9 & 15). Despite these limitations, all 16 studies were of adequate quality to be included in the review (see Appendix C for item-by-item scores).

2.4.2 Emotion regulation

2.4.2.1 Measures

Of the 16 included studies, 10 measured emotion regulation (1-10). Eight of these measured emotion regulation using questionnaires (1-8), two of which also utilised observer ratings of emotion regulation (7 & 8). One study used naturalistic observation of lived experiences in families (9) and one used a computer-based paradigm to measure distress tolerance as an index of emotion regulation (10). Questionnaire methods included the Emotion Regulation Questionnaire (ERQ: Gross & John, 2003, 3, 4 & 6), the Difficulties in Emotion Regulation Scale (DERS: Gratz & Roemer, 2004, 1, 2, 5, 7 & 8) and the Emotion Regulation Checklist (ERC: Shields & Cicchetti, 1997, 5, 7 & 8). The ERQ is comprised of items reflecting two subscales - an adaptive cognitive reappraisal strategy to emotion regulation (e.g. “when I want to feel less negative emotions I change the way I am thinking about the situation”) and a less adaptive expressive suppression strategy (e.g. “I keep my emotions to myself). The ERC measures a child’s tendency towards negativity such as emotional outbursts and intense emotional displays (e.g.

"responds angrily to limit setting by adults") and adaptive emotion regulation (e.g. "is a cheerful child). The DERS includes 6 subscales, with the majority of studies utilizing a single aggregated dysregulation score, and study 5 the emotion dysregulation and lack of emotional awareness subscales.

Observational methods of emotion regulation included ratings of intensity and frequency of negative emotional expressions in the parent-child dyad during conflict discussion tasks (7 & 8) and other parent-child interactive tasks (8; i.e. an "imaginary happening" task involving discussion about life 50 years in the future, a drawing task and a logic puzzle task) in the parent-child dyad. One study conducted in-depth video observations over a period of six months in the homes of four families, to capture parents' and children's emotion regulation strategies in naturalistic contexts (e.g. when the child is not able to get what they want, or have to do something they do not want to, 9).

The final study measured distress tolerance as a proxy of emotion regulation through a computer-based paradigm where distress was experimentally induced. Distress tolerance was captured as a dichotomous variable categorised as either high distress tolerance (i.e. participants completed the distress tolerance phase) or low distress tolerance (i.e. participants opted to withdraw during the distress tolerance phase, 10). All studies were cross-sectional with the exception of study 6.

2.4.2.2 Associations between parents and children

When assessing emotion regulation, studies have considered dysregulation, adaptive regulation and possible moderators of the association. The majority of studies on emotion regulation included an assessment of parents and children's' dysregulation (1-8, 10), of which half included adolescent participants. In these, small but significant positive correlations were consistently reported for emotion dysregulation (1; r=.26) and suppression (4; r=.24) between parents and adolescents, mothers and children's use of

suppression (3; r=.21), and between mothers and daughters' dysregulation (2; r=.27) and distress tolerance (10; r=.26).

Two studies provided data on middle-childhood. Both studies combined questionnaires with observation in samples of eight-to-eleven-year-olds and their mothers (7 & 8). In one study (7), mothers reported on their own and their child's emotion dysregulation using the DERS and the ERC respectively, and showed a modest positive correlation (r=.31) between the two. However, the mother's report on her own emotional dysregulation was unrelated to both the observer report and child self-reported dysregulation. The second study (8) also included an observation measure of maternal emotion dysregulation. Observed adaptive maternal regulation was marginally negatively associated with child self-reported dysregulation (r=-.25), but after gender, ethnicity and family income were all controlled for this relationship became non-significant. Study 7 similarly reported that demographic variation was associated with emotion regulation, with lower income mothers reporting more dysregulation in themselves and their child, mothers of boys self-reporting more dysregulation, and African-American children self-reporting more difficulties in emotion regulation.

Two of the ten studies explored emotion regulation in younger children, one longitudinally (6) and one cross-sectionally (5). Study 5 considered links between mothers and children's dysregulation in a sample of three-to-seven-year-olds using the two scale version of the DERS (maternal lack of awareness and difficulties in managing emotions) and the ERC. Significant correlations were reported between child dysregulation and subscales measuring maternal lack of awareness, and maternal difficulties in managing emotions for both the younger (three-to-four-year-olds) and older children (five-to-seven-year-olds). Child negativity assessed on the ERQ was also significantly correlated with maternal difficulties in managing emotions across both age groups, and for the younger age group, child negativity was positively related to maternal lack of awareness (see Table 2.1

for correlation coefficients). The only longitudinal study identified, study 6, reported a positive correlation (r= .24) between parental use of suppression at age five and children's use of suppression approximately 1.5 years later.

Four of the ten studies (3, 6, 8 & 9) assessed associations between parents and children's' adaptive emotion regulation. In a sample of nine-to-19-year-olds, no association between use of reappraisal in parents and offspring was found (3). As with the findings for dysregulation, study 8 found a significant negative association for mothers' dysregulation and her reports of her child's adaptive emotion regulation. However, once gender, ethnicity and family income were controlled for the association was only marginally significant (r=-.27, p=.05). A further study (6) reported that parents' use of reappraisal when children were five years old, predicted their children's use of reappraisal 1.5 years later.

One qualitative study explored emotion regulation in depth in a sample of four families with children aged three-to-six-year-olds (9). Five emotionally charged interactions were observed in the families (e.g. interest-vanishing, when the child loses interest in a task), within which 20 parent emotion regulation strategies were observed. These strategies were then grouped into larger categories of emotion regulation strategies, for example touch and distracting the child's attention were classified as behavioural strategies and approach/avoidance behaviours as antecedent focused. The authors reported a large degree of correspondence between these 20 strategies observed in parents and the five strategies observed in their children.

Child gender was assessed as a moderator in two studies but only in relation to associations between parents' and their children's dysregulation (2, 10). Both reported that associations remained significant between mothers' and their adolescent daughters', but not sons', emotion dysregulation (2) and distress tolerance (10). One study considered parent gender (3). The only association reported in this study was between mothers', but

not fathers', and their children's use of suppression, although the association between mothers and children did not remain significant once paternal emotion regulation strategies were entered into the model. While the other studies did not statistically explore parent or child gender as a moderator, it is worth noting that study 4 reported associations for the use of suppression in both mother-child and father-child dyads which were significant for both parents with both their daughters and sons.

In summary, all ten studies which assessed the link between emotion regulation in parents' and children, reported a positive association. Nine studies found modest associations (r=.21-.31) across different methodologies (questionnaires, observations and a computer task). All studies considered the association between mothers and their children. Only two included measures of fathers' emotion regulation with one reporting no direct association between fathers and their children's emotion regulation but fathers' emotion regulation moderated the association between mothers' and their children's suppression. The other study reported significant association between fathers and their children's suppression. Two studies considered the role of child gender and converged in reporting significant effects for mother-daughter but not mother-son dyads (2 & 10). Two studies (7 & 8) highlighted further important associations with demographic variables such as family ethnicity and income. Associations between adaptive emotion regulation in families were reported in studies with predominantly younger children (three-to-seven-year-olds, 6, 8 & 9) and not older children (nine-to-19-year-olds, 3). The majority of studies were conducted on adolescents (5/10), were cross-sectional (9/10), and focused on emotion dysregulation (9/10), with relatively few studies including children younger than eight (5, 6 & 9), investigating adaptive emotion regulation strategies (3, 6, 8 & 9), or using longitudinal designs (6).

2.4.3 Emotion recognition

2.4.3.1 Measures

Five studies assessed emotion recognition abilities in both parents and children (11-15). All five studies presented computer based emotional stimuli but differed as to whether they operationalised emotion recognition as the ability to recognise the other dyad members' expressions (13 & 14) or those of unfamiliar adults (11, 12 & 15). Differences were also apparent in the mode of presentation, with three studies presenting static emotional faces (11, 12 & 15) and two presenting short video clips (13 & 14). In two studies, participants were also asked to self-complete the Toronto Alexithymia Scale (TAS: Bagby, Parker, & Taylor, 1994) to assess either overall emotional functioning (reverse scored, 15) or the two subscales of difficulties in identifying feelings and describing feelings (12). Two studies reported neuroscientific data for both dyad members using near-infrared spectroscopy (NIRS, 14) and fMRI (15).

2.4.3.2 Associations between parents and children

In contrast to emotion regulation, the majority of studies examining emotion recognition were conducted on samples of children in middle childhood with ages ranging from five-to-twelve-year-olds (11, 12 & 13). One study found a significant positive correlation ($r = .26$) between parents and their children's (eight to eleven years old) ability to recognise each other's emotions in short video clips from a problem-solving task (13). However, other studies found conflicting results. One of these studies (11) presented a sample of mothers and their five-to-twelve-year-old children with morphed faces of strangers which transformed in 1% increments from 0% emotion (neutral) to 100% of either sadness, anger or fear (fear was not included for the child participants). Participants were asked to press a stop button and label the emotion as soon as they were able to. Only recognition of sadness was explored, and no association was found between the mother and

child's ability to recognise sadness, nor for the tendency to incorrectly attribute sadness to a different emotion (response bias). Similar to the findings of study 11, study 12 did not detect an association between mothers and their children's fear biases (i.e. tendency to attribute fear to non-fearful faces). Aiming to explore social biases which may underlie reports of victimisation, a sample of 58 six-to-ten-year-olds and their mothers were presented with children's faces from the DANVA2 (Diagnostic Analysis of Nonverbal Accuracy 2: Nowicki Jr, 2006) and asked to identify the emotion presented. Mothers additionally completed the TAS. Children's fear bias was unrelated to maternal difficulty in identifying feelings, but showed a significant negative association ($r = -.26$) with maternal difficulty in describing emotions on the TAS.

In summary, the current studies provide weak evidence for an association between parents' and their children's emotion recognition ability based on studies using facial emotion recognition paradigms. One study, however, reported an association when video expressions of the other dyad member were presented.

Two studies (14 & 15) presented data using neuroscientific methods to assess correspondence in dyad's responding to emotional stimuli. In one study (14), soundless video clips of the other dyad member or an unfamiliar peer were presented to mothers and their 15-month-old infants (i.e. presenting the infant with a video of their own mother smiling or a video of an unfamiliar women smiling). Using NIRS, activation in the orbitofrontal cortex was found to be significantly higher in response to the display of the dyad member compared to the unfamiliar peer, with the strongest effects evident for the smiling condition (vs neutral) for both mothers and infants. However, despite mothers and infants showing this similar pattern of response, there were no correlations between their neural responses in specific channels.

The second study was a mixed methods study and assessed the correlation between parent and adolescent's ability to label negative emotional faces (fearful and angry;

Tottenham et al., 2009) from the NimStim during an fMRI task (15). Emotional competence in adolescents was also assessed using a self-reported reverse scored TAS. Consistent with study 14, no significant correlations were found between activation of specific brain regions in parents and adolescents (e.g. amygdala activation in the parent did not correlate with amygdala activation in the adolescent). However, increased activation in parents in response to the emotional faces in regions associated with emotion processing (i.e. bilateral amygdala, bilateral ventromedial prefrontal cortex, bilateral superior temporal sulcus (STS), right temporal parietal junction (TPJ), dorsomedial prefrontal cortex and precuneus (PCC)) correlated with greater emotional competence (TAS score) in adolescents. The authors further tested whether this relationship was mediated by adolescent activation in brain regions associated with emotion processing, focusing on those most commonly associated with 'mentalising' (i.e. inferring other's emotional states). A significant indirect effect of parental brain activation on adolescent's emotional competence via adolescent brain activation was demonstrated for both the right TPJ and the right temporal pole, accounting for 28-65% of the variance in the adolescents' TAS score. This finding suggests a neural mechanism through which adolescents may develop emotional competence. None of the other brain regions associated with emotion processing (STS, PCC, and precentral gyrus) in adolescents were significant mediators.

In summary, characterising dyadic emotion recognition at the neural level using neuroimaging methods is an emerging field of investigation. The two studies identified in this systematic search showed that similar patterns of neural response to emotional stimuli were observed in parents and their infants (14) and adolescents (15), but there were no associations between specific brain regions (15) and channels (14). Secondly, study 15 provided some preliminary evidence for parents' neural responding in regions associated with emotion processing, to be correlated with adolescent self-reported emotional competence score using the TAS. Moreover, activation in adolescents' right TPJ and

temporal pole mediated the association between parental brain activation in response to emotional stimuli and their adolescents' TAS score.

2.4.4 Emotion understanding

Only one study (16) examined emotion understanding in children in relation to their parent's emotion regulation. Three-to-six-year-old children completed two subscales of the Affective Knowledge Test (Denham, 1986) to indicate their own level of emotion understanding. Their parents reported on their emotion dysregulation on the DERS. Parental emotion dysregulation was not associated with their child's emotion knowledge.

2.5 Discussion

The primary aim of the review was to assess the relationship between emotional functioning in parents and children. Emotional functioning was operationalised to include emotion recognition, regulation and understanding. Sixteen studies were identified which included measures of emotional functioning in both parents and children and reported their association. Ten studies focused specifically on emotion regulation, five on emotion recognition, and one on emotion understanding. Two studies provided neuroimaging data from both dyad members to explore the relationship between parents' and their children's patterns of emotion processing at the neural level.

This review highlighted the considerable heterogeneity across studies within this field. Studies differed in relation to the age of the sample, spanning all the different developmental periods from infancy to late adolescence. Second, because the construct of emotional functioning was operationalised to include emotion recognition, regulation and understanding, this meant that studies ranged in their specific focus (e.g. whether they examined emotion recognition versus emotion regulation). Thirdly, the ways in which

emotional functioning was assessed varied across studies and included questionnaires, observations, experimental tasks, neuroimaging, or a combination of these approaches.

The most common outcome measure was child emotion regulation, used in ten of the sixteen studies. Emotion regulation was measured across age groups and via diverse methodologies including questionnaire, observational, and experimental methods. All 10 studies demonstrated modest, but significant associations between emotion regulation strategies in parents and children. These associations are consistent with the theoretical model by Morris et al. (2007), proposing that parent's individual emotion characteristics, including regulation of emotion, would contribute to emotional development in their children by influencing the family environment and parenting behaviour. The association in the current review was most evident for studies assessing emotion dysregulation or suppression (e.g., 3). It is possible that some strategies linked to emotion regulation, such as suppression, may be more overtly observable (Gross & John, 2003) to children than the more internal cognitive strategies such as reappraisal.

Two of the 10 studies focusing on emotion regulation explored child gender as a moderator (2 & 10). Both reported that correlations for emotion regulation were only significant between mothers and their adolescent daughters. These findings could in part be due to differing socialisation of daughters and sons. Social learning theory (Bandura, 1977), for example, stresses the importance of parental modelling, and there is suggestion that daughters may attend more to models of the same gender (Daughters et al., 2014). Further studies have found that parents tend to discuss sadness more with daughters and anger more with sons (Dunn, Bretherton, & Munn, 1987). A third study in this review (3) found that parent-child correlations of emotion suppression were only significant for mothers but not for fathers. The authors suggested that mothers may be more involved in emotion socialisation and thus children may more directly model their regulation

strategies, although the broader literature, including study 4, also supports the influence of paternal emotional functioning.

Importantly, a recent meta-analysis highlighted differential effects of maternal and paternal parenting behaviours on child emotional development (i.e. anxiety symptoms; Möller, Nikolić, Majdandžić, & Bögels, 2016). Specifically, they showed that fathers who elicited more challenging behaviours in children (i.e. encouraged children to engage in activities that were out of their comfort zone) had children with fewer anxiety symptoms. This association was not evident for mothers and children. The paper is important in highlighting different parenting pathways to internalising difficulties in children. Not all studies in the current review included fathers, and not all of those which did, found an association with children and adolescents (e.g. 3).

Emotion recognition was assessed in five studies (11-15) two of which used neuroscientific methods (14 & 15). Two studies assessed emotion recognition via facial expressions in unfamiliar faces of children (12) and adults (11). Neither study detected significant correlations between parent and child ability. In contrast, when an affect recognition task was used which required the recognition of emotions in the other member of the dyad (13), a significant association between mothers and children's emotion recognition was found. In other studies, infants from as young as three-and-a-half-months were shown to more accurately recognise and show preference for emotional expressions displayed by their mothers as opposed to strangers, suggesting that social context may be a key factor when studying emotion recognition (Kahana-Kalman & Walker-Andrews, 2001). Consistently, attachment theory emphasises the ability to identify correctly and respond to emotions from caregivers as key to infant survival (Bowlby, 1978). Study 14 supports this by finding an emotion specific effect between infants and mothers, in which smiling was significant compared to neutral expressions.

In addition to person familiarity, study 13 also used a paradigm for emotion recognition based on dynamic instead of static facial expression of emotions through displaying short video recordings, thus enhancing ecological validity and meaning (Niznikiewicz, 2013). The three studies (11, 12 & 13) which did not use neuroimaging methods were all conducted on samples of children in middle childhood (ages five-to-12-years-old), thus developmental differences underpinning the contrasting findings are unlikely. Instead, it seems likely that differences in task stimuli account, at least partially, for the contrasting results. Indeed, research has consistently found a 'facilitation effect' for cross-modal emotional stimuli with larger neural responses and shorter processing time being reported (Jessen et al., 2012; Kokinous et al., 2014; Yeh et al., 2016). Taken together, these studies indicate that emotion recognition in children is partly a function of the mode of presentation (Nelson & Russell, 2011).

Two studies used neuroimaging data to assess the relationship between parent and children's neural response during emotion recognition. Neither study detected a significant correlation between mothers' and children's emotion recognition in specific channels and brain regions (14 & 15). However, study 15 provided evidence for a neural mediation model in which adolescent brain activity mediated the relationship between parent neural activation and adolescents' self-rated emotional competence. This study extends previous research by providing an index of more implicit forms of emotion recognition. Moreover, its findings provide the first tentative evidence for a dyadic neural pathway through which adolescents may achieve greater emotional competence. Together, the studies suggest that person-familiarity may also be important for the study of the relationship between emotion recognition in parents and children.

Only one study was identified which used the child's emotion understanding as the outcome measure (16). The child's emotion understanding was not related to parental emotion dysregulation. Notably, although emotion regulation, recognition and

understanding are commonly conceptualised together in theoretical models (e.g. Eisenberg et al., 1998; Mirabile, 2010), this was the only study identified in the review to combine measurement of different indices of emotional functioning (16). Additionally, no studies explored emotion understanding in parents, which in part may be due to a lack of well-validated measures. Existing measures such as the Situational Test of Emotion Understanding (MacCann & Roberts, 2008) have demonstrated poor reliability in follow up research (Austin, 2010; MacCann, 2010) with alphas of .48 and .55 respectively.

This review highlighted that parent emotion regulation was associated with emotion regulation in children, with some studies indicating stronger relationships between mothers and daughters. Findings concerning the association in the parent-child dyad for emotion recognition were mixed, with only two of the five studies reporting a link between parents and children. Only one study explored emotion understanding in children, finding no association with parental emotional dysregulation. This limited literature on emotion understanding and recognition makes it hard to draw reliable conclusions on the associations in families, highlighting the need for future research focusing on these elements of emotional functioning. Furthermore, the scarcity of studies using neuroscientific methods limits our ability to assess its contribution to an emerging field. Nevertheless, existing research does suggest that these studies have extended current understanding to demonstrate evidence for neural mechanisms of emotional transmission.

2.5.1 Limitations and Future Directions

Several limitations in this body of work need to be considered. Firstly, all but one of the studies were cross-sectional. Accordingly, inferences about the direction of effects for transmission of emotional functioning in the family are not possible. Indeed, research has highlighted bidirectional influences in the family (Arellano, Gramszlo, & Woodruff-Borden, 2018; Reitz et al., 2006; Storch et al., 2015). Furthermore, these studies do not

consider genetic influences which may underlie the relationship between parents and children's emotional functioning. For example, research with same-sex twin pairs found that genetics accounted for 43% of the variance in emotion regulation scores in three-year-olds (Wang & Saudino, 2013), demonstrating the importance of considering factors beyond family environment. Secondly, while the diverse age ranges and methods used across studies allowed for the investigation of effects across development, it made it difficult to draw firm conclusions about the dependency over time of children's development of emotional functioning in relation to their parents' emotional functioning. Thirdly, there is a chronic lack of studies assessing fathers' emotional functioning, limiting understanding of the contributions of the broader family system to the development of children's emotional functioning. Fourthly, the majority of studies focused on older children and adolescents. Future research should aim to include younger participants to allow for exploration of developmental trajectories, for example by using neuroscientific methods to assess emotional functioning from infancy. Finally, several of the studies relied on parental self-report and parent-report of the child's emotional competencies, subjecting the findings of these studies to a possible reporter bias. In the context of depression, for example, parents have been found to over-report emotional problems in their children (England & Sim, 2009).

The review process itself was not without its limitations. Although the use of peer-reviewed journals ensured good quality of results, with all studies being rated of moderate or high quality according to the quality assessment used, the exclusion of grey literature risks the findings being subject to a publication bias. The exclusion of clinical samples, while allowing for exploration of typical emotional trajectories, limits the ability to generalise these findings to clinical populations. Additionally, this search included only articles published in English. This decision, although restricted by funding practicalities,

may have led to relevant articles not published in English being missed, thus introducing an element of language bias to this review.

In conclusion, the present findings present consistent associations between emotion regulation in families, supporting theoretical models, and suggest some correspondence between emotion recognition in parents and children. Future research using longitudinal designs is needed to better understand the developmental trajectories of these associations. Further studies utilising neuroscientific methods would allow for study of more implicit forms of emotion processing, as well as the further elucidation of potential mechanisms of transmission for the sharing of emotional functioning in families and its development in children. Research including fathers would allow for a more comprehensive assessment of the family influence on emotional development. Despite theoretical interest, few studies currently exist which explore the direct association between emotional functioning in parents and children. Importantly, only one of these select studies assessed emotional understanding and explored different components of emotional functioning (16), which future research should continue to address.

The limitations detailed above were informative for the design of the empirical work conducted within this thesis. The scarcity of both neuroscientific research and studies exploring different facets of emotional functioning together, drove the decision to comprehensively measure emotional functioning in families, examining emotion processing using ERPs, emotion understanding and regulation. Additionally, this thesis aimed to address the direct relationship between emotional functioning overtime, and develop the limited understanding of longitudinal associations.

2.5.2 Recent Literature Developments

In the two years since this review was conducted, the literature in the field of emotional functioning has grown dramatically, with a further 13 studies being identified by

an updated systematic search following the same initial process and criteria (conducted 11/10/2019; Binion & Zalewski, 2018; Doan, Son, & Kim, 2018; Kiser et al., 2019; Li et al., 2019; Melim, Matias, Ferreira, & Matos, 2019; Oattes, Kosmerly, & Rogers, 2018; Quetsch, Wallace, McNeil, & Gentzler, 2018; Reindl, Gerloff, Scharke, & Konrad, 2018; Shaw & Starr, 2019; Shorer, Swissa, Levavi, & Swissa, 2019; Silva, Freire, & Faria, 2018; Tan & Smith, 2019; Turpyn et al., 2018). All of the recent studies addressed the research question by considering parents' emotion regulation, with twelve exploring the link with emotion regulation in their child, and one neural processing of emotion (Turpyn et al., 2018). With regards to the second research question, assessing the contribution of neuroscientific studies to this knowledge base, two further studies were identified (Reindl et al., 2018; Turpyn et al., 2018).

In support of the findings of the original systematic review, the most common outcome measure in the updated search was emotion regulation (12/13). Again, across development (ages two-to-eighteen years old), 12 studies reported a positive correlation between emotion regulation in parents and children. Moreover, the DERS, which focuses on emotion regulation difficulties, was the most common measure of emotion regulation in parents (in 8/13 studies), further supporting the identified research focus on dysregulation. Collectively, these studies provide support for the theoretical model by Morris et al. (2007), proposing that parent's individual emotion characteristics, including regulation of emotion, would contribute to the development of emotion regulation in their child.

These studies included one longitudinal study, which when considered along with the one identified study in the systematic review (study 6) makes it an area of continued research need. In this new longitudinal study, mothers self-reported on their emotion reappraisal and emotional expressivity when children were aged four-to-five, with children's observed emotion regulation (operationalised as effortful control) being taken at age four-to-five and eight-to-nine, in addition to a teacher rating of effortful control at T2

(Tan & Smith, 2019). While direct associations between parent and child emotion regulation were not reported, the authors found support for a moderated mediation effect over time where maternal reappraisal had an indirect effect on child emotion regulation, via maternal positive expressivity. This model was only significant for families in which maternal negative expressivity was low.

Consistent with the systematic review, a further single study was identified exploring a different facet of emotional functioning in parents and their adolescent (Turpyn et al., 2018). Specifically, parents self-reported on their emotion regulation using the DERS and their experience of negative emotion (sadness, anger, fear and anxiety), and adolescents viewed positive, negative and neutral images from the International Affective Picture System (IAPS; Lang et al., 2008) and were asked to rate their intensity. The authors reported a significant moderation, in which high negative emotion experience in parents was positively associated with larger brain activation (in the left anterior cingulate cortex) in adolescents, for parents with greater emotion regulation difficulties. This study suggests emotion regulation is a key influence in the family, and may interact meaningfully with other parental characteristics.

Two additional neuroscientific studies were identified in the updated search. One study found a moderated association between parental negative emotion and emotion regulation and adolescents' emotional brain activation (Turpyn et al., 2018). The second study explored emotion regulation using questionnaires with parents and their five-to-nine-year-old child, finding a positive association between these measures (Reindl et al., 2018). In addition, this direct association was found to be significantly mediated by parent-child brain synchrony, as assessed with fNIRS, when completing a cooperative task together (as opposed to completing the task with an adult stranger). This study highlights the role of the parent-child relationship as an important mechanism of emotion development.

Findings from the systematic review identified gender as a potential moderator of the association between parents and children's emotional functioning. This was supported by the updated search, with two studies reporting parental gender as a moderator. The first assessed parental emotional regulation and distress tolerance (operationalised as quitting or completing a complex computer task) in eight-to-twelve-year-olds, finding a significant positive correlation between maternal reappraisal and children's distress tolerance (Doan et al., 2018). Importantly, however, this relationship was not found between the father and the child, further strengthening the argument for the inclusion and study of father-child dyads in the literature. Similarly, research has found correlations between mothers' and adolescents' use of reappraisal and suppression, with no association for fathers (Silva et al., 2018). Taken together, these studies support the findings of the original systematic review (e.g. study 3) and suggest that mothers may be more influential in children's emotional development.

Child gender was identified as a moderator of emotion regulation in two studies in the systematic review (studies 2 & 10). Less support was found for this in the recent literature search, with only one study reporting a significant association between emotion lability in girls and father's reports of their own emotion regulation strategies on the DERS (Oattes et al., 2018).

This recent evidence highlights an increase in studies with young children. In the systematic review, only three of the ten studies assessing emotion regulation used children under the age of eight (5, 6 & 9). In the updated search, six of the 13 studies involved children under eight, highlighting this as an area of growing research interest.

Collectively, this growth in emotional functioning research with children highlights the importance and interest in this field. The updated search demonstrates advances in knowledge, namely research with younger children, as well as supporting the identified limitations of present research. Specifically, future research would benefit from more

longitudinal studies as well studies utilising neuroscientific methods and assessment of different elements of emotional functioning.

Chapter 3 The Maternal Brain and Behaviour: Implications for Children's Emotional Development and Psychosocial Adjustment

3.1 Abstract

A large body of research has demonstrated the impact of parental socialisation on emotion developmental in children. Researchers have further suggested that for parents to be effective socialisers of emotions, they need to emotionally 'competent' (e.g. appropriately regulate emotions and have a good understanding of basic and complex emotions). However, research assessing parents' emotional functioning directly, and its association with children's emotional functioning, is sparse. This study tested the relationship between parental emotional functioning (emotion regulation, understanding, neural processing of emotion and symptoms of anxiety and depression) and emotional functioning (emotion regulation, understanding and neural processing of emotion) and adjustment (prosocial behaviour and internalising and externalising symptoms) in children. In addition, it investigated the mediating role of the quality of the dyadic relationship (levels of positivity and negativity). Emotional functioning in mothers and children was assessed using questionnaire and scenario-based tasks, and mothers reported further on their child's psychosocial adjustment. ERP measures were utilised as a neural index of emotion processing with both mothers and children viewing cross-modal happy, angry, fear and neutral stimuli. The dyadic relationship was measured using an interactive etch-a-sketch task and a maternal speech sample. Participants were 35 mothers and their three-to-five-year-old children. The N1 and P2 were observed in adults, and the P1, N170 and LPP in children of which the P2 and LPP were significantly modulated by emotion. Positive

associations were found between internalising symptoms in children and maternal use of suppression, and externalising symptoms with child lability. Externalising symptoms in the child were negatively associated with maternal positivity. Prosocial behaviour in children was negatively associated with maternal symptoms of anxiety and depression, observed child negativity and their LPP amplitude to happy stimuli. Mechanisms of emotion development in families were observed, with emotion dysregulation in children significantly mediating the relationship between maternal positivity and externalising symptoms in children, and maternal negativity mediating the relationship between maternal P2 amplitudes and emotion knowledge in their children. These results highlight the importance of maternal neural responses to emotion and interaction behaviour in their child's emotion development and psychosocial adjustment.

3.2 Introduction

Children's emotional functioning assessed through emotion recognition, understanding of emotions, and emotion regulation has been consistently found to predict their social functioning and wellbeing. Preschoolers who scored more highly on measures of emotional functioning were less likely to experience internalising and externalising problems (Heinze et al., 2015; Mirabile, 2010), and demonstrated better social functioning both concurrently (Heinze et al., 2015) and across time (Denham et al., 2003).

Emotional functioning emerges across early childhood. For example, a large body of work has documented the development of facial emotion recognition. Early research, assessing fixation lengths, found that infants as young as four months were able to differentiate between basic emotions such as joy and anger (LaBarbera et al., 1976; Nelson & Dolgin, 1985) Further studies have explored the recognition of emotion from facial and vocal cues in development (see recent review by Morningstar et al., 2018). Specifically, when comparing the development of accurate recognition of emotions presented across

different modalities, facial expressions were more accurately recognised than vocal expressions in three-to-five-year olds (Nelson & Russell, 2011). Moreover, the ability to accurately recognise facial expressions develops earlier compared to vocal expressions (Chronaki et al., 2015). Across several studies exploring the accuracy of emotion recognition, findings indicate that by five-years-old, children recognised happiness and anger at above chance levels in unimodal face and voice stimuli (Chronaki, Hadwin, et al., 2015; Sauter et al., 2013).

Studies have also explored a possible 'facilitation effect' in which emotions are significantly more accurately recognised when emotionally congruent faces and voices were presented together (Hunter et al., 2010). Such facilitation has been reported in adulthood (Hunter et al., 2010; Schirmer & Adolphs, 2017) and late childhood (> 9 years), but not in younger age groups (< 7 years; Gil et al., 2016; Nelson & Russell, 2011).

Parents are important socialization agents in children's emotional development. Theoretical models propose positive associations between parents' and their children's emotional functioning and their children's adjustment (Cunningham et al., 2009; Gottman et al., 1996; Mirabile, 2010, see figures 1.4, 1.3 and 1.2 respectively). The focus of these models is typically on parental socialisation (i.e. the ways in which parents discuss and express emotion, and react to their child's emotional displays) and specifically the way in which parents influence outcomes in their children (Darling, 1999).

There is consistent evidence in support of parental socialization of emotion. For example, research has found that mothers who more frequently discuss emotions, including the causes and consequences of emotions, and react more positively when their child displays negative emotion, have children with better understanding and regulation of emotion (Denham et al., 1997; Garner et al., 1997).

Parental socialisation may be influenced by the ways in which parents themselves recognise, understand and regulate emotion (Bariola et al., 2011; Castro et al., 2015). For

example, associations have been found between parents' and children's ability to recognise and label each other's emotions in middle childhood (Castro et al., 2015). In support, an fMRI study reported a significant positive correlation between parents' greater brain activation in response to unfamiliar adults' facial expressions (suggestive of greater emotion recognition and sensitivity) and higher adolescent-reported emotional functioning (Telzer et al., 2014). Furthermore, this association was significantly mediated by measures of the adolescents' neural activation in response to the emotional faces. These findings provide initial indications of important neural characteristics related to the processing of emotional information, and their possible role in parental socialization of children's emotional functioning.

Consistent with the proposition of modelling emotional functioning, research has found links between emotion regulation strategies in mothers and their children, such that suppression in mothers was found to correlate with suppression in their children in a sample aged 9-19 (Bariola et al., 2012). Studies have begun to explore associations between maternal and child emotional regulation early in development. Two studies reported a correlation between parental difficulty in managing their emotions, and their reports of emotion lability in their children aged between three and seven (Crespo et al., 2017; Oattes et al., 2018). Parental use of reappraisal and suppression was also found to predict the same strategies in children a year and a half later (as measured by the ERQ), in a sample of five year olds (Gunzenhauser et al., 2014). Notably, few studies exist that explore the associations between other aspects of emotional functioning in families.

Through conceptualizing symptoms of anxiety and depression as indicators of poorer emotional functioning, research has explored the effects of maternal anxiety and depression on emotional development in children across the preschool and middle childhood years. These studies highlight that maternal depression is associated with poorer recognition and regulation of emotion, and higher levels of internalising and externalising

problems in children (Hoffman et al., 2006; Joormann et al., 2010; Silk et al., 2006). Furthermore, mothers with higher levels of trait anxiety report their child to have more difficulties in regulation (measured via a "crying, whining and sleeping" subscale; Richter & Reck, 2013)

A different set of studies demonstrated that parent-child relationships which are characterised by higher levels of maternal warmth and positivity were associated with better emotion regulation (Davidov & Grusec, 2006) and fewer externalising symptoms in children both concurrently and longitudinally (Caspi et al., 2004). Furthermore, children's emotion regulation has been theorised as an important mediator between characteristics of the parent-child relationship and child adjustment operationalised as internalising, externalising, and prosocial behaviour (Morris et al., 2007, see Figure 1.5).

In summary, emotional functioning, compromised of recognition, understanding and regulation of emotion, develops across early childhood and has key implications for children's wellbeing and social adjustment. Research has consistently highlighted parents as key agents of socialisation for their children, and increasingly a growing body of literature has begun to explore the role of parental emotional functioning.

3.2.1 ERP studies and emotion

To assess the development of emotional functioning at the neural level, research studies have increasingly utilised imaging methods to assess neural markers of processing emotional information. For example, ERP studies have highlighted several components that are sensitive to the processing of facial emotional stimuli in childhood, including the P1 and the LPP (facial expressions) and the N1 and P2 (for cross-modal face and voice processing) in adults.

Most developmental studies have compared emotional stimuli with neutral stimuli. Differences in the processing of emotional compared to neutral faces are most evident for

negative emotional stimuli. For example, with respect to early ERP components, the P1 was found to discriminate emotional compared to neutral facial expressions in children aged between three-to-eight-year-olds, with larger amplitudes for negative (fearful) compared to neutral faces in younger compared to older children (Vlamings et al., 2010). Larger amplitudes are indicative of less automatization and more effortful processing (Batty & Taylor, 2006).

Considering the LPP, proposed to reflect attentive and evaluative processing of emotional stimuli (Chronaki et al., 2018; Kujawa et al., 2012a), studies have found significantly larger amplitudes for sad compared to neutral faces. In six-year-old-children, emotional faces (sad, angry, fearful and happy) elicited larger LPP amplitudes compared to neutral faces in a passive viewing task, which was evident at earlier latencies in occipital sites (200-600ms) than parietal sites (600-1000ms; (600-1000ms; Kujawa et al., 2012b).

Cross-modal (face and voice) emotion processing studies have identified the N1 and P2 as important components in adults. The N1 was linked to sound detection and attention orienting towards a stimulus, and is suggested to be the earliest point at which vocal emotions can be processed (Liu et al., 2012a; Näätänen & Picton, 1987; Schirmer & Kotz, 2006). The N1 has been found to sensitive to emotion, observing smaller amplitudes for emotional compared to neutral stimuli (Jessen & Kotz, 2011). Conversely, the P2 was reported to have larger amplitudes for emotional (angry, happy, and fearful) compared to neutral stimuli (Jessen & Kotz, 2011; Liu et al., 2012a). There are no known studies exploring cross-modal emotion processing in preschoolers.

More recently, ERP methods are being utilised to find biomarkers of future adjustment, by exploring the link between neural measures of processing emotional information and behavioural measures of children's social and emotional functioning. For example, one study testing the association between emotion knowledge (measured via LPP amplitudes to a series of static cartoons depicting emotion inducing scenarios e.g. having

to do homework while your brother watches television) and parent-reported social functioning (i.e. levels of prosocial behaviour, communication and emotion regulation). Contrary to the behavioural literature, no relationship was found between the two constructs in six-year-olds (Bennett, 2013). In a different study providing evidence for the use of ERPs as effective biomarkers of future adjustment, Decety and colleagues used a perspective taking and empathic concern task with three-to-five-year-old children. Participants were shown neutral and pain images and asked to consider either how the person felt (perspective-taking), or how sorry they felt for the person (empathic concern). The ERP measures were assessed in relation to children's prosocial behaviour measured by asking children how many of their allotted ten stickers they would share with another unknown child. Increased prosocial (sharing) behaviour in children was predicted by greater differentiation between the empathic concern and the perspective taking condition in the late LPP (600-800ms) and slow wave (800-1000ms), with larger amplitudes being found for the painful stimuli indexing more effortful empathic processing (Decety, Meidenbauer, & Cowell, 2018).

In addition to associations between ERPs and behavioural outcomes in children, research is beginning to elucidate relationships between ERPs and parenting behaviours. For example, a small negative association was found between parents' use of elaborative discussion about negative emotions and their child's posterior LPP amplitudes (Leventon et al., 2019). This finding highlights one potential mechanism through which parenting behaviour exerts an influence on emotion development, which may be most evident for negative emotions. Further research has demonstrated associations between mothers' level of directiveness (e.g. critical and controlling behaviours) and six-month-old infants neural processing of emotion using functional near-infrared spectroscopy. The researchers reported that larger responses to angry vocalisations in infants were associated with increased maternal directiveness during play with their infant (Zhao et al., 2019). This

finding suggests that early experiences with parents influence neural processing of emotion in children, in this case leading to neural specialisation for anger.

Taken together, these studies illustrate how ERP measures are being increasingly utilised to identify neural components which may underpin emotion processing. Several components have been identified in childhood, with the LPP in particular demonstrating meaningful relations with both parenting and child adjustment. Studies linking ERP components with behavioural measures are in their infancy, but are beginning to identify neural biomarkers and mechanisms of emotional development. In adults, the N1 and P2 have been observed as markers of cross-modal emotion processing, with an identified lack of similar studies in children.

3.2.2 The current study

Current research highlights parental socialisation as a key factor in emotion and behavioural development in children. However, there is a lack of consideration of the effects of parental emotional functioning in current research and its association with the characteristics of the parent-child relationship, on the one hand, and emotional adjustment in their children, on the other. In addition, few studies have explored the construct of emotional functioning at both the behavioural and neural level in both parent and child. Developing existing frameworks, the current study explores possible mechanisms which underlie parental socialization of emotional functioning in children. Specifically, the present study explores the various associations between the constructs of mother emotional functioning (i.e. emotion regulation, understanding, neural processing, and symptoms of anxiety and depression), their preschool-aged children's emotional functioning (i.e. emotion knowledge, regulation and neural processing), the children's adjustment (i.e. the presence of internalising and externalising symptoms and prosocial behaviour) and characteristics of the dyadic relationship between mothers and children (i.e. levels of

positivity and negativity (see Figure 3.1). In line with the parental socialization framework, we hypothesised that parental emotional functioning would be related to child adjustment, with the dyadic relationship quality and the child's emotional functioning mediating this relationship.

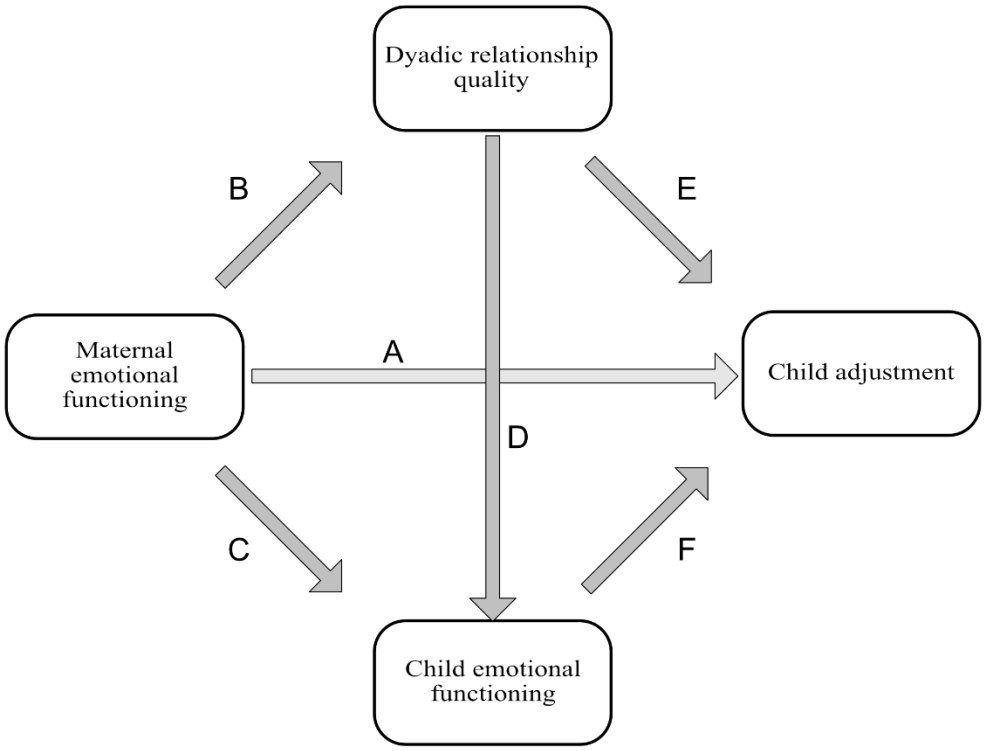

Figure 3.1 Theoretical model predicting relationships between maternal emotional functioning, the dyadic relationship quality, and children's emotional functioning and adjustment

We extended existing research to include neural indices of cross-modal emotion processing from faces and voices in both mothers and children. We expected that an N1 and a P2 component would be observed in mothers, with larger amplitudes to neutral compared to emotional stimuli in the N1, and the opposite in the P2. We explored these components in children, as well as those typically associated with unimodal face perception (i.e., the P1, N170 and LPP), however, due to a lack of previous research, this analysis was partially exploratory.

3.3 Method

3.3.1 Participants

Participants were 35 mothers (M =36.90 years old, SD =4.43 years, range = 28 - 45years) and their child (M =4.29 years old, SD =0.71 years, range = 3.25 – 5.50 years; 12 girls) who was either in their final year of preschool (N= 21) or reception year of primary school (N =14). Participants were asked to provide data on ethnicity, maternal and paternal education, marital status and childcare schedule.[3] Further demographic information is presented in Table 3.1.

Participants opted into the study after being recruited via nurseries and schools, playgroups, online adverts and word of mouth. This study had ethical approval by the University of Southampton's Research Governance Office and the ethics' committee in the School of Psychology (ERGO ID: 18473).

[3] All child participants had an IQ in the normal range (scores over 70 on the receptive vocabulary and block design sub-test of the Weschler primary and preschool scale of intelligence, fourth edition (WPPSI-IV, Weschler, 2012)), and normal hearing following the British Society of Audiology's guidelines.

Table 3.1.

Demographic Information for the Participants

Demographic variables	N
Gender of child	
Male	23
Female	12
Ethnicity (Mother)	
White British	29
Other white background	2
White and Black Caribbean	1
Pakistani	2
Other	1
Ethnicity (Child)	
White British	28
Other white background	2
White and Black Caribbean	1
Pakistani	2
White & Asian	1
Other	1
Family Composition	
Married	30
Cohabiting	3
Other	2
Childcare schedule	
Fulltime school	14
Halftime preschool and home	6
Majority with mother	7
Majority in childcare	8
Highest level of maternal education	
School qualifications	1
Sixth form college qualifications	7
Undergraduate degree	14
Master's degree	8
PhD	5
Highest level of paternal education	
No qualifications	1
School qualifications	3
Sixth form college qualifications	7
Undergraduate degree	13
Master's degree	8
PhD	3

Note. N=35 for all variables. Ns are in the total column, with percentages in brackets.

3.3.2 Materials

3.3.2.1 Maternal emotional functioning

3.3.2.1.1 Emotion regulation questionnaire

We measured mothers' emotion regulation using the 10 item Emotion Regulation Questionnaire (ERQ, Gross & John, 2003). The ERQ is divided into two sub-scales: reappraisal and suppression. The reappraisal sub-scale consists of six items (e.g., "When I'm faced with a stressful situation, I make myself think about it in a way that helps me stay calm") and the suppression sub-scale included four items (e.g., "When I am feeling positive emotions, I am careful not to express them"). All 10 items were scored on a 7-point Likert scale (1= strongly disagree to 7 = strongly agree). Possible score range for each subscale was 6 - 42 (reappraisal) and 4 - 28 (suppression), with higher scores indicating an increased use of that strategy. The reappraisal and suppression subscale have been found to have good internal consistency (αs > .70, Gross & John, 2003).

3.3.2.1.2 Anxiety and depression symptoms

Mothers completed the Hospital Anxiety and Depression Scale (HADS) created by Zigmond and Snaith (1983). The HADS requires participants to report on their experiences of anxiety (e.g., "I feel tense or wound up") and depression (e.g., "I feel as if I am slowed down") symptoms in the past week across 14 items (seven for each subscale). Each item was scored between 0 and 3, dependent on the degree of agreement on that item. Total scores on each subscale ranged from 0-21 and were separated into three classifications of normal (0-7), borderline abnormal (8-10) and abnormal (11-21). Although devised for clinical settings, the HADS has been widely used in research settings (Breeman, Cotton, Fielding, & Jones, 2015), with previous research finding good reliability for both sub-scales in community samples (αs > .70, Crawford, Henry, Crombie, & Taylor, 2001).

3.3.2.1.3 Maternal emotional scenario understanding

Mothers completed an Adult Emotion Understanding (AEU) measure to assess their emotion understanding across 22 scenarios. Participants were asked to generate an emotional term that describes each scenario organised by high/low valence and arousal, see Figure 3.1 (Russell, 1980; Russell & Barrett, 1999). Initial validation, in a sample of 12 mothers and 86 undergraduate students showed good internal consistency (α=.70, Chadwick, 2015).[4] The AEU also demonstrated good predictive validity, predicting participants use of reappraisal as an emotion regulation strategy (F (1, 84) = 8.22, p = .005).

Mothers' responses were coded as follows; 1 for correct answer (label and valence), 0 .75 for emotions in the same quadrant as the target emotion, but with an incorrect emotion label, 0.5 for answers of the correct valence but incorrect quadrant, and 0 for a wrongly valenced emotion and incorrect label. This produced a possible total score range of 0 - 22. The questionnaire was found to have acceptable reliability in the current sample (α=.68).

[4] Additional validation work has been undertaken since then with a further 94 undergraduate students, finding an overall alpha of .61 for the two samples combined.

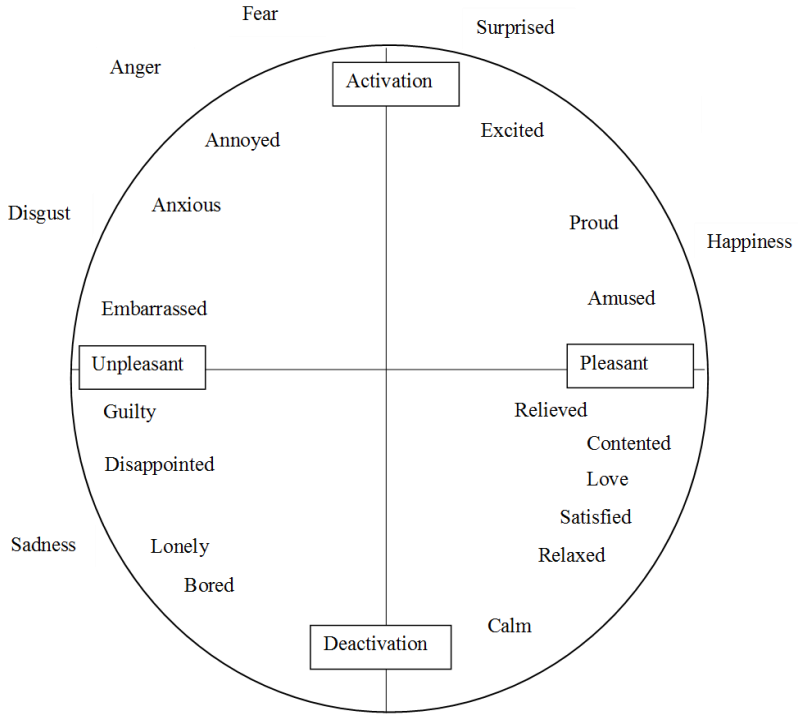

Figure 3.2. An adapted wheel from Russell (1980) and Russell and Barrett (1999) showing the positions of the emotions used in the present study. Emotions on the outside of the wheel are classified as simple emotions.

3.3.2.1.4 ERP task

3.3.2.1.4.1 Facial emotion stimuli

Facial emotional expressions (happiness, anger, fear and neutral) from two female actors were selected from the Radboud battery (Langner et al., 2010). This battery was selected because it had been (i) well validated and standardised by the creators of the battery in a large sample of 276 students, (ii) used successfully in a behavioural study with a sample of four-to-eleven-year-old children in the author's previous research (Chadwick, 2014) (iii) used in a similar cross-modal study in adults (Liu et al., 2012a).

3.3.2.1.4.2 Vocal emotion stimuli

Two female actors using non-verbal vocalisations were obtained from the Maurage battery (Maurage, Joassin, Philippot, & Campanella, 2007). This battery has been well-validated by the creators (pre-selected by expert raters and then validated with a sample of 70 undergraduates) and has been used in several behavioural studies (Chadwick, 2014;

Chronaki, Hadwin, et al., 2015). Further, these vocal stimuli have been used in an ERP to identify a neural marker of vocal emotion processing in six-to-eleven-year-old children (Chronaki et al., 2012).

The vocal stimuli were standardised for duration and intensity to ensure that acoustic properties of the stimuli did not affect the ERP components. As the voices in the Maurage battery had a duration of 700ms, these were extended to 1000ms in order to match the facial stimuli. All stimuli were standardised to the mean intensity of 75.87dB. Vocal extension was conducted on Adobe Audition whilst controlling for pitch, and intensity was standardised using Praat (version 6.0.06).

3.3.2.1.4.3 Experimental paradigm (for mothers and children)

All stimuli were presented cross-modally, with the same face model being consistently matched to the same voice actor to remove any incongruence. Only congruent trials were included, whereby the facial and vocal expressions displayed the same emotion.

Primate faces and voices were also included in the task as attention check stimuli. The task was presented to children as a game, in which they had to watch all the people and respond with a button press to catch all the monkeys. This paradigm has been used in both adult cross-modal (Liu et al., 2012a) and child unimodal ERP research (Batty & Taylor, 2003, 2006; Vlamings et al., 2010). One gorilla stimulus and one chimpanzee stimulus were selected for the task. The face of the gorilla and chimpanzee were downloaded from Google images and were matched to the image size of the faces. Primate vocalisations were obtained from www.animal-sounds.org and were matched to the vocal intensity of the human stimuli.

There was a brief practice block which consisted of 10 trials, one trial per emotion (angry, happy, fear and neutral) per model (two females) and one chimpanzee and one gorilla trial. The practice block lasted about a minute. For the practice block only,

feedback was given to the participants in the form of a green tick when they correctly identified the primate stimuli.

Following the practice block, participants viewed four experimental blocks each lasting 2 minutes and 15 seconds. Each block consisted of 50 trials; 10 trials of each of the four emotions, and five chimpanzee and five gorilla trials. Trials within each block were randomised. The primate stimuli were randomly interspersed between the 40 emotional stimuli and so there was at least one and no more than 10 emotional stimuli between them. Children were required to correctly identify at least 50% (20/40) of the monkeys to be included, and mothers 80% and all participants met this criteria (mothers: *M* = 39.74, *SD*=0.62, range=38-40; children: *M*=36.81, *SD*=4.00, range=27-40).

All stimuli were preceded by a cross in the middle of the screen presented for 500ms, (see Chronaki, 2011). The cross-modal stimuli were presented for 1000 milliseconds and as no response was required on these trials this was immediately followed by the 1000ms inter-stimulus interval (ISI). For the primate stimuli, if a response was given during the stimulus duration the task moved onto the ISI. If no response was given during the stimuli duration, a further 1000ms response window was allowed before the onset of the ISI. See Figure 3.3 for a graphical representation.

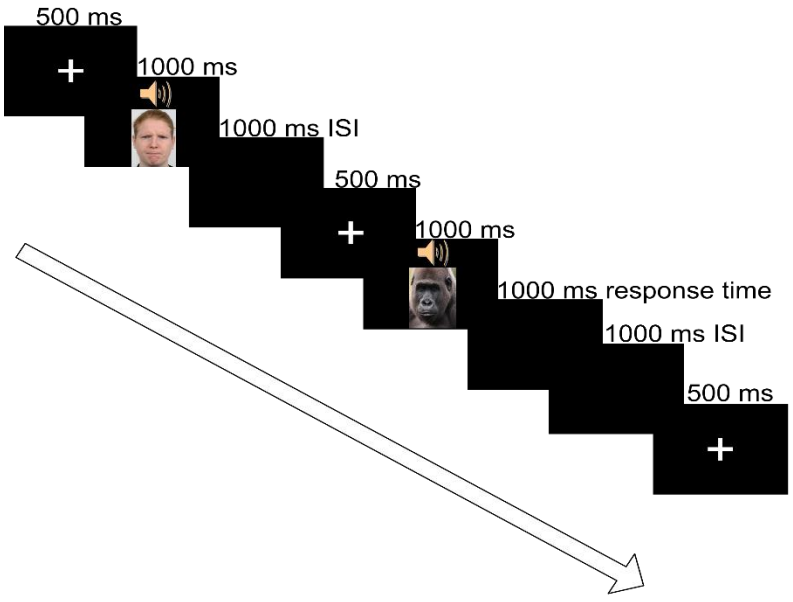

Figure 3.3. A visual representation of the ERP task

3.3.2.2 Child emotional functioning

3.3.2.2.1 Affective knowledge test

Children completed three subscales of the Affective Knowledge Test (AKT) to assess emotions from faces and situations (Denham, 1986). The AKT was developed for children up to five years of age, but has been used up to 74 months (Mirabile, 2010; Morgan, Izard, & King, 2009)[5]. Children were presented with faces, displaying the emotions of happiness, sadness, anger and fear. The AKT tests expressive and receptive emotion recognition (scored 2 points for a correct answer, 1 for an incorrect answer of the same valence and 0 for an incorrect answer; range = 0-16). This subscale has been found to have good internal consistency (α=.89; Denham, 1986).

For emotion understanding, the experimenter acted out eight scenarios (two scenarios each for anger, fear, sadness and happiness; score range = 0-16). This measure has been found to have excellent reliability (α =.93; Denham, 1986). Expressive recognition, receptive recognition and situation emotion understanding were summed to create an emotion knowledge variable (possible score range = 0-32).

3.3.2.2.2 Emotion regulation checklist

Mothers reported emotional regulation in children using the 24 item Emotion Regulation Checklist (ERC; Shields & Cicchetti, 1997). The ERC includes two subscales: emotion regulation (8 items, e.g., "is a cheerful child") and lability (15 items, e.g., "responds angrily to limit setting by adults"). Items are scored on a four point likert scale (1= never, 2= sometimes, 3= often and 4= almost always), generating possible score ranges from 8 - 32 (regulation) and 15-60 (lability), with higher scores indicating an increased tendency to react in this way. Although originally devised for six-to-twelve-year-old

[5] Eight of the children in the current sample were over the recommended upper age of 60 months, but there was no significant difference between scores in those above (M = 27.86, SD = 3.04) and below (M = 25.07, SD = 4.37) 60 months (t (33) = -1.69, p = .101).

children, the ERC has been used with younger children in previous studies (obtaining alphas αs > .67, see Chronaki, 2011; Graziano & Hart, 2016; Graziano et al., 2007; Morgan et al., 2009).

3.3.2.3 Dyadic interaction

3.3.2.3.1 Etch-a-sketch

We asked mother and child pairs to work together to reproduce three shapes (two simple and one test figure) within the allotted time of five minutes per drawing using an etch-a-sketch (see Ginsburg, Grover, & Ialongo, 2005). Mothers and children used one dial each (one allowing vertical and the other horizontal drawings) to complete the task.

Observed behaviours were coded in one minute intervals for the final drawing only, with each behaviour being given a score from 0-4 (0 = never, 1 = very rarely; 2 = a little, 3 = some of the time, 4 = most of the time). The behaviours were aggregated into child negativity (over-control, negative affect, unresponsive behaviour, anxious behaviour and oppositional behaviour), child positivity (positive affect, efficacy and problem solving), mother negativity (over-control, negative affect, unresponsive behaviour, anxious behaviour, self-blame and doubts concerning child competency) and mother positivity (granting of autonomy, positive affect, efficacy and problem solving; Croft, O'Connor, Keaveney, Groothues, & Rutter, 2001).

The etch-a-sketch videos were coded by one person and five were double coded to ensure reliability. Reliability was operationalised as the raters being within one score for each of the individual subscales, following the coding manual (Ginsburg et al., 2005). Following this criteria, 100% agreement was obtained for all subscales (105 in total) across the five dyads.

3.3.2.3.2 Five minute speech sample

Mothers completed the preschool version of the five minute speech sample (PFMSS) where they were asked to talk uninterrupted about their child for five minutes. (PFMSS; Daley, Sonuga-Barke, & Thompson, 2003). The PFMSS is coded using three global categories of (i) initial statement (positive, negative, neutral) (ii) relationship (positive, negative, neutral), and (iii) warmth (high, moderate, low), as well as by frequency counts of positive and negative comments across the duration of the speech sample. These categories are combined to create a rating of expressed emotion (EE), where high EE necessitates at least one global negative category and more negative than positive comments. Due to the presence of very little negativity in the PFMSS, mothers were classified for high EE if any negativity was present. The inter-rater reliability for the present study was found to be moderate (two-way mixed model ICC, with absolute agreement and single measures, = .74; Koo & Li, 2016).

3.3.2.4 Child Adjustment

3.3.2.4.1 Strengths and Difficulties Questionnaire

Mother reported on 25 items; five items across five behaviour categories measured on a three point likert scale of not true (= 0), somewhat true (= 1) and certainly true (= 2). Categories include emotional and peer problems (making up the internalising subscale, score range = 0-20), hyperactivity and conduct problems (making up the externalising subscale, score range = 0-20), and prosocial behaviour (score range = range 0-10).[6] The SDQ has shown good reliability in previous research, with αs from .63-.80 for three-year-olds and from .71 -.85 with five-year-olds (Croft, Stride, Maughan, & Rowe, 2015).

[6] Following coding instructions, subscale scores were calculated as long as at least 3/5 items had been responded to, and any scales with missing data were scaled up pro-rata, e.g. a score of 4 on 3 items would equate to a score of 7 (6.67 rounded up) on 10 items.

3.3.3 Procedure

Mothers and children visited the University for two sessions. Maternal informed consent and child assent was collected in the first session. The first, a behavioural assessment, lasted between 30 minutes and an hour. Mothers completed questionnaires online using iSurvey, and in a fixed order (demographics, emotion understanding, ERQ, HADS, ERC and finally the SDQ). During this time the child completed the AKT, and the WPPSI subscales in the prescribed order (vocabulary first for children < 4 years of age and blocks first for those > 4 years). Mother and child then completed the etch-a-sketch task. Each completed picture was photographed, and the whole etch-a-sketch task was videotaped. Additional consent was taken after the recording for the tape to be stored and coded.

The second ERP assessment ranged from one and a half to two and a half hours. In the EEG assessment, a hearing test was first administered to the children on a standard audiometer, following the British Society of Audiology (2004), to ensure that they were able to hear the stimuli used in the study.[7] Mother and child EEG was completed in whichever order the participants preferred. Participants were seated approximately 120cm away from a 16 inch CRT monitor. The child was able to play with a tablet whilst the cap and ocular channels were fitted. The capping up process took between 20 and 30 minutes.

The experimental task lasted approximately ten minutes. Participants were instructed to sit as still as possible, and to passively view the human stimuli and respond with a button press to the primate stimuli. During the child ERP, the mother was asked to provide the PFMSS. When both participants had completed the ERP the study was concluded. Participants were debriefed, reimbursed for their time and travel expenses, and children received a certificate, stickers and a small gift.

[7] Due to the young age of the children, only the 1000Hz, followed by the 1500Hz and 500Hz conditions were used.

3.3.4 EEG recording and processing

EEG data was recorded using an Easycap (Hersching, Germany) which consisted of 66 silver/silver chloride electrodes laid out equidistantly and referenced to the nose. Vertical electro-oculogram (vEOG) was recorded from four electrodes: two bipolar electrodes beneath the pupils and two situated in the cap. Data was recorded using Neuroscan Synamps 70 channel EEG system. The data were sampled at a frequency of 250Hz with a band pass filter of 0.1-70Hz consistent with previous research (Granic, Meusel, Lamm, Woltering, & Lewis, 2012; Grossmann et al., 2006) and impedances were kept below 5kΩ. ERPs were recorded from 30 active sites, spread evenly across the scalp, see Figure 3.4. The selected electrodes and their location on the scalp is consistent with previous research in cross-modal emotion processing in adults (Balconi & Carrera, 2007; Brett-Green, Miller, Gavin, & Davies, 2008; Grossmann et al., 2006) and unimodal emotion processing in children (Batty & Taylor, 2006; Chronaki et al., 2012; Curtis & Cicchetti, 2011; Vlamings et al., 2010).

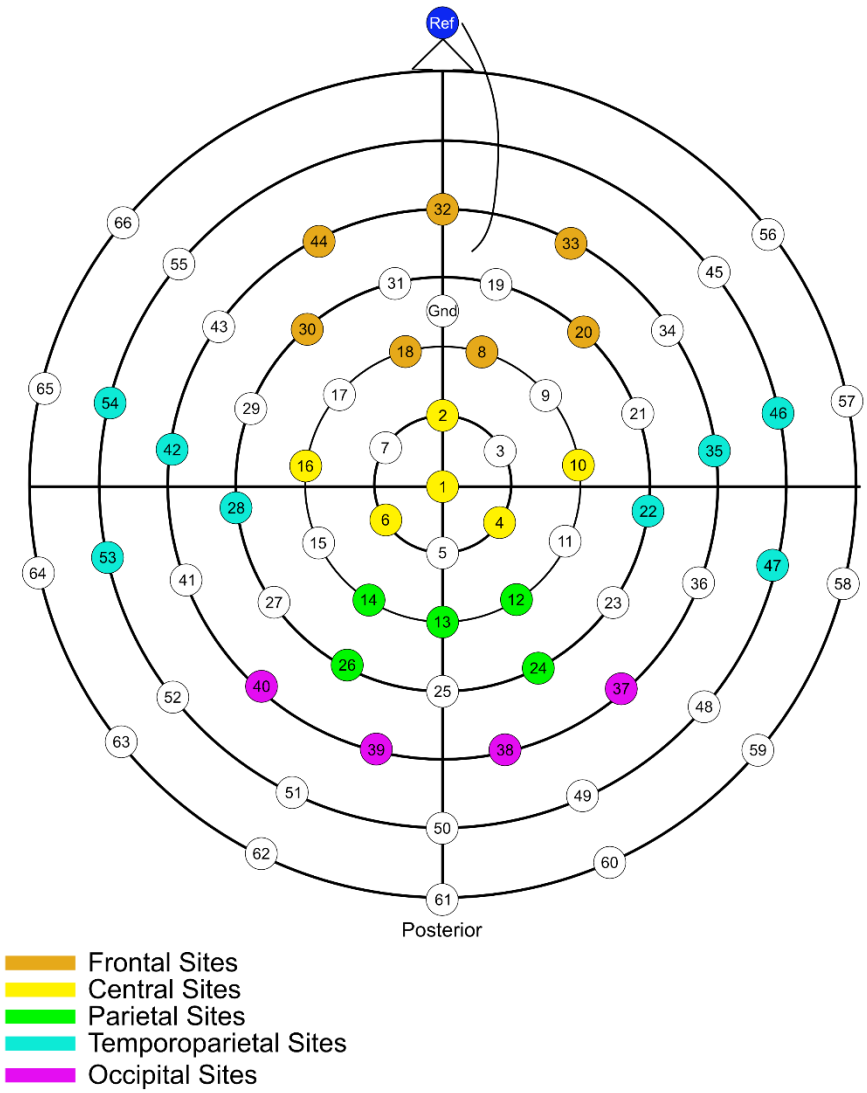

Figure 3.4 A montage showing the 30 sites recorded from in the present study, adapted from Chronaki et al. (2012)

Analyses were conducted with Neuroscan 4.5. An epoch of 100ms pre-stimulus to 1000ms post-stimulus was used and the EEG signal was bandpass filtered with cut-offs of 0.1 and 15 Hz, based on electrode activity to remove the influence of blink and other artefacts (Semlitsch, Anderer, Schuster, & Presslich, 1986).

A total of 32 children and 33 mothers completed the ERP task. An epoch of 100ms pre-stimulus to 1000ms post-stimulus was used and the EEG signal was bandpass filtered with cut-offs of 0.2 and 15 Hz, based on electrode activity to remove the influence of blink and other artefacts (Semlitsch et al., 1986). Due to the young age of the children, and to allow for comparisons between the mother and child data, more flexible inclusion criteria

were adopted for both mothers and children which were consistent with the literature (Curtis & Cicchetti, 2011; Decety et al., 2018; Granic et al., 2012). Trials were excluded if the signal exceeded ±200 μV in any vEOG or scalp site. For participants with noisy data, one channel was permitted to be deleted and the amplitude value for that channel was replaced with an interpolated value from the two neighbouring channels (N=3 for child participants, all different channels; N=2 for adult participants, different channels). Data were also subject to visual inspection, and any noisy trials (e.g. those with a non-zero baseline) were removed.

Only participants with a total number of 20 clean epochs per emotion (angry, happy, fear and neutral) were included in ERP analyses (following Chronaki, Benikos, et al., 2015), with the final sample being made up of 24 mothers and 17 children. Included children did not differ from excluded children on gender ($x^2(1) = 1.52$, $p = .485$), age ($t(31) = 1.49$, $p = 147$) or IQ ($t(31) = -0.62$, $p = .539$). There was no significant difference in the number of clean epochs per emotion for the included mother ($F(3, 69) = .87$, $p = .46$) or child participants ($F(3, 48) = 1.32$, $p = .278$, see Table 3.2 for descriptive statistics).

Table 3.2.

Descriptive statistics for the epochs per emotion

Group	Status	N	Mean (SD)				Range			
			A	F	H	N	A	F	H	N
M	Included	24 (73%)	35.21 (6.09)	35.63 (5.05)	34.75 (5.97)	35.33 (5.64)	20-40	25-40	21-40	21-40
	Excluded	9	4.43 (6.58)	4.67 (6.27)	3.33 (4.47)	3.22 (3.42)	1-19	1-18	1-13	1-9
C	Included	17 (53%)	27.17 (4.42)	27.82 (6.12)	28.71 (5.00)	26.82 (5.11)	20-38	20-40	20-35	20-37
	Excluded	15	2.20 (2.62)	2.53 (3.07)	2.73 (3.79)	2.40 (3.33)	1-9	1-10	1-14	1-13

Note. A= Angry, F = Fear, H = Happy, N = Neutral. Group; M=Mother, C=Child.

A baseline-to-peak mean amplitude method was employed, following ERP practice guidelines and previous research (Chronaki et al., 2012; Picton, 2000). Based on the literature, nine target fronto-central and centro-parietal sites were identified for analysis for

the mothers (1, 2, 4, 6, 10, 12, 13, 14, 16, see Figure 3.4). These were confirmed by preliminary data exploration as the sites where components could be seen maximally. Two components were observed, a fronto-central N1 (sites 1, 2, 4, 6, 10 & 16, 100-180ms) and a centro-pareital P2 (sites 1, 2, 4, 6, 10, 12, 13, 14, 16, 190-320ms).

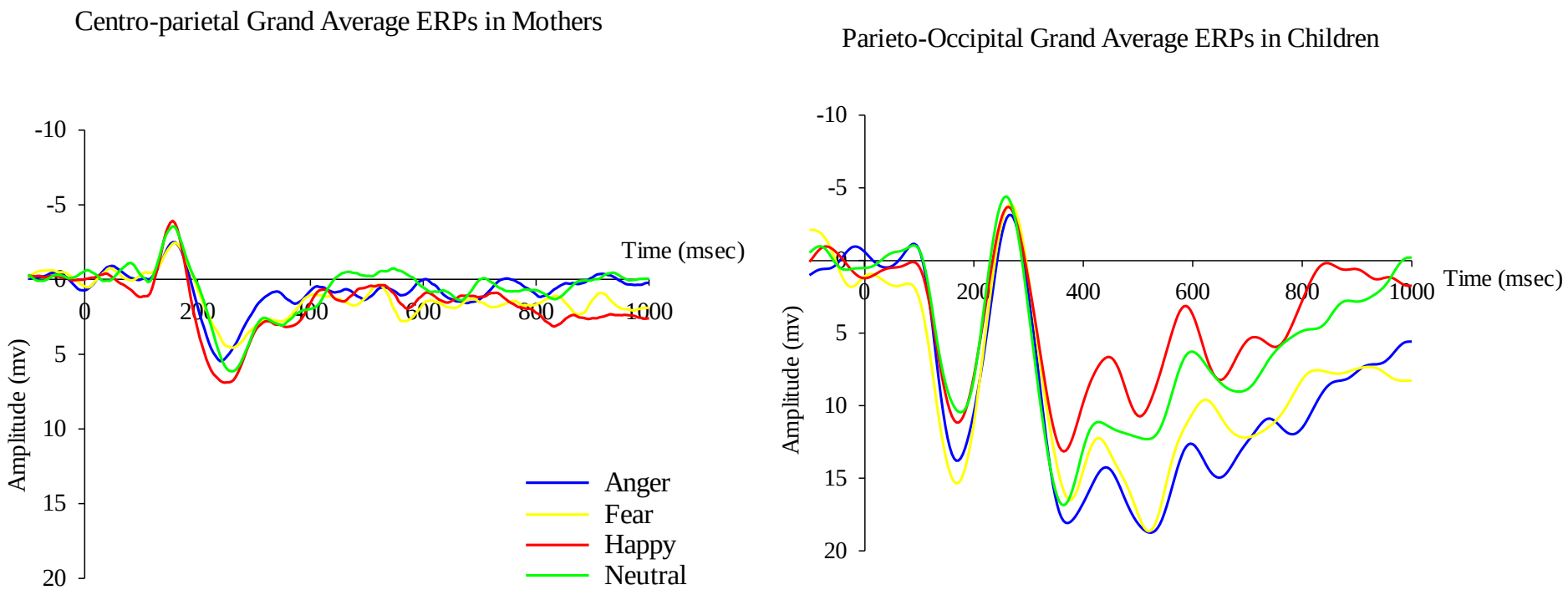

Figure 3.5. Grand averages to angry, fear, happy and neutral cross-modal stimuli in mothers and children.

In children, visual inspection of the data showed components were cleanest and maximal over the parieto-occipitial sites, so analysis was focused on these target channels (24, 26, 37, 38, 39, and 40). Three components were evident based on visual inspection of the grand averages, as well as the individual subject averages; the P1 (100-200ms), the N170 (200-340ms), and an LPP (350-1000ms), see Figure 3.5. No outliers were found in the mean amplitude for each emotion per region in children or mothers, and data were normally distributed (based on visual inspection of histrograms and boxplots, Field, 2013).

3.3.5 Approach to data analysis

The data were first checked for normality using histograms, following APA recommendations (Wilkinson, 1999), and for outliers using boxplots (Field, 2013). The majority of variables were normally distributed, and as such all subsequent analysis was parametric, with bootstrapping used for the non-normally distributed variables (emotion regulation, maternal suppression, child internalising symptoms, mother negativity and child negativity).

The analysis consisted of three steps. Firstly, we explored emotion differences in the observed components for mothers and children separately, using repeated measures ANOVAs on the amplitude of the observed components for the four emotion (angry, fear, happy and neutral). Components with significant emotion modulation were identified as markers of cross-modal emotion processing, and analysed alongside the behavioural data. Secondly, we assessed correlational associations between the four constructs of maternal emotional functioning (emotion regulation, understanding, neural processing, and symptoms of anxiety and depression), child emotional functioning (i.e. emotion knowledge, regulation and neural processing), child adjustment (internalising and externalising symptoms and prosocial behaviour) and dyadic relationship quality (levels of positivity and negativity, see Figure 1.7), and only significant associations were reported in

text (see full correlation matrix in Appendix F). Pearson's bivariate correlations, and biserial correlations were run for all variables and interpreted such that r >.50 signifies a large effect, r >.30 a medium and r >.10 a small effect (Field, 2013). This analysis informed the third stage of analysis, the testing of mediations models. Simple mediation models were constructed following Hayes (2013), using 10000 bootstrap samples and calculating the significance of the indirect effect via the bootstrapped confidence intervals. Unstandardised betas were reported for all models. All correlational analyses were conducted using SPSS (v24), and mediation models using PROCESS (v2.16.3).

3.4 Results

3.4.1 Descriptive statistics

No gender effects were found. Accordingly, all subsequent analyses were run for the total sample. Age was significantly correlated with child emotion knowledge (r= .56, p=.001), and all relevant analyses therefore included child age as a covariate.

The descriptive statistics and psychometric properties of the behavioural variables are presented in Table 3.3. Five dyads were classified as having negative relationships on the PFMSS, and 29 as positive. One mother did not complete the PFMSS due to prior knowledge of the test.

Table 3.3.

Descriptive and Psychometric Properties of the Variables

				Range	
Variable	*M*	*SD*	α	Potential	Actual
Mother					
Emotion understanding	15.12	4.59	.69	0-22	3-19.5
Reappraisal	31.00	4.11	.70	6-42	22-37
Suppression	13.17	4.59	.71	4-28	7-24
Anxiety	6.43	2.96	.77	0-21	1-13
Depression	3.37	2.69	.69	0-21	0-9
*Positivity	3.20	1.62	-	0-16	1-7
*Negativity	0.77	0.97	-	0-24	0-4
Child					
Emotional knowledge	25.71	4.23	.70	0-32	14-32
Emotion regulation	27.17	2.74	.64	8-32	20-31
Lability	27.23	4.87	.77	15-60	17-38
Internalising symptoms	2.14	1.99	.53	0-20	0-8
Externalising symptoms	5.29	3.13	.77	0-20	0-12
Prosocial behaviour	7.69	1.73	.63	0-10	3-10
*Positivity	1.13	1.08	-	0-12	0-4
*Negativity	1.00	1.14	-	0-20	0-5

Note. *Inter-rater reliability for these etch-a-sketch scales can be seen in the materials section.

3.4.2 ERP Emotion Effects to Cross-Modal Stimuli in Mothers

The amplitudes to the fronto-central N1 were not modulated by emotion (F (3, 69) =0.69, p=.560, ηp^2 =.03). However, the centro-parietal P2 amplitudes were modulated by emotion (F (3, 69) =4.88, p=.004, ηp^2=.18). Planned contrasts showed that the amplitudes to happy were significantly larger compared to the amplitudes for angry, fear, and neutral stimuli (see Table 3.4).

Table 3.4.

Planned Contrasts for the Centro-Parietal P2 in Mothers.

P2	A v F	A v H	A v N	F v H	F v N	H v N
Means	3.36 vs 3.08	3.36 vs 5.03	3.36 vs 3.68	3.08 vs 5.03	3.08 vs 3.68	5.03 vs 3.68
F	0.32	**7.88**	0.35	**7.94**	2.05	**6.19**
p	.578	**.010**	.558	**.010**	.166	**.020**

Note. A=Angry, F= Fear, H=Happy, N=Neutral. Contrasts in bold represent significant effects.

3.4.3 ERP Emotion Effects to Cross-Modal Stimuli in Children

In children, the LPP was found to be significantly modulated by emotion, see Table 3.5. Planned contrasts showed that the amplitudes to both angry and fearful cross-modal stimuli were significantly larger compared to both happy and neutral stimuli, see Table 3.6.

Table 3.5.

Emotion Effects on the Parieto-Occipital Components in Children

Component	*F* (3, 48)	*p*	*ηp²*
P1	2.20	.100	.12
N170	0.31	.821	.02
LPP	**4.22**	**.010**	**.21**

Note. Bold text represents significant results. *ηp2* represents partial eta-squared, the effect size. Degrees of freedom are in brackets.

Table 3.6.

Planned Contrasts for the LPP in Children.

LPP	A v F	A v H	A v N	F v H	F v N	H v N
Means	13.46 vs 11.85	13.46 vs 5.92	13.46 vs 8.24	11.85 vs 5.92	11.85 vs 8.24	5.92 vs 8.24
F	0.41	**9.84**	**4.48**	**6.95**	**4.63**	0.75
p	.532	**.006**	**.050**	**.018**	**.047**	.399

Note. A=Angry, F= Fear, H=Happy, N=Neutral. Contrasts in bold represent significant effects.

3.4.4 Associations between variables: Testing Figure 3.1

Associations between all variables can be seen in Appendix F. Several associations were observed for path A, between maternal emotional functioning and child adjustment. Firstly, maternal suppression was positively associated with levels of internalising symptoms in their child (r= .34, p =.048). Additionally, both maternal symptoms of anxiety (r= -.47, p =.005) and depression (r= -.43, p =.010) were negatively correlated with their reports of their child's prosocial behaviour, such that increased levels of mental health difficulties in the mother were associated with fewer prosocial behaviours in the child. Path B predicted associations between maternal emotional functioning and the mother-child

relationship quality. Maternal P2 amplitudes to fearful (r= .50, p =.012), happy (r= .49, p =.015) and neutral (r= .65, p =.001) cross-modal stimuli were found to be associated with observed maternal negativity in the etch-a-sketch. No significant associations were found for path C between maternal emotional functioning and child emotional functioning.

In support of path D, the dyadic relationship quality was found to be significantly associated with emotional functioning in children. Increased maternal negativity in the etch-a-sketch was negatively associated with child LPP amplitudes to fearful and neutral stimuli, and with child emotion knowledge. Child negativity in the etch-a-sketch was significantly positively correlated to their own LPP amplitudes to both angry and happy cross-modal stimuli (see Table 3.7). There was also support for path E, the association between characteristics of the parent-child relationship and child's emotional functioning. Specifically, maternal positivity in the dyad (via both the etch-a-sketch and PFMSS) was negatively association with maternal reports of both lability and externalizing symptoms (see Table 3.7).

Table 3.7. *Correlation matrix between the Dyadic Relationship Quality and Child Emotional Functioning and Adjustment.*

	Child indices of emotional functioning, behaviour and ERP to emotion faces								
Relationship Indices	Emotion Knowledge	Emotion Regulation	Lability	LPP Angry	LPP Fear	LPP Happy	LPP Neutral	Externalising	Prosocial
Mother negativity	**-.40**	.12	.14	-.38	**-.53**	-.27	**-.54**	.24	.15
Mother positivity	.17	-.27	**-.45**	-.26	.23	-.27	-.12	**-.48**	-.02
Child negativity	.04	-.14	.13	**.52**	.17	**.54**	.11	.16	**-.38**
Child positivity	.03	-.29	-.33	-.46	.01	-.31	-.15	-.32	.04
EE	-.24	.02	**.68**	-.37	-.21	.03	-.22	**.59**	-.16

Note. For behavioural correlations N=35, child ERP (LPP) N=17. For EE N-1 on the above. EE was coded such that 0=low, 1=high. Significant correlations are represented in bold.

Finally, significant associations for path F emerged between indices of emotional functioning and adjustment in children. Maternal-reported child emotion regulation showed a large negative correlation with their reports of internalising symptoms (r= -.63, p

<.001). Maternal reported child lability was found to be significantly positively correlated to externalising symptoms, again with a large effect size (r= .67, p <.001). Children's LPP amplitudes to happy were found to be marginally significantly and negatively (r= -.48, p =.050) associated with their levels of maternal reported prosocial behaviour.

3.4.4.1 Mediation model testing

The proposed theoretical model, see Figure 1.7, predicted that maternal emotional functioning (i.e. emotion regulation, understanding, neural processing, and symptoms of anxiety and depression) would exert an influence on maternal-reported child adjustment (internalising and externalising symptoms, prosocial behaviour), that was mediated by either the dyadic relationship quality (operationalised as levels of positivity or negativity) or the child's own emotional functioning (i.e. emotion regulation, understanding and neural processing). Using the measures which were significantly correlated in the preceding analyses, the association between maternal suppression (as an indicator of maternal emotional functioning) and internalising symptoms in the children, via child emotion regulation was tested. This model was significant (R^2 = .43, F (2, 32) = 12.04, p <.001, see Figure 3.6), but there was no significant mediation (B = 0.06, SE= .05, 95% CI [-0.02, 0.20]).

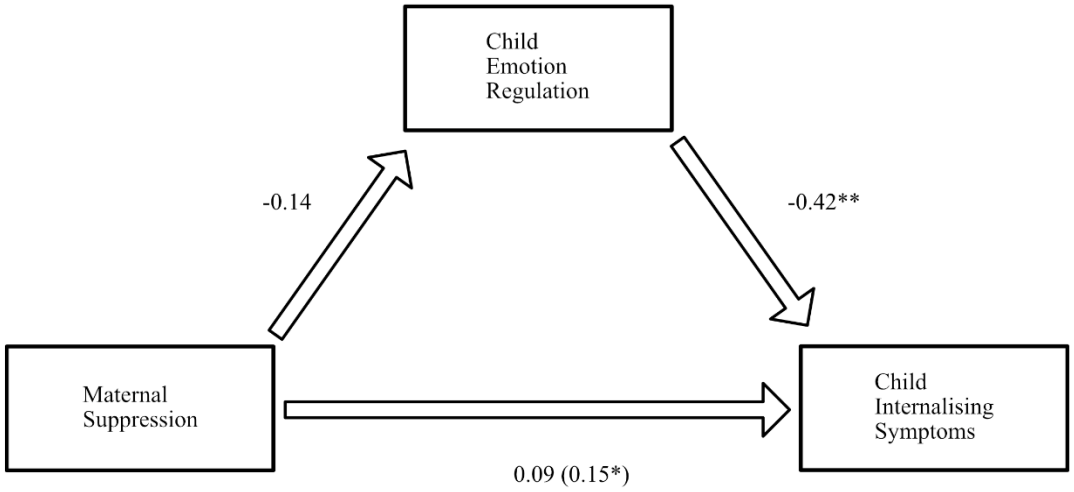

Figure 3.6. A simple mediation model of maternal suppression, child emotion regulation and internalising symptoms (N=35). A * denotes a significant path.

Maternal P2 amplitudes to fearful, happy and neutral cross-modal stimuli were all individually associated with observed maternal negativity, which in turn was associated with children's emotion knowledge and their LPP amplitudes to fearful and neutral stimuli. Thus, nine mediation models were run (see Appendix G). Three models predicting child emotion knowledge from maternal P2 amplitudes (to fear, happy and neutral respectively) via observed maternal negativity were significant (see Figure 3.7 for path coefficients). Of these, only the model with maternal P2 amplitudes to fear showed a significant indirect effect on child emotion knowledge (*B* = -0.39, *SE*= 0.23, 95% CI [-0.94, -0.04]). Specifically, those mothers with larger amplitudes to fearful stimuli had children with less emotion knowledge, and this relationship was mediated by the levels of negativity mothers showed during parent-child interaction.

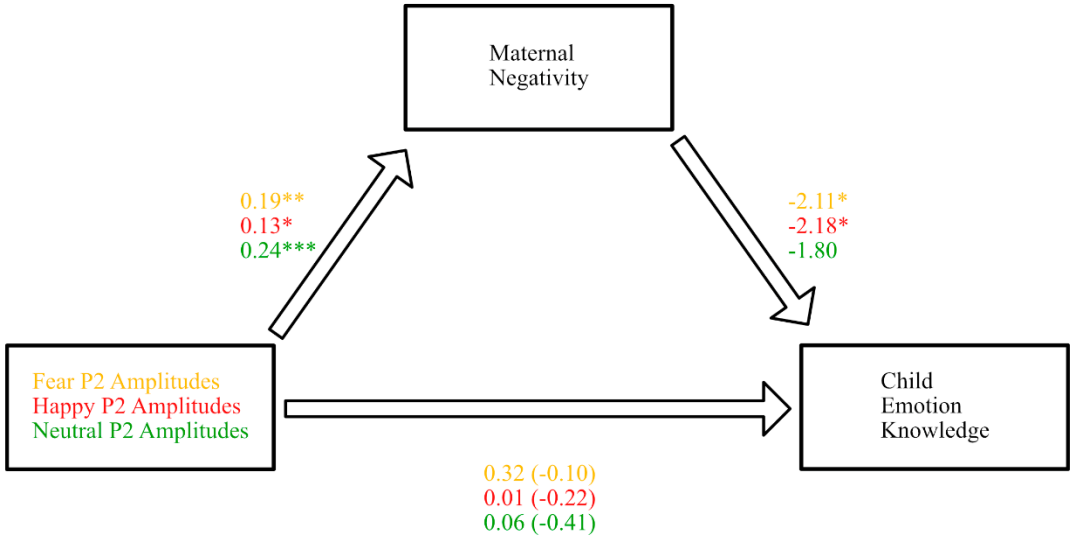

Figure 3.7. Simple mediation models testing the relationships between maternal P2 amplitudes, child emotion knowledge and maternal negativity (N=24). A * denotes a significant path.

An association also emerged between dyadic positivity (both in the PFMSS and the etch-a-sketch) and child externalising symptoms, via child lability. For the etch-a-sketch data, the overall model was significant (R^2 = .48, F (2, 32) = 14.98, p <.001) and lability was a significant mediator of the relationship between maternal positivity and child externalising symptoms (*B* = -0.42 *SE*= 0.21, 95% CI [-0.98,-0.13]). The positive effect of

maternal positivity on reduced child externalising symptom via reduced lability accounted for 48.35% of the variation in externalising symptoms (see Figure 3.8 for path coefficients). Consistently, the model predicting child externalising symptoms from EE assessed on the PFMSS via lability was also significant (R^2 = .42, F (1, 32) = 11.39, p <.001), finding lability to be a significant mediator of the relationship between EE and child externalising symptoms (B = 2.24, 95% CI [0.92, 4.18]).

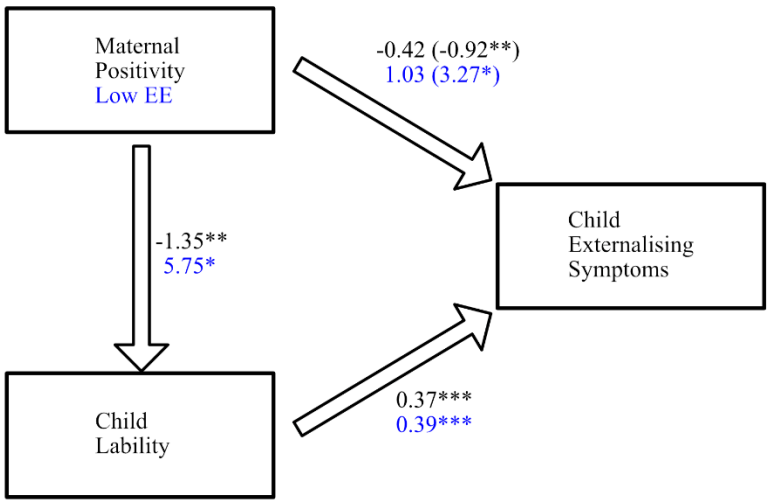

Figure 3.8 A simple mediation model of the relationship between increased maternal positivity and decreased child externalising problems via decreased child lability mapped onto the theoretical model in Figure 3.1 (N=35 for maternal positivity, 34 for EE). A * denotes a significant path.

3.5 Discussion

This study tested putative mechanisms of the role of parents in children's emotional development and social and behavioural adjustment. This study explored the various associations between the constructs of parental emotional functioning, indices of the parent-child relationship quality, child emotional functioning and child adjustment. The present study proposed based on previous theoretical and empirical work that parent-child relationship characteristics, and indicators of the child's emotional functioning, would mediate the association between maternal emotional functioning and child behavioural and social adjustment. This study also aimed to combine neural and behavioural indices of

emotional functioning, and in doing so provide the first evidence for an ERP marker of cross-modal processing in preschoolers. The results of the ERP data will first be discussed, followed by a discussion of the effectiveness of the theoretical model presented in Figure 3.1.

Considering ERP markers, N1 and P2 components were observed in mothers in response to cross-modal stimuli, consistent with the findings of other cross-modal studies in adults (Jessen & Kotz, 2011; Jessen et al., 2012; Kokinous et al., 2014; Yeh et al., 2016). In addition, the P2 amplitudes to happy stimuli were found to be significantly larger than those to angry, fearful or neutral stimuli, thus supporting the inclusion of positive emotions in future research (Sauter, 2010; Sauter et al., 2013). Unlike previous studies the data showed no emotion modulation of N1 amplitudes. While the present study presented participants with static face-voice stimuli, previous research with adults has utilised body postures to portray emotions (Yeh et al., 2016), dynamic video expressions (Kokinous et al., 2014) or both (Jessen & Kotz, 2011), and these methodological differences may explain contradictory findings.

Three ERP components were identified in the children in response to the cross-modal emotional stimuli; the P1, the N170 and the LPP. The LPP was modulated by emotion, with larger amplitudes being observed for angry and fearful stimuli compared to both happy and neutral stimuli, and for happy compared to neutral stimuli, indicating more effortful processing for negative emotions. This is consistent with previous research finding larger LPP amplitudes for emotional versus neutral stimuli (Kujawa et al., 2012a; Kujawa et al., 2012b). The larger LPP amplitudes to angry and fearful stimuli compared to happy stimuli, also support the idea of an attentional bias in which young children recognise salient threat cues and allocate more attentional resources to them (see also Dennis et al., 2009; O'Toole et al., 2013). Earlier components, in this case the P1 and N170, were not sensitive to cross-modal emotion, suggestive of less automatic and more

deliberate and evaluative emotion processing in this age group. It is, therefore, suggested that the data support the proposition of the LPP as a neural marker of cross-modal emotion processing in preschool children.

3.5.1 Associations for the theoretical model

Associations were tested for each of the pathways in Figure 3.1, with mixed results. Contrary to expectations, no associations were found between indices of emotional functioning in mothers (i.e. emotion regulation, understanding, neural processing, and symptoms of anxiety and depression) and emotional functioning in children (i.e. emotion regulation, understanding, and neural processing). Previous research in similar-aged children has reported a correlation between maternal dysregulation and child lability (Oattes et al., 2018), and both lability and emotion regulation (Crespo et al., 2017). These results suggest that some measures (e.g. the Difficulties in Emotion Regulation Scale used in both studies with the mothers) may be more sensitive to picking up concurrent associations particularly in the larger samples used in previous research.

Some positive associations emerged in support of path B between maternal emotional functioning and the dyadic relationship quality, specifically between maternal P2 amplitudes to fear, happy and neutral stimuli and observed negativity in interactions with offspring. Moreover, maternal P2 amplitudes to fear were linked to emotion knowledge in children, mediated via maternal negativity. This result extends current findings to show that neural responsivity to emotion in mothers is associated with the development of emotion knowledge in children and where interactions between mothers and children explain the associations between parental and child emotional functioning, consistent with both theory (Morris et al., 2007) and research (Reindl et al., 2018). Previous research has found that mothers who displayed increased negativity in interactions with their child had children who showed poorer emotion identification and

emotion understanding (Denham et al., 1994). Moreover, a similar within-child relationship was found in the present study, where child negativity during interactions with their mother was associated with larger child LPP amplitudes to angry and happy stimuli. This finding is consistent with previous research with five-to-seven-year-olds which found larger LPP amplitudes (to unpleasant compared to neutral stimuli) to be positively associated child anxiety symptoms (DeCicco et al., 2012).

Considering emotional functioning in the mothers, higher levels of reported anxiety and depression symptoms in mothers was associated with less maternal-reported prosocial behaviour in children as predicted in pathway A. This finding is consistent with previous research finding associations between maternal history of depression and social skills in adolescents (Brennan et al., 2003) and indicates an early emerging effect on development. Additionally, mothers reporting increased use of suppression also reported increased symptoms of internalising symptoms in children. Maternal suppression in previous research has been found to be associated with suppression in children (Bariola et al., 2012) which in turn has been linked to decreased wellbeing and increased emotional problems (Gross & John, 2003).

Maternal positivity was also associated with reduced externalising symptoms and child lability. Although not predicted a priori, child lability was found to be a significant mediator of this relationship. This model was supported for two indices of maternal negativity including the PFMSS and the etch-a-sketch interaction. This finding provides empirical support in preschoolers for the theoretical proposition that disrupted emotion regulation is a mechanism through which the dyadic relationship impacts child adjustment (Morris et al., 2007; Raval & Walker, 2019). This finding could be informative for intervention, by proposing maternal positivity as a factor that might reduce externalising behaviour and dysregulation in children. On a theoretical level, this model suggests that the parent-child relationship may be a more informative predictor of emotional functioning

and adjustment, particularly in light of the non-significant relationships between maternal and child emotional functioning.

Further associations with child adjustment were found. In support of path E, child negativity when interacting with mothers was associated with lower maternal-reported prosocial behaviour (Pianta et al., 1997). Considering path F, mothers who reported increased emotion regulation in their children, also reported fewer internalising symptoms, mirroring the findings of similar research in this age group (Mirabile, 2010). Finally, children with larger LPP amplitudes to happy stimuli were reported as displaying less prosocial behaviour by their mothers. This finding is consistent with research in adults showing a trend for larger P3 amplitudes, a component argued to have a similar function to the LPP (Kok, 1997), when participants chose not to help others in need of help (Chiu Loke, Evans, & Lee, 2011). Additional research in children has found that larger LPP differentiation to painful compared to neutral stimuli in an empathic concern task was associated with less prosocial behaviour in a sticker sharing task (Decety et al., 2018).

3.5.2 Summary of key contributions

This study makes several novel contributions to the field. It is the first known study to provide evidence of the LPP as an ERP marker of cross-modal emotion processing in preschool aged children. Secondly, it adds a multifaceted exploration of the associations between emotional functioning in parents and children. Of particular note is the importance of maternal positivity during interaction with their child, as well as neural emotion processing, and thus this study helps to illuminate potential antecedents of emotion socialisation (Bariola et al., 2011; Castro et al., 2015). Exploring these factors at both a behavioural and neural level is a further strength of the study, allowing for a more ecologically valid understanding of how parental factors influence emotional development and adjustment in their children (Bennett, 2013; Maupin, Hayes, Mayes, & Rutherford,

2015). Finally, this study provides a novel theoretical framework within which to consider emotion development, as well as supporting aspects of more recent theoretical models (e.g. Raval & Walker, 2019), in particular the importance of the parent-child relationship and the role of emotion dysregulation as a risk factor in children.

3.5.3 Limitations and future directions

The findings of this study may be limited by the small sample size, although in line with similar studies (see e.g. Jessen & Kotz, 2011: 23 adults; Jessen et al., 2012: 24 adults; Kestenbaum & Nelson, 1992: 15 children and adults; Kokinous et al., 2014: 17 adults; Yeh et al., 2016: 18 adults). The sample size may have particularly impacted the reliability of the statistical mediation, in which adequate power is needed to assess the relationship between both the predictor and mediator, and mediator and outcome variable (Fritz, Cox, & MacKinnon, 2015). The results of this study can provide effect sizes to aid power calculations for future larger scale replication. This additional power will allow for statistical controls for multiple comparisons. Alternatively, future research could employ statistical methods such as adding blocking or predictor variables to increase the reliability of the model (Fritz et al., 2015).

Additionally, while recruitment efforts were made to engage with families of all backgrounds, the majority of mothers in the study were university graduates. Furthermore, despite recruitment efforts, the sample was fairly homogenous, consisting of predominantly university-educated mothers with low levels of mental health symptoms and high levels of positivity with their child. These factors may have potentially limited the detection of associations in the data, although meaningful relationships were still observed in the relationship quality measures.

Further limitations concern the stimuli used. The study relied on observable facial expressions, and this choice of emotional stimuli in young children necessarily creates an

imbalance between positive and negative emotions. However, this depiction of simple emotion is developmentally appropriate and is widely used in ERP research (Ekman, 1992). While the study did adopt a mixed method approach, a further limitation of the present study is that for some indices of emotional functioning we relied on maternal reports of their own behaviour, as well as their child, creating shared method variance. For example, mothers who report increased symptoms of depression have been found to over-report behavioural difficulties in their children (England & Sim, 2009). Future work with this sample will aim to include fathers as research has found differential influences of mothers and fathers on emotion development (Bariola et al., 2012; Möller et al., 2016), and teachers.

Chapter 4 Exploring the Longitudinal Correlates of the Family Environment and Emotional Functioning in the Early School Years

4.1 Abstract

The early school years are recognised as a major transition and developmental challenge for young children, and thus a better understanding of factors which can predict the success of this developmental transition could be of great benefit. Better emotional functioning in children has been linked to higher academic achievement, social skills and more positive perceptions of school. However, no studies have investigated the impact of parental emotional functioning on school outcomes. Additionally, less is known about the predictive nature of neural emotional functioning which has been argued to be beneficial for potential interventions. This study extends the author's previous work by exploring the key predictors of child adjustment across time, with 29 mother-child dyads retained at Time 2 (82.86% of the original sample). Mothers and teachers reported on children's levels of prosocial behaviour, internalising and externalising symptoms and school adjustment, alongside an observational method of fear reactivity. Maternal anxiety and child emotion regulation were found to be key predictors of later adjustment. Additionally, LPP amplitudes to happy stimuli in children are suggested as a biomarker for prosocial behaviour. These findings can inform the focus of future research and intervention.

4.2 Introduction

Starting primary school and moving through the early school years is recognised as a major transition and developmental challenge for young children, in which they are required to meet certain environmental and behavioural demands. Specifically, children must form new friendships, learn new knowledge and skills all while adjusting to the rules and expectations of the school environment (Harrison & Murray, 2014). Early academic achievement is consistently found to predict later achievement (Claessens, Duncan, & Engel, 2009; Jordan, Kaplan, Ramineni, & Locuniak, 2009) and teacher-reported inter-personal and regulatory skills (Caemmerer & Keith, 2015), highlighting the importance of understanding factors which predict early school success (Fabian, 2000; Rhoades, Warren, Domitrovich, & Greenberg, 2011). These factors are often conceptualised as "school readiness", a set of interdependent developmental competences that facilitate learning and development in the school environment (High, 2008), for the promotion of adjustment and achievement in school.

The role of emotional functioning (emotion regulation, recognition and understanding) in school readiness and adjustment is receiving increasing focus and empirical support (Collie, Martin, Nassar, & Roberts, 2018; Jones, Greenberg, & Crowley, 2015; Rhoades et al., 2011). For example, an intervention focused on improving socio-emotional skills in low-income preschool children was associated with better reading achievement and learning engagement, operationalised as attention, self-discipline and intellectual curiosity, compared to the control children and even when controlling for concurrent language and literacy skills (Nix, Bierman, Domitrovich, & Gill, 2013). Emotion regulation has also been found to uniquely predict maths and literacy grades in five-year-olds, over and above the effects of IQ (Graziano, Reavis, Keane, & Calkins, 2007). In addition, both emotion regulation and understanding were found to predict better teacher-reported school adjustment, an aggregate of social, regulatory and academic skills,

at age four-to-five, when controlling for verbal ability and behavioural difficulties (Shields et al., 2001).

Studies also support the indirect effects of emotional functioning on school adjustment and achievement. For example, four-year-olds with better peer and teacher relationships in preschool were found to score more highly on measures of mathematical problem solving and identifying letter awareness in kindergarten, which was mediated by their level of emotion knowledge (Torres, Domitrovich, & Bierman, 2015). Further research has found that both emotion knowledge in preschool (Rhoades et al., 2011) and regulation at age six (Trentacosta & Izard, 2007) were predictive of academic achievement, which was mediated by their observer-rated ability to allocate attention to a task. Collectively, the above studies highlight the need for considering factors that may promote emotional functioning in children.

In summary, a large body of research supports the importance of emotional functioning on school adjustment. This evidence base is predominantly based on findings from behavioural studies. The current study aimed to extend this literature to consider whether neural indices predict school adjustment over time. Researchers have argued that understanding the neurobiological developmental processes which underlie school readiness, could both inform and provide key objective indices for the evaluation of interventions in school (Blair, 2002). In support, an attention-based intervention with preschoolers and their parents found larger ERP amplitude differences (reflected by increased attention to the target story) between the story they were instructed to attend to and the distractor story, compared to control children enrolled in other programmes (Neville et al., 2013). Additionally, children in the attention-intervention group scored more highly on the behavioural, social, receptive language, and non-verbal IQ measures.

Experiences within the family, including style of parenting and the parent-child relationship quality, have also been identified as important for school adjustment (Carlton

Latorre & Winsler, 1999; High, 2008). Specifically, parent-child relationships classified as more positive at school entry were correlated with better socioemotional (Connell & Prinz, 2002; Pianta et al., 1997) and academic outcomes (a combined test of reading, language, maths and vocabulary) at follow up assessments two, three and four years later (Pianta & Harbers, 1996). Children who perceived their parents as more warm and comforting in response to their negative emotions, showed better concurrent emotional competence in the classroom setting (Denham et al., 1997). Additionally, early parenting behaviours have been found to predict school adjustment. For example, more supportive parenting in interactions with their child, an aggregate of positive regard, cognitive stimulation and sensitivity, at 14 months old was associated with better vocabulary and word knowledge at age five (Chazan-Cohen et al., 2009) in a sample of low-income families. Moreover parents exerted a strong influence on later school adjustment, outweighing the impact of Head Start programmes and further highlighting the importance of elucidating parental factors that contribute to school adjustment. This research also explored parental functioning more broadly, finding that the presence of maternal depressive symptoms when children were 14 months of age was related to higher instances of behavioural problems at school age. Further research has found maternal depression when offspring were three months and three years of age was related to teacher reports of increased aggressive and antisocial behaviours, and poorer academic performance when children were five-to-eight (Wright, George, Burke, Gelfand, & Teti, 2000). Together, these studies demonstrate the importance of family environment and parental emotional functioning on later school adjustment.

One index underpinning parent emotional functioning is parents own emotional functioning. Several researchers have argued that parental emotional functioning is an important predictor of parenting (Bariola et al., 2011; Castro et al., 2015).

In the current study, we propose that parental emotional functioning, alongside mother-child relationship quality and child emotional functioning, will play an important role, in socio-behavioural adjustment during the early school years in children. This paper extended the previously proposed theoretical model (Figure 4.1) to consider adjustment outcomes in school a year later, with a specific focus on the key indices of these variables identified in the Time 1 paper (Chapter 3).

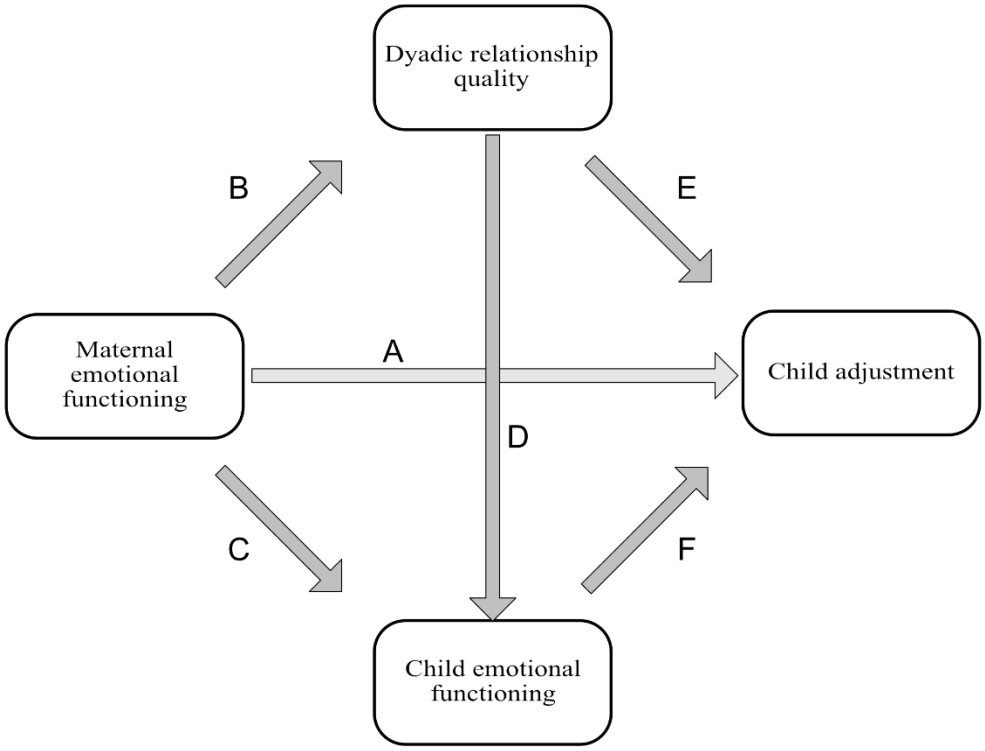

Figure 4.1. The proposed conceptual model showing the four key constructs

We hypothesised that more positive early dyadic relationships will be associated with fewer instances of externalising symptoms at follow up. Mothers with better emotional functioning were also expected to have children with fewer internalising symptoms and who displayed more prosocial behaviours. Children with smaller LPP amplitudes to happy stimuli were also expected to show more prosocial behaviours at follow up. Children who showed better emotion regulation at Time 1 were expected to have fewer internalising and externalising symptoms.

4.3 Method

4.3.1 Participants

Participants were 29 mothers (*M* =38.50 years old, *SD* =4.03 years, range = 30 – 46 years) and their child (*M* =5.35 years old, *SD* =0.72 years, range = 4.33 – 6.50 years; 10 girls) who had participated in the first part of the study approximately one year ago. Six dyads were lost to follow up (N=1 moving away, N=1 pregnancy, N=1 new work commitments, N=3 non-responsive). Participants had consented to be contacted about the follow up, and received three emails and one phone call before cessation of recruitment attempts. Unretained participants did not differ from retained participants on child age (*t* (33) =-1.05, *p*=.301), maternal age (*t* (33) =.81, *p*=.423) or child gender (χ^2 (1) = .003, *p*=.957). All child participants had an IQ in the normal range (WPPSI-IV, Weschler, 2012).[8]

Participants also included 17 class teachers, from 13 local schools, reporting on 23 children. Parent-child dyadic data was available for 22 of these children. All participating parents consented to have their child's teacher contacted, and teachers were emailed twice and followed up with one phone call. This study had ethical approval by the University of Southampton's Research Governance Office and the ethics' committee in the School of Psychology (ERGO ID: 18473.A6).

4.3.2 Materials

Due to the large degree of overlap with the methods for Time 1 (Chapter 3), only new or adapted methods will be discussed in detail (see Appendix D for a table of

[8] Scores over 70 on the receptive vocabulary and block design sub-test of the Weschler Preschool and Primary Scale of Intelligence, fourth edition.

measures used in each study). Table 4.1 details the psychometric properties of the measures.

4.3.2.1 Maternal emotional functioning

As in Time 1 (T1), mothers completed three questionnaire measures of their emotional functioning. Firstly, they completed 10 item Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) assessing two subscales of reappraisal and suppression (see 3.3.2.1.1 for more detail). Items are scored on a 7-point likert scale with higher scores indicating an increased use of that strategy. Secondly, mothers completed the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983), a 14 item scale assessing their symptoms of anxiety[9] and depression (see 3.3.2.1.2 for more detail). Participants responded to each item indicating their level of agreement with that item, on a scale of 0-3, with higher scores indicating higher symptoms. Finally, mothers completed the 22 item Adult Emotion Understanding Questionnaire (AEU; Chadwick, 2015) described in section 3.3.2.1.3. In this, participants were presented with items and asked to free label the most appropriate emotion term for each scenario, with higher scores indicative of greater emotion understanding.

4.3.2.2 Child emotional functioning

As in T1 the mothers also reported on their child's emotion regulation and lability using the Emotion Regulation Checklist (ERC; Shields & Cicchetti, 1997). The ERC includes 24 items assessing regulation and lability, with higher scores indicating an increased tendency to act in that way (see section 3.3.2.2.2 for more detail).

A combined measure of emotion knowledge was used at Time 2 (T2). Firstly, children were presented with three stories, alongside picture aids, detailing a time a person would feel mixed emotions (Gordis, 1989). This task was administered only at T2.

[9] One participant had missing data on one item of the anxiety subscale, which was imputed with their subscale mean, following Bell, Fairclough, Fiero, and Butow (2016)

Children were asked to identify any feelings they thought the story's protagonist would have, and provide an explanation for stated feelings. An example scenario was "This is about Jade/Andy. Jade/Andy has some new roller-blades that s/he got two weeks ago. Until now, her/his Dad has been helping her/him. But today s/he is going to skate on her/his own for the first time." Participants were scored no points for explaining no emotions, one point for identifying an emotion and providing a justification for this, and two points for explaining two oppositely-valenced emotions. To reflect the older age of the children at this time point, two more complex emotions were added to the emotion understanding measure of the Affective Knowledge Test (AKT; Denham, 1986)[10], embarrassment ('Nancy/Johnny's friend, Henry/Harriet's invited them to lunch. Nancy/Johnny knocked the glass over and spilled milk all over Henry/Harriet's mommy's table') and pride ('Nancy/Johnny is at school. They tell the teacher and friends that "I know all of my ABCs!"; scenarios obtained from Bosacki & Moore, 2004). These were scored in accordance with the original AKT such that participants scored 2 points for a correct answer, 1 for an incorrect answer of the same valence and 0 for an answer of the wrong valence with a total of 6 (see 3.3.2.2.1 for further detail). These two scenarios were combined with the three Gordis stories to create the emotion knowledge variable, with a maximum score of 10 (α=.70).

4.3.2.3 Relationship indices

Both relationship indices from T1 were repeated. Firstly, mothers completed the Preschool Five Minute Speech Sample (PFMSS; Daley et al., 2003) to assess the levels of warmth, positivity and criticism in the mother-child relationship (see 3.3.2.3.2 for more detail). As in T1, there was very little negativity in the sample so mothers were classified as high EE if any negativity was present, or low EE if they did not. Seven mothers were

[10] The full AKT was measured at this time point, but due to very low overall scale reliability (α=.26), only the new items were retained.

classed as high EE. One mother did not complete the PFMSS due to prior knowledge of the test, and one due to equipment failure, so there was data for 27 mothers in this task.

Secondly, mothers and children completed the etch-a-sketch measure requiring them to complete three drawings, using one dial each to necessitate interaction (Ginsburg et al., 2005). The final, and only coded, picture of the etch-a-sketch was changed at Time 2, both to reflect the older age of the children and also to necessitate coordination of the mother and child's activity (in the form of a diagonal line, see Appendix E). Five dyads were double coded for inter-rater reliability, and all but three observations were rated within 1 score of each other (97.15%). There were no instances of mother unresponsive/uninvolved behaviour, and codes were aggregated as in the previous study to create mother positivity, mother negativity, child positivity and child negativity subscales.

4.3.2.4 Child Adjustment

As in T1, mothers completed the SDQ for 4-to-17 year olds (SDQ; Goodman, 1997). The SDQ comprises of five subscales assessing levels of prosocial behaviour, hyperactivity, peer problems, emotional problems, and conduct problems (see 3.3.2.4.1). Teachers also completed the teacher version of the SDQ for 4-to-17 year olds (Goodman, 1997). Due to strong correlations between the parent and teacher reported internalising (r = .56) and externalising subscales (r = .61), the scores were averaged to create a combined score. Scores on the prosocial subscale between teachers and mothers were not correlated, and were analysed separately (r = .00).

Two new measures were added to T2. Firstly, children's anxious behaviour and coping reactions were measured via a novelty/present threat task (Mian, Carter, Pine, Wakschlag, & Briggs-Gowan, 2015). This subscale of the Anxiety Dimensional Observation Scale (ANXDOS) presents children with a remote control tarantula which is then made to move. Items associated with emotional (fearful) responding are coded on two subscales, fear composite; including fear arousal; physical avoidance and exaggerated

startle, and mother proximity seeking.[11] Participants received an overall rating of 0 (no evidence), 1 (mild/normative), 2 (moderate, originally termed "of concern") or 3 (high, originally termed "atypical") for each subscale. The two subscales were strongly correlated (r_s = .63), and thus a fear reactivity composite scale was created. 22 participants completed this measure, with three opting out, and four being unable to complete the task due to equipment failure.

The second novel measure at T2 was the short form of the Teacher's Rating Scale of School Adjustment (TRSSA; Betts & Rotenberg, 2007). The TRSSA is comprised of 16 items assessing the three subscales of on-task classroom involvement (six items, e.g. "follows teacher's directions"), positive orientation (five items, e.g. "laughs or smiles easily") and maturity (five items, e.g. "is mature"). Items are scored on a three point scale (0=doesn't apply, 1=sometimes applies, 2=certainly applies) generating total possible scores from 0-32. The total TRSSA showed acceptable reliability and validity in a sample of five-to-seven-year-olds (see Betts & Rotenberg, 2007 for details).

[11] The separation distress subscale was not relevant to the spider portion of the ANX-DOS. The later subscales, of concern and atypical behaviours, were renamed due to the non-clinical nature of the sample.

Table 4.1.

Psychometric properties of the Study variables.

				Range	
Variable	M	SD	α	Potential	Actual
Mother Emotional Functioning					
Emotion understanding	16.84	1.62	.58	0-22	13.5-19
Reappraisal	31.21	5.31	.84	6-42	21-42
Suppression	12.45	4.04	.69	4-28	6-20
Anxiety	5.97	2.47	.57	0-21	1-9
Depression	2.48	2.01	.57	0-21	0-7
Relationship Quality Indices					
Mother Positivity	4.52	2.50	-	0-16	0-11
Mother Negativity	1.65	1.74	-	0-24	0-7
Positivity	1.28	1.25	-	0-12	0-4
Negativity	2.86	3.15	-	0-24	0-14
Child Emotional Functioning					
Emotional knowledge	4.86	1.83	.70	0-10	1-8
Mixed emotions	2.35	1.17	.69	0-6	0-4
Emotion regulation	28.72	2.31	.57	8-32	23-32
Lability	25.48	4.84	.80	15-60	15-35
Child Adjustment					
Internalising symptoms	2.34	2.04	.81	0-20	0-7
Externalising symptoms	3.72	2.68	.91	0-20	0-10.5
Prosocial behaviour (M)	7.97	1.57	.58	0-10	5-10
Prosocial behaviour (T)	7.95	1.91	.74	0-10	4-10
Positivity	1.28	1.25	-	0-12	0-4
Negativity	2.86	3.15	-	0-24	0-14
School adjustment	24.18	4.46	.85	0-32	14-29

Note. N=29 for all variables except *N* =28 for EE and *N*= 21 for school adjustment. Relationship quality indices refer to the etch-a-sketch aggregates. For prosocial behaviour, the T indicates teacher report and the M mother reported.

4.3.3 Procedure

Mothers and children visited the University for one session, lasting an hour on average. Mothers completed questionnaires on iSurvey, in the fixed order of demographics, emotion understanding, ERQ, HADS, ERC and finally the SDQ. The questionnaires typically took between 15 and 30 minutes to complete. During this time the child completed the AKT and Gordis' mixed emotion stories in a counterbalanced order, followed by the WPPSI subscales.

For the second part of the session, the mother and child completed the interactive tasks together in a counterbalanced order. Both the etch-a-sketch and the picture book task

were videotaped, and the experimenter left the room during each. Additional consent was taken after the recording to ensure participants still consented for the tape to be stored and coded. The PFMSS was collected last. Participants were debriefed, reimbursed for their time and travel expenses, and children received a certificate, stickers and a small gift.

Parents were asked to provide contact details for their child's class teacher. The headteachers of the school was first sent an email notifying them of the study and providing contact details for the researcher should they wish to opt out. Teachers were then sent the questionnaires, and reimbursed with a £5 amazon voucher for filling them out.

4.3.4 Approach to Data analysis

The analyses consisted of three steps. Firstly, concurrent associations between the Time 2 constructs of maternal emotional functioning, the dyadic relationship quality, child emotional functioning and child adjustment were explored. For correlational analyses, any skewed variables (mother positivity and child negativity) were bootstrapped (Mooney & Duval, 1993). Secondly, the key predictors of child adjustment at Time 1 were considered in relation to the child adjustment outcomes at Time 2; internalising symptoms, externalising symptoms and prosocial behaviour. For the novel outcomes of fear reactivity and school adjustment, all the identified Time 1 predictors were explored. Initially, bivariate correlations were run with the Time 1 predictor and Time 2 outcome. If these were significant, a partial correlation was run controlling for the Time 2 measure of the predictor, in order to isolate any predictive power at Time 1. Only significant associations are discussed in the text. A full correlation matrix is presented in Appendix H.

The final stage of analysis extended the significant mediations found at Time 1 with the equivalent Time 2 outcome. Any other identified mediation models from the first stage of the concurrent analysis were also tested. All correlational analyses were conducted using SPSS (v24), and mediation models using PROCESS (v2.16.3).

4.4 Results

4.4.1 Descriptive statistics

The potential demographic confounds of age and gender were explored in relation to the measured variables. Child age was negatively correlated with mother-reported prosocial behaviour, so all subsequent analysis with this variable included age as a covariate. Child gender was not significantly associated with any child variable, and thus all subsequent analyses were run across gender.

4.4.2 Concurrent associations

Concurrent associations were explored for all T2 variables, see Appendix H. These showed that child lability and mother positivity on the PFMSS were positively associated with the combined parent-teacher ratings of externalising symptoms. Children's fear reactivity in the spider task was associated with increased depressive symptoms in the mother, and emotion regulation in the child. Considering observed maternal behaviour, maternal positivity was correlated to emotion knowledge in their child and observed maternal negativity was positively correlated to the teacher's reports of their child's school adjustment.

4.4.3 Longitudinal associations between T1 and T2

The results of all correlations can be seen in Appendix I. Only significant associations are reported in text.

4.4.3.1 Internalising symptoms

T1 maternal suppression and child emotion regulation were both associated with concurrent internalising symptoms in the child. When assessed longitudinally, only a child's emotion regulation was significantly negatively correlated with their internalising

symptoms a year later (r = -.41, p = .026) indicating that poor emotional control at T1 predicted more internalising symptoms over time. However, this effect did not persist when later emotion regulation scores were controlled for (r = -.29, p = .135).

4.4.3.2 Externalising symptoms

T1 maternal positivity (assessed in the PFMSS and etch-a-sketch) and child emotion lability were both associated with concurrent externalising symptoms in the child. When assessed longitudinally, only increased T1 lability in children was a significant positive predictor of their later levels of externalising symptoms (r = .41, p = .026), but again this effect did not persist when later lability scores were controlled for (r = .19, p = .336).

4.4.3.3 Prosocial behaviour

Maternal-reported prosocial behaviour at T1 was negatively associated with concurrent maternal self-reported anxiety and depression, child observed negativity during the etch-a-sketch and children's LPP amplitude to happy cross-modal stimuli (Chapter 3). When analysed longitudinally, maternal anxiety was significantly associated with later maternal-reported prosocial behaviour (r = -.39, p = .035), but not when later anxiety scores were controlled for (r = -.36, p = .066). Children's LPP to happy stimuli at Time 1 was negatively associated with their Time 2 maternal-reported prosocial behaviour (r = -.61, p = .036), indicating that those who showed larger neural amplitudes to happy stimuli at T1 were reported to display fewer prosocial behaviours by the mothers a year later.

4.4.3.4 Fear reactivity

All T1 predictors of child adjustment were assessed in relation to fear reactivity in the spider task. Observed increased child negativity in the etch-a-sketch task was significantly related to later increased fear reactivity (r = .43, p = .044), even when controlling for levels of negativity at T2 (r = .49, p = .023).

4.4.3.5 School adjustment

All T1 predictors of child adjustment were assessed in relation to school adjustment. Maternal-reported T1 child regulation was positively associated with school adjustment a year later (r = .50, p = .017), and was marginally non-significant when later regulation was taken into account (r = .43, p = .055). In addition, higher levels of maternal self-reported anxiety were associated with poorer teacher-reported school adjustment (r = -.45, p = .036), even when controlling for levels of maternal anxiety at follow up (r = -.49, p = .024).

4.4.3.6 Mediation analysis

To further test longitudinal associations in the proposed theoretical model (Figure 1.7), the significant mediation models identified at T1 were extended to include the T2 outcome data. Two models testing the effects of the dyadic relationship quality at T1 on externalising symptoms at T2, via child lability at T1, were explored. The first used maternal positivity, as assessed on the etch-a-sketch, but the model was not significant (R^2 = .18, F (2, 26) = 2.85, p = .076). The second model, using T1 EE as the predictor, was also non-significant (R^2 = .13, F (2, 25) = 1.82, p = .183).

A third model extended the T1 mediation to explore whether early maternal P2 amplitudes to fear would significantly predict later emotion knowledge in the children, and be mediated by mothers' negativity during the T1 interaction task. This model was non-significant (R^2 = .07, F (2, 16) = 1.82, p = .552).

4.5 Discussion

The present study aimed to identify predictors of social, behavioural and academic adjustment in children during the early school years. We proposed, based on theory and the author's earlier work, that maternal emotional functioning, the mother-child relationship

quality and child emotional functioning would provide key predictors of later adjustment. Alongside this, we explored concurrent relationships amongst these four key constructs.

Few concurrent relationships were observed at T2, compared to the T1 data. Mothers who were rated as more positive during the etch-a-sketch with their child, had children with higher emotion knowledge. This finding supports previous work demonstrating consistent links between more warm and positive parental relationships and greater emotion knowledge (e.g. Denham, 1997). Contrary to the findings at Time 1, maternal positivity measured on the Five Minute Speech Sample was positively associated with the combined parent and teacher report of externalising symptoms. Similarly to the findings of Mirabile et al. (2018), it is possible that in the older Time 2 sample increased mother positivity becomes detrimental to child outcome. Although this cannot be disentangled using the current binary measure of maternal positivity/negativity, future work could aim to utilise a more nuanced measure of maternal positivity.

Consistent with the T1 findings, and previous empirical research (Mirabile, 2010), children who were rated as more dysregulated by their mothers were also rated as showing more externalising symptoms concurrently, and longitudinally, by their mothers and teachers. The replication of this finding is consistent with previous research finding high stability for externalising symptoms between age three and five years old (Kerr et al., 2007), and low-moderate stability for emotion regulation between age four-to-five and eight-to-nine (Tan & Smith, 2019). The mediating role of emotion lability between maternal positivity and externalising symptoms in the child did not hold up over time.

Mothers and teachers were found to agree on their perception of internalising and externalising symptoms in the child, but not on their level of prosocial behaviour. Other research using the SDQ found low to moderate agreement for the subscales, with the lowest agreement found for the prosocial behaviour subscale across seven European countries (Cheng et al., 2018), supporting the findings presented in this study. Context has

been argued to be a key driver of the reporting discrepancy (Strickland, Hopkins, & Keenan, 2012), which in the case of prosocial behaviour may reflect parents seeing the child interact with friends and siblings, and teachers with a wider peer group. More broadly, the dearth of significant findings at T2 compared to the T1 assessment of this sample could in part be due to the fact that all the children were now in formal schooling, and as such were experiencing a wider range of socialisers in the form of teachers and peers (see commentary by Fabes, Hanish, & Martin, 2003).

Some relationships emerged with the novel outcome measures at T2. Firstly, children who showed more fear reactivity in response to the spider task were found to have mothers with increased symptoms of depression. In support, recent research has found mothers classed as "melancholic", high in depressive symptoms, to have more emotionally reactive preschoolers (Hooper, Feng, Christian, & Slesnick, 2015). Somewhat surprisingly, mothers' reports of their child's emotion regulation were positively correlated to their observed fear reactivity. It is possible that the use of the specific fear stimulus of a spider may not provide an accurate measure of overall fear reactivity. A further surprising finding was that observed maternal negativity was positively correlated to teacher reports of school adjustment, contradicting previous research (e.g. Chazan-Cohen et al., 2009).

Several of the identified correlates of adjustment at T1 were also observed longitudinally, providing some support for the proposed theoretical model across time. Firstly, children who were reported as having better emotion regulation also demonstrated fewer maternal-reported internalising symptoms a year later, consistent with previous research (Mirabile, 2010). Emotion regulation was also predictive of school adjustment a year later, further highlighting the importance of emotion regulation and supporting its inclusion in existing theoretical models (Morris et al., 2007; Raval & Walker, 2019).

Maternal anxiety also emerged as an important predictor of later child outcomes. Mothers who self-reported increased symptoms of anxiety also reported fewer prosocial

behaviours in their child. Additionally, maternal anxiety at T1 was predictive of later school adjustment, even when concurrent anxiety was controlled for. These findings support the notion of maternal anxiety as a key risk factor for children's adjustment (O'Connor, Heron, Golding, Beveridge, & Glover, 2002), and suggest maternal anxiety as a potential area of intervention. With research highlighting significant stability in maternal anxiety from pregnancy to two years post birth, interventions focused on maternal anxiety may help facilitate lasting change (Dipietro, Costigan, & Sipsma, 2008).

Extending the current literature, children's LPP amplitudes to happy stimuli were found to be significantly correlated to their later maternal-reported prosocial behaviour. This finding may suggest that LPP processing of happy stimuli is suitable as a biomarker for mother-reported prosocial behaviour, a relationship which held up concurrently and at the one year follow up. T1 data found that maternal P2 amplitudes to fear were significantly related to emotion knowledge in their child, and that maternal negativity was an observed mechanism of this. This relationship did not persist over time, suggesting maternal neural processing of emotion may have less predictive power than the child's own neural processing.

The findings of the present study are important in identifying markers of later adjustment, during a period of change and increased environmental demands on young children. Maternal anxiety and emotion regulation in children emerged as key predictors, supporting theoretical propositions and suggesting a focus for intervention work. This study also tentatively suggests the LPP to happy stimuli as a biomarker for maternal-reported prosocial behaviour in children.

The use of multiple methods and reporters is a strength of the present study, allowing for a more comprehensive assessment of variables whilst attempting to minimise the effects of common reporter bias. The longitudinal data presented in this paper allow for the identification of earlier risk and resilience factors for later adjustment by controlling for

concurrent measures, providing data which could inform interventions, albeit at the expense of exploring the stability of constructs. This study also provides some of the first evidence in linking neural emotion processing to later adjustment in children.

However this study is not without its limitations. The small sample size limited power, which may have driven some of the close to significant longitudinal relationships when controls were accounted for (e.g. between emotion regulation and school adjustment). The sample was further reduced by being unable to obtain teacher data for all children. Due to the small sample and exploratory nature of some of the analyses, multiple comparisons were not controlled for, increasing the risk of a Type 1 error. Additionally, the sample was fairly homogenous, consisting of mothers who tended to be university educated and positive in interaction with their child. This lack of variation may in part have led to limited concurrent associations between detected.

The present study tested associations on the assumption that child adjustment, internalising, externalising, prosocial behaviour, fear reactivity and school adjustment, were the outcome variables. Although possible that these variables may be exerting an influence on maternal behaviours and child functioning, there is strong theoretical (Cunningham et al., 2009; Raval & Walker, 2019) and empirical (Blandon et al., 2010) support of the approach adopted in the present study.

Chapter 5 General Discussion

The importance of emotional functioning in early childhood is widely recognised, with research finding emotional functioning to be linked to a variety of academic, social and wellbeing outcomes (Collie, Martin, Nassar, & Roberts, 2018; Heinze, Miller, Seifer, Dickstein, & Locke, 2015). This thesis built on this literature by testing a theoretical model of emotion development (see Figure 1.7) adapted from existing models (Mirabile, 2010). This model considered the relationship between emotional functioning in mothers and children, the dyadic relationship quality and child adjustment. It anticipated that parents' ability to recognise and understand emotions, and to regulate effectively their own emotions, would be associated with emotional functioning and adjustment in their child (i.e. following Bariola et al., 2011; Buckholdt et al., 2014; Castro et al., 2015). In previous research the focus has been on parenting, defined broadly as a set of interacting behaviours that influence development in offspring (Darling, 1999). The thesis extended this literature to consider child characteristics as well, and assessed the quality of the dyadic relationship, operationalised as dimensions of positivity and negativity. In addition, it utilised a broad set of measurements associated with emotional functioning in mothers and their children, which included both behavioural and neural measures (Bennett, 2013; Maupin, Hayes, Mayes, & Rutherford, 2015).

5.1 Findings from the systematic review

Firstly, existing research findings were reviewed systematically to assess the evidence for a direct association between parents and children's emotional functioning (Chapter 2). The systematic review identified 10 studies that reported a significant association between emotion regulation in parents and their children. These associations were most evident for studies exploring emotion dysregulation, with nine of the ten studies

including measures of emotion dysregulation or suppression. Some studies suggesting that associations only existed for mothers and daughters, for example, finding associations between mothers' and daughters' distress tolerance (Daughters et al., 2014). The review highlighted that five studies that investigated associations between emotion recognition in parents and children reported less consistent results. In addition, methods across studies were diverse. For example, the studies differed in terms of whether they required both participants to passively view or label the emotional stimuli, whether these stimuli were static facial expressions or dynamic video expressions, and whether the emotions were portrayed by their family member or a stranger. Studies also differed by level of measurement, with three behavioural and two neuroscientific studies being identified. The findings of these studies suggested that person familiarity and mode of presentation may be key features, with two studies finding associations between emotion recognition in parents and children when video clips of the other dyad member were used. One study in the systematic review explored situational emotion understanding in children, finding no associations with parents' self-reported emotion dysregulation.

The exploration of existing research via a systematic review highlighted two areas for development. Specifically, the review highlighted a lack of focus in existing research on emotional functioning broadly defined - only one study explored a different aspect of emotional functioning in parents and children, by exploring parental emotion regulation and child emotion understanding. Furthermore, no study assessed more than one facet of emotional functioning, i.e. assessing both emotion regulation and understanding in the family, despite these being frequently conceptualised together (e.g. Eisenberg et al., 1998; Mirabile, 2010).

In addition, the review highlighted the lack of valid and reliable measures of emotion understanding in adults, a potential factor explaining the lack of studies assessing parental understanding of emotion. Existing research has assessed related constructs such

as emotional intelligence (Bar-On, 1997) and mentalising/theory of mind (e.g. Reading the Mind in the Eyes; Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997), but to the author's knowledge few exist which assess situational emotion understanding in adults (comparable to the AKT in children). One measure of emotion understanding, the Situational Test of Emotion Understanding (MacCann & Roberts, 2008), was limited by low scale reliability in some follow up studies (e.g. Cronbach's α=.48 and α=.55 in Austin, 2010; MacCann, 2010). Moreover, measures of emotional functioning have been criticised for having a disproportionate number of negative compared to positive emotions (Sauter, 2010; Sauter et al., 2013), and thus, for example, scores may not reflect increased accuracy of happiness recognition but rather a positive vs negative recognition. In the current programme of research an Adult Emotion Understanding (AEU) was developed with two samples of undergraduate students. The AEU presented 22 emotion scenarios, across both positive and negative, and high and low intensity emotion, and asked respondents to list the most appropriate for the given scenario. Initial results found acceptable-good reliability for this measure (initial α of .70, and .61 overall), with a significant association with emotion reappraisal providing some initial evidence of criterion validity.

An updated systematic search identified a further 13 papers, with all bar one study (Turpyn et al., 2018) focusing exclusively on emotion regulation in parents and children. Eleven of these studies reported significant associations between emotion regulation in parents and children, which again was primarily focused on the measurement of maladaptive emotion regulation (dysregulation and suppression). The updated search demonstrated advances in knowledge, namely research with younger children, as well as supporting the identified limitations of a lack of longitudinal, multimethod and neuroscientific research. Collectively, this increase in the last two years of studies supports the research approach adopted in the current thesis, and the exploration of emotional

functioning in families both concurrently and across time and that utilises a mixed methodology.

5.2 Key empirical findings

The proposed association between parents' and children's emotional functioning (see Figure 1.7) were tested empirically in Chapters 3 (cross-sectionally) and Chapter 4 (longitudinally). Measures of maternal anxiety and depression were included alongside measures of maternal emotion regulation and emotion understanding as measured via the AEU and also using an ERP measure of processing emotions presented cross-modally (face and voice). Children's emotional functioning was assessed through measures of emotion understanding (including the ERP cross-modal task), and emotion regulation. The mother-child relationship quality was also assessed using an interactive etch-a-sketch drawing task and a mother speech sample, and operationalised as levels of positivity and negativity. These relationship indices were proposed as possible mediators between maternal emotional functioning and child adjustment (see Figure 1.7).

Chapters 3 and 4 did not support a direct association between parents' and children's emotional functioning (i.e., no behavioural measures of emotional understanding or regulation in mothers correlated with those in children cross-sectionally or longitudinally). The lack of concurrent associations between maternal and child emotion regulation did not fit with existing studies that have reported associations between emotion regulation in families, for example finding links between parental emotional dysregulation and their preschoolers' emotion lability (Crespo et al., 2017). Of note is that the effect sizes for these associations in the empirical work in this thesis were small, and as such the lack of an association does not reflect inadequate power. One longitudinal study with preschoolers, identified in the updated systematic search (Tan & Smith, 2019), also reported no direct associations between maternal and child emotion regulation. The authors

did find evidence for a moderated mediation over time in which maternal reappraisal had an indirect effect on child emotion regulation, via maternal positive expressivity for families in which maternal negative expressivity was low, suggesting that exploring a combination of factors together may be more informative for longitudinal studies. Alternatively, the discrepant findings may be due in part to the measures used. Both the present thesis, and the study by Tan and Smith (2019) used the ERQ to measure emotion regulation in mothers, whereas other research using the DERS consistently picked up on associations with emotion regulation in pre-schoolers (Crespo et al., 2017; Oattes et al., 2018).

The inclusion of an ERP measure of cross-modal emotion processing reflects a novel extension to existing research. Chapter 3 showed that the LPP was identified as a neural marker for cross-modal emotion processing, and it provides the first evidence for this index of emotion processing in preschool aged children. This thesis found that the LPP to happy stimuli was a biomarker for mother reports of prosocial behaviour in children both concurrently and over time (Chapter 4), extending previous work in adults and empathy tasks in children. This finding also develops understanding as to how measures of neural emotion processing in children may relate to social behaviour. Furthermore, the use of cross-modal stimuli provides a more ecologically valid measure of emotion processing than paradigms using only facial expressions (Ding et al., 2017; Gross & Ballif, 1991).

The findings did however highlight an indirect association between indices of maternal and child emotion functioning via positive and negative interactions. For example, Chapter 3 showed significant positive associations between maternal P2 amplitudes to fear, happy and neutral stimuli and observed maternal negativity during the etch-a-sketch task. Furthermore, maternal P2 amplitudes to fear were associated with concurrent emotion knowledge in the child via maternal negativity. These findings indicate that emotion processing in mothers indirectly impacts the development of emotion

understanding in offspring via the nature of mother-child interactions. Similarly, a neuroscientific study identified in the updated systematic search found an association between emotion regulation in parents and their five-to-nine-year-old child, which was mediated by their brain synchrony when completing a cooperative task together (Reindl et al., 2018). These results highlights the needs to use neural and behavioural measurements of emotion processing to understand factors that potentially impact the development of emotional understanding within families (Bennett, 2013; Maupin et al., 2015).

The thesis incorporated several measures that developed the research by considering the quality of the dyadic relationship between mothers and children. The results highlighted interactions as an important context where the transmission of emotional competencies between mothers and their children takes place. Moreover, the results shift the focus from isolated parenting behaviours (e.g., parent control or reactions to children's emotions) to measures which capture the interactive nature of the relationship. The importance of the interaction has been found to be significant in understanding children's emotional functioning and adjustment, for example finding maternal positivity in the dyad to be negatively associated with anger displays in boys aged nine-to-ten and calming down time in girls (McDowell, Kim, O'Neil, & Parke, 2002). Additionally, the parent-child relationship quality has been included in a recent theoretical model of emotion development, with the authors highlighting the need for more research to include measures of this component of development (Raval & Walker, 2019). In this framework, the family context operationalised as the quality of the caregiver-child relationship is proposed to influence emotion regulation and psychosocial functioning in the child (see Figure 1.6).

Chapter 3 found low levels of maternal positivity to be a concurrent predictor of increased mother-reported emotion lability and externalising problems in children, with emotion lability mediating the relationship between maternal positivity and child externalising symptoms. This relationship was consistent across two independent measures

of maternal positivity, an observer-rated measure from the etch-a-sketch task and a maternal speech sample, increasing the reliability of this finding. However, less support was found for this research question in the T2 data in Chapter 4, with only a direct association between lower maternal positivity in the speech sample and increased child externalising symptoms being observed. With all children now in formal schooling, the results here raise the possibility that other socialisers such as peers (Dunsmore & Karn, 2004) or teachers (Morris, Denham, Bassett, & Curby, 2013) may have become more influential in children's adjustment. None of the six theoretical models presented in the literature review included peers as an influencer of children's emotional functioning and adjustment, suggesting an area for future research.

This thesis included a longitudinal element, allowing for predictors of later adjustment to be identified. Chapter 2 outlined that longitudinal studies exploring associations between parent and child and adjustment are scarce, with only one of the sixteen original identified studies and one of the thirteen from the updated search presenting longitudinal data. The longitudinal analysis presented in Chapter 4 highlighted child better emotion regulation as a key predictor of later school adjustment and lower levels of internalising and externalising symptoms. Few associations were found for other aspects of child emotion functioning (i.e. neural processing of emotion and emotion understanding) predicting school adjustment over time. The clear associations with emotion regulation suggest that this component of emotional functioning has predictive value for adjustment in the early school years.

Chapter 4 also showed that maternal anxiety was a further predictor of later child school adjustment, even when concurrent anxiety was controlled for. The results of the longitudinal study suggest that poor emotion regulation and increased maternal anxiety are risk factors for poorer adjustment in school, and potential targets for intervention. This finding supports the results of other longitudinal work, finding maternal antenatal anxiety

to predict children' adjustment (also measured on the SDQ) at age 4 (O'Connor, Heron, Glover, & Team, 2002).

5.3 Theoretical implications

The findings of this thesis provide support for existing theoretical models. Emotion regulation in children, both in terms of lability and positive regulation, were found to be key predictors of both concurrent (Chapter 3) and longitudinal adjustment outcomes (Chapter 4). All six theoretical models discussed in this thesis include child emotion regulation as a predictor of child outcome, three of which as the only included element of children's emotional functioning (Gottman et al., 1996; Morris et al., 2007; Raval & Walker, 2019). The findings of this thesis support the theoretical importance placed on emotion regulation in this age group.

The importance of the parent-relationship quality was highlighted in Chapter 3, finding mothers who were more positive with their child had children with fewer externalising problems, which was mediated by the child's emotion lability. This finding supports the tentatively proposed pathway in the model by Raval and Walker (2019) from the parent-child relationship to child functioning, via child emotion regulation. Further, this suggests that future models would benefit from considering the parent-child relationship in addition to the traditional socialisation measures.

Maternal anxiety also emerged as a key predictor of child outcome in Chapter 3 and 4. Existing theoretical models account for the influence of broad parent characterises (Eisenberg et al., 1998; Morris et al., 2007; Raval & Walker, 2019), with the model by Morris et al. (2007) including a specific reference to parental mental health. The results of the work in this thesis would tentatively suggest maternal anxiety as more influential in children's emotional development and adjustment in the preschool years, than maternal

depression. Going forward, more nuanced models may be more informative for future research and intervention.

The theoretical model proposed within this thesis hypothesised associations between four key constructs of emotional functioning in mothers, children, the parent-child relationship and child adjustment. Contrary to expectation, maternal emotional functioning was largely unrelated to emotional functioning in children in the empirical chapters. However, there was strong support for this pathway from the systematic review, for the role of parental emotion regulation particularly, meriting the need for future research into this relationship. As discussed above, strong concurrent support was found between the mother-child relationship and child emotional competence and adjustment, with some relationships also emerging over time. Thus, widening the focus of parenting to include the dyadic relationship would appear to benefit research into emotion development in families. Emotional functioning in children was found to exert an influence on both their concurrent and later adjustment, with emotion regulation being observed as a prominent predictor.

In line with other models, the parent-child relationship and children's emotional functioning were proposed as mediators of the relationship between parent emotional functioning and child adjustment. The findings of Chapter 3 in particular would suggest that a more nuanced sequence would be more appropriate. For example, the significant mediation models presented in this chapter found maternal P2 amplitudes (indices of maternal emotional functioning) to predict child emotion knowledge (an index of child emotional functioning) via maternal negativity (an index of the parent-child relationship). Additionally, maternal positivity (an index of the parent-child relationship) was found to predict children's externalising symptoms (an index of child adjustment) via their emotion lability (an index of child emotional functioning). In both these cases, the parent-child relationship was conceptualised as the predictor of the child emotional functioning

construct, and thus should be reflected in the model. An updated version of the conceptual model is therefore shown below.

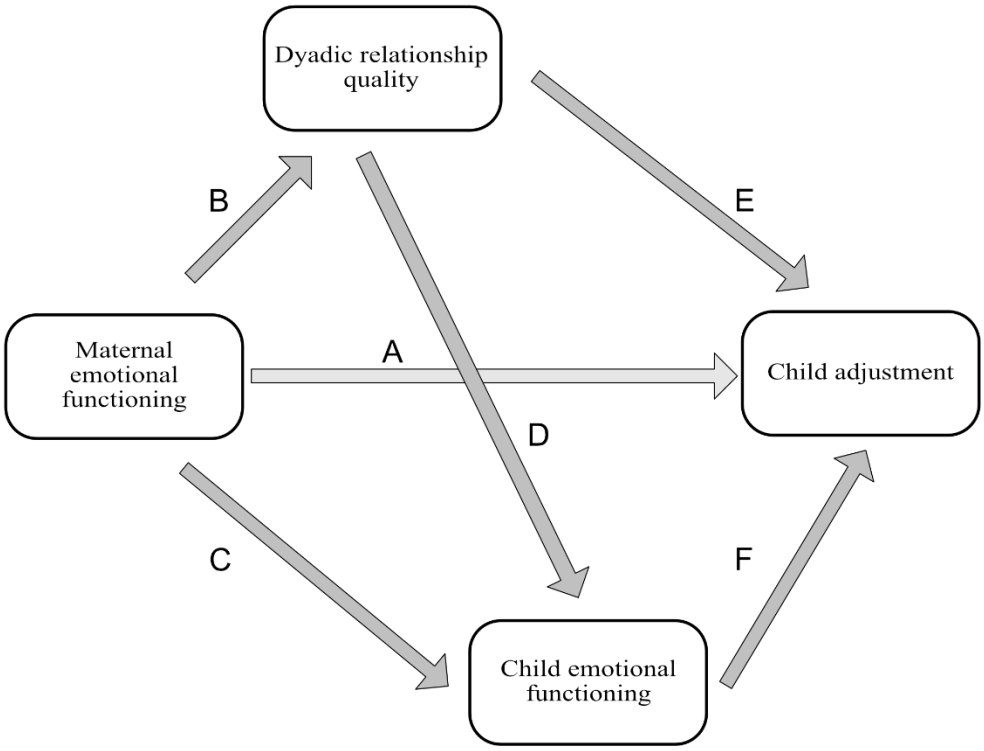

Figure 5.1. Updated theoretical model based on the findings of this thesis

5.4 Limitations and Future Directions

As discussed above, this thesis provides some novel insights into the transmission of emotional functioning in the family environment. However, one must recognise the influence of shared genetics on emotional functioning and adjustment. Although limited in nature, twin studies have suggested emotion regulation, identified as a key predictor of children's adjustment in the current study, to have mild-moderate heritability (Hawn, Overstreet, Stewart, & Amstadter, 2015). One study in three-year-olds twin pairs argued that genetics accounted for 43% of the variance in emotion regulation scores (Wang & Saudino, 2013). Anxiety, another of the main identified predictors of adjustment across time, has also been found to be moderately heritable (Hettema, 2001). Taken together,

these studies highlight the need for future research to consider the influence of genetics on emotional functioning in families.

The sample size for ERP research in young children is a strength of the thesis, however, for the behavioural measures the sample size is low which limits the power of the analyses conducted. Larger scale replication of this programme of research would be of great benefit. The data should also be viewed in light of the sample demographics. Although every effort was made to recruit a wide range of participants, the majority of mothers were university educated and as such the data may not fully represent the population. This limitation may be most relevant to specific outcomes measured in the children, for example previous research has found parental education to affect child academic attainment (Magnuson, Sexton, Davis-Kean, & Huston, 2009).

The research also focused solely on mothers. While previous research has found differences in how mothers and fathers interact with their children that have differential impact on child development (Möller et al., 2016), the focus on mothers limits generalisation and future research should aim to include fathers to gain a more comprehensive account of the influence of parents (Mirabile, 2010). Furthermore, as highlighted above, none of the theoretical models account for the influence of other children on development, and as such the role of siblings could be an avenue for future work.

The findings do have implications for the development of prevention and intervention research. The concurrent data indicate that maternal anxiety and emotion regulation in children were associated with adjustment outcomes concurrently. Moreover, maternal anxiety and child regulation were predictive of child adjustment at follow up, in some cases even when concurrent levels were controlled for. These findings indicate that maternal anxiety and child emotion regulation would be proposed as the main focus for interventions. The findings of this thesis, alongside other work (e.g. O'Connor et al., 2002)

highlight the importance of early intervention for maternal anxiety, and would suggest that to impact school adjustment interventions should be delivered prior to the start of school.

Existing interventions lend support to these conclusions. For example, from a preschool version of the PATHS (Promoting Alternative Thinking Strategies), a teacher led Head Start programme aimed at improving emotion awareness, regulation, problem solving and peer relations in children. The data from the PATHS found that the intervention children had higher emotion knowledge and reported social competence across multiple reporters following the 30 week intervention (Domitrovich, Cortes, & Greenberg, 2007).

Research has also aimed to elucidate the most beneficial time to conduct an intervention. Work with control and very low birth-weight children demonstrated improvements in maternal warmth during an intervention in infancy, with an additional intervention needed at age two to improve later developing skills such as language and social competence (Landry, Smith, Swank, & Guttentag, 2008). In order to improve complex adjustment outcomes such as those assessed in this thesis, the results of Landry et al. (2008) would suggest that intervention efforts would be optimal if conducted during both the infancy and toddler years.

Many existing interventions, including those detailed above, have understandably focused on low-income and otherwise at risk children. However, the results from this study would suggest that reducing maternal anxiety and increasing emotion regulation skills would be of general benefit for all children. Findings from other research would suggest that in low-risk populations such as the current sample, an informational booklet would be sufficient to reduce mothers' symptoms of anxiety and depression, which in turn would benefit their parenting (Farris, Bert, Nicholson, Glass, & Borkowski, 2013).

With regards to emotion regulation, educators and parents have consistently called for a focus on fostering socioemotional skills prior to school entry, with few teachers rating

number and letter knowledge as important (Buis, 2014; Lewit & Baker, 1995; McAllister, Wilson, Green, & Baldwin, 2005). It is the hope that the continuation of research, such as the work conducted in this thesis, will further support these arguments.

In conclusion, this programme of work showed the importance of the family context and emotional functioning in the family on children's adjustment. Support was found for the proposed theoretical model, with several markers of adjustment being identified both concurrently and across time. Future research should aim to replicate these findings in larger samples, and address some of the highlighted areas for development.

Appendix A Search Terms

S1= Parent* OR Mother* OR Father* OR Matern* OR Patern*

S2 = Adolescen* OR Infan* OR Teen* OR Toddler* OR Child* OR Preschooler* OR preschooler*

S3 = ("emotion funct*" OR "emotion competen*" OR "emotion regulat*" OR "emotion comprehen*" OR "emotion understand*" OR "emotion recog*" OR “emotion know*”) NOT (ASD OR "autism spectrum" OR ADHD OR "attent* deficit hyperactiv* disorder" OR epilepsy OR "brain injury" OR "severe development* delay" OR tumour)

S4= S1 AND S2 AND S3

Appendix B Reasons and References for Articles Excluded following Full-text Assessment

Paper Reference	Reason	Stage
Allen, N. B., Kuppens, P., & Sheeber, L. B. (2012). Heart rate responses to parental behavior in depressed adolescents. Biological Psychology, 90(1), 80-87. doi:10.1016/j.biopsycho.2012.02.013	No parental factor	1
Allhusen, V., Belsky, J., Booth, C. L., Bradley, R., Brownell, C. A., Burchinal, M., . . . Net, N. E. C. C. R. (2004). Affect dysregulation in the mother-child relationship in the toddler years: Antecedents and consequences. Development and Psychopathology, 16(1), 43-68. doi:10.1017/s0954579404040404	No parental factor	1
Amole, M. C., Cyranowski, J. M., Wright, A. G. C., & Swartz, H. A. (2017). Depression impacts the physiological responsiveness of mother–daughter dyads during social interaction. Depression and Anxiety, 34(2), 118-126. doi:10.1002/da.22595	Clinical populations	2
Anderson, S. E., & Keim, S. A. (2016). Parent-child interaction, self-regulation, and obesity prevention in early childhood. . Current Obesity Reports, 5(2), 192-200. doi:10.1007/s13679-016-0208-9	Review without relevant papers	1
Atzaba-Poria, N., Deater-Deckard, K., & Bell, M. A. (2017). Mother-child interaction: Links between mother and child frontal electroencephalograph asymmetry and negative behavior. Child Development, 88(2), 544-554. doi:10.1111/cdev.12583	Neither measured	1
Baardstu, S., Karevold, E. B., & von Soest, T. (2017). Childhood antecedents of agreeableness: A longitudinal study from preschool to late adolescence. Journal of Research in Personality, 67, 202-214. doi:10.1016/j.jrp.2016.10.007	No parental factor	1
Balottin, L., Nacinovich, R., Bomba, M., & Mannarini, S. (2014). Alexithymia in parents and adolescent anorexic daughters: Comparing the responses to TSIA and TAS-20 scales. Neuropsychiatric Disease and Treatment, 10, 1941-1951. doi:10.2147/ndt.s67642	Clinical populations	2
Bamford, C., & Lagattuta, K. H. (2012). Looking on the bright side: Children's knowledge about the benefits of positive versus negative thinking. Child Development, 83(2), 667-682. doi:10.1111/j.1467-8624.2011.01706.x	No parental factor	1
Batha, K. (2015). Clever connections: A pilot whole-family programme exploring opportunities to enhance carer-child attunement. Children Australia, 40(3), 221-231. doi:10.1017/cha.2015.19	Neither measured	1
Beebe, B., Jaffe, J., Markese, S., Buck, K., Chen, H., Cohen, P., . . . Feldstein, S. (2010). The origins of 12-month attachment: A microanalysis of 4-month mother-infant interaction. Attachment & Human Development, 12(1-2), 3-141. doi:10.1080/14616730903338985	Neither measured	1

Paper Reference	Reason	Stage
Beebe, B., Lachmann, F. M., Markese, S., Buck, K. A., Bahrick, L. E., Chen, H. N., . . . Jaffe, J. (2012). On the origins of disorganized attachment and internal working models: Paper II. An empirical microanalysis of 4-month mother-infant interaction. Psychoanalytic Dialogues, 22(3), 352-374. doi:10.1080/10481885.2012.679606	Neither measured	1
Berge, J. M., Jin, S. W., Hannan, P., & Neumark-Sztainer, D. (2013). Structural and interpersonal characteristics of family meals: Associations with adolescent body mass index and dietary patterns. Journal Of The Academy Of Nutrition And Dietetics, 113(6), 816-822. doi:10.1016/j.jand.2013.02.004	Neither measured	1
Blackford, J. U., & Walden, T. A. (1998). Individual differences in social referencing. Infant Behavior & Development, 21(1), 89-102. doi:10.1016/s0163-6383(98)90056-x	No parental factor	1
Borelli, J. L., Rasmussen, H. F., St John, H. K., West, J. L., & Piacentini, J. C. (2015). Parental reactivity and the link Between parent and child anxiety symptoms. Journal of Child and Family Studies, 24(10), 3130-3144. doi:10.1007/s10826-015-0117-7	Physiological	2
Bridges, L. J., Margie, N. G., & Zaff, J. F. (2001). Background for community-level work on emotional well-being in adolescence: Reviewing the literature on contributing factors. Washington DC: Child Trends, Inc.,	Review without relevant papers	1
Bridgett, D. J., Burt, N. M., Edwards, E. S., & Deater-Deckard, K. (2015). Intergenerational transmission of self-regulation: A multidisciplinary review and integrative conceptual framework. Psychological Bulletin, 141(3), 602-654. doi:10.1037/a0038662	Review without relevant papers	1
Brooker, R. J., Davidson, R. J., & Goldsmith, H. H. (2016). Maternal negative affect during infancy is linked to disrupted patterns of diurnal cortisol and alpha asymmetry across contexts during childhood. Journal of Experimental Child Psychology, 142, 274-290. doi:10.1016/j.jecp.2015.08.011	No parental factor	1
Brophy-Herb, H. E., Horodynski, M., Dupuis, S. B., Bocknek, E. L., Schiffman, R., Onaga, E., . . . Thomas, S. (2009). Early emotional development in infants and toddlers: Perspectives of Early Head Start staff and parents. Infant Mental Health Journal, 30(3), 203-222. doi:10.1002/imhj.20211	Neither measured	1
Brown, E. D., & Ackerman, B. P. (2011). Contextual risk, maternal negative emotionality, and the negative emotion dysregulation of preschool children from economically disadvantaged families. Early Education and Development, 22(6), 931-944. doi:10.1080/10409289.2010.508033	No parental factor	1
Brownell, C. A., Etheridge, W., Hungerford, A., & Kelley, S. (1997). Socialization of self-regulation: Continuity and discontinuity over age and context. Paper presented at the Biennial Meeting of the Society for Research in Child Development, Washington DC.	Excluded reference type	1
Brumariu, L. E., Kerns, K. A., & Seibert, A. (2012). Mother-child attachment, emotion regulation, and anxiety symptoms in middle childhood. Personal Relationships, 19(3), 569-585. doi:10.1111/j.1475-6811.2011.01379.x	Missed duplicate	1

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Paper Reference	Reason	Stage
Brumariu, L. E., Kerns, K. A., & Seibert, A. (2012). Mother–child attachment, emotion regulation, and anxiety symptoms in middle childhood. Personal Relationships, 19(3), 569-585. doi:10.1111/j.1475-6811.2011.01379.x	No parental factor	1
Bylsma, L. M., Yaroslavsky, I., Rottenberg, J., Kiss, E., Kapornai, K., Halas, K., . . . Kovacs, M. (2016). Familiality of mood repair responses among youth with and without histories of depression. Cognition & Emotion, 30(4), 807-816. doi:10.1080/02699931.2015.1025707	Neither measured	1
Calkins, S. D. (1994). Origins and outcomes of individual differences in emotion regulation. Monographs of the Society for Research in Child Development, 59(2), 53-72. doi:10.1111/j.1540-5834.1994.tb01277.x	Excluded reference type	1
Carson, J., & Gerber, E. (1999). Emotion regulation in marital and parent-child relationships: Predicting academic and social outcomes in children. Paper presented at the Biennial Meeting of the Society for Research in Child Development, New Mexico: Albuquerque.	Excluded reference type	1
Castro, V. L., Halberstadt, A. G., Lozada, F. T., & Craig, A. B. (2015). Parents' emotion-related beliefs, behaviors, and skills predict children's recognition of emotion. Infant and Child Development, 24(1), 1-22. doi:10.1002/icd.1868	Missed duplicate	1
Castro, V. L., Halberstadt, A. G., Lozada, F. T., & Craig, A. B. (2015). Parents' emotion-related beliefs, behaviours, and skills predict children's recognition of emotion. Infant and Child Development, 24(1), 1-22. doi:10.1002/icd.1868	Missed duplicate	1
Castro, V. L., Halberstadt, A. G., Lozada, F. T., & Craig, A. B. (2015). Parents' emotion-related beliefs, behaviours, and skills predict children's recognition of emotion. Infant and Child Development, 24(1), 1-22. doi:10.1002/icd.1868	Missed duplicate	1
Cavanaugh, A. M., Supple, A. J., Stein, G. L., Helms, H. M., Plunkett, S. W., & Sands, T. (2017). Examining predictors of mexican american adolescents' coping typologies: Maternal and paternal behaviors and adolescent gender. Journal of Family Issues, 38(6), 755-775. doi:10.1177/0192513x15580164	Neither measured	1
Chen, S.-J., & Fujino, Y. (Eds.). (2001). Research and Clinical Center for Child Development Annual Report, 1999-2000, No. 23. Hokkaido University: Japan.	Excluded reference type	1
Cole, P. M., Teti, L. O., & Zahn-Waxler, C. (2003). Mutual emotion regulation and the stability of conduct problems between preschool and early school age. Development and Psychopathology, 15(1), 1-18. doi:10.1017/S0954579403000014	Not parent on parent	2
Conn, K. M., Fisher, S. G., & Rhee, H. (2016). Parent and child independent report of emotional responses to asthma-specific vignettes: The relationship between emotional states, self-management behaviors, and symptoms. Journal of Pediatric Nursing-Nursing Care of Children & Families, 31(2), E83-E90. doi:10.1016/j.pedn.2015.10.002	Neither measured	1
Connell, A. M., Hughes-Scalise, A., Klostermann, S., & Azem, T. (2011). Maternal depression and the heart of parenting: Respiratory sinus arrhythmia and affective dynamics during parent–adolescent interactions. Journal of Family Psychology, 25(5), 653-662. doi:10.1037/a0025225	Physiological	2

Paper Reference	Reason	Stage
Connell, A. M., McKillop, H., Patton, E., Klostermann, S., & Hughes-Scalise, A. (2015). Actor-partner model of physiology, negative affect, and depressive symptoms in mother-child dyadic interactions. Journal of Social and Personal Relationships, 32(8), 1012-1033. doi:10.1177/0265407514555274	Missed duplicate	1
Connell, A. M., McKillop, H., Patton, E., Klostermann, S., & Hughes-Scalise, A. (2015). Actor–partner model of physiology, negative affect, and depressive symptoms in mother–child dyadic interactions. Journal of Social and Personal Relationships, 32(8), 1012-1033. doi:10.1177/0265407514555274	Clinical populations	2
Covell, K., & Miles, B. (1992). Children's beliefs about strategies to reduce parental anger. Child Development, 63(2), 381-390. doi:10.1111/j.1467-8624.1992.tb01634.x	No parental factor	1
Criss, M. M., Morris, A. S., Ponce-Garcia, E., Cui, L. X., & Silk, J. S. (2016). Pathways to adaptive emotion regulation among adolescents from low-income families. Family Relations, 65(3), 517-529. doi:10.1111/fare.12202	Missed duplicate	1
Criss, M. M., Morris, A. S., Ponce-Garcia, E., Cui, L., & Silk, J. S. (2016). Pathways to adaptive emotion regulation among adolescents from low-income families. Family Relations: An Interdisciplinary Journal of Applied Family Studies, 65(3), 517-529. doi:10.1111/fare.12202	No parental factor	1
Crossley, I. A., & Buckner, J. C. (2012). Maternal-related predictors of self-regulation among low-income youth. Journal of Child and Family Studies, 21(2), 217-227. doi:10.1007/s10826-011-9465-0	No parental factor	1
Crugnola, C. R., Gazzotti, S., Spinelli, M., Ierardi, E., Caprin, C., & Albizzati, A. (2013). Maternal attachment influences mother–infant styles of regulation and play with objects at nine months. Attachment & Human Development, 15(2), 107-131. doi:10.1080/14616734.2013.745712	Not parent on parent	2
Crugnola, C. R., Gazzotti, S., Spinelli, M., Ierardi, E., Caprin, C., & Albizzati, A. (2013). Maternal attachment influences motherinfant styles of regulation and play with objects at nine months. Attachment & Human Development, 15(2), 107-131. doi:10.1080/14616734.2013.745712	Missed duplicate	1
Crugnola, C. R., Ierardi, E., Gazzotti, S., & Albizzati, A. (2014). Motherhood in adolescent mothers: Maternal attachment, mother–infant styles of interaction and emotion regulation at three months. Infant Behavior & Development, 37(1), 44-56. doi:10.1016/j.infbeh.2013.12.011	Not parent on parent	2
Cui, L. X., Morris, A. S., Harrist, A. W., Larzelere, R. E., & Criss, M. M. (2015). Dynamic changes in parent affect and adolescent cardiac vagal regulation: A real-time analysis. Journal of Family Psychology, 29(2), 180-190. doi:10.1037/fam0000067	No parental factor	1

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Paper Reference	Reason	Stage
Davenport, E., Yap, M. B. H., Simmons, J. G., Sheeber, L. B., & Allen, N. B. (2011). Maternal and adolescent temperament as predictors of maternal affective behavior during mother–adolescent interactions. Journal of Adolescence, 34(5), 829-839. doi:10.1016/j.adolescence.2011.02.003	Neither measured	1
David, O. A. (2014). The Rational Positive Parenting program for child externalizing behavior: Mechanisms of change analysis. Journal of Evidence-Based Psychotherapies, 14(1), 21-38.	No child factor	1
de Haan, M., Belsky, J., Reid, V., Volein, A., & Johnson, M. H. (2004). Maternal personality and infants' neural and visual responsivity to facial expressions of emotion. Journal of Child Psychology and Psychiatry, 45(7), 1209-1218. doi:10.1111/j.1469-7610.2004.00320.x	Neither measured	1
De Rubeis, S., & Granic, I. (2012). Understanding treatment effectiveness for aggressive youth: The importance of regulation in mother-child interactions. Journal of Family Psychology, 26(1), 66-75. doi:10.1037/a0026837	Clinical populations	2
Deater-Deckard, K., Wang, Z., Chen, N., & Bell, M. A. (2012). Maternal executive function, harsh parenting, and child conduct problems. Journal of Child Psychology and Psychiatry, 53(10), 1084-1091. doi:10.1111/j.1469-7610.2012.02582.x	Neither measured	1
Degnan, K. A., Calkins, S. D., Keane, S. P., & Hill-Soderlund, A. L. (2008). Profiles of disruptive behavior across early childhood: Contributions of frustration reactivity, physiological regulation, and maternal behavior. Child Development, 79(5), 1357-1376. doi:10.1111/j.1467-8624.2008.01193.x	No parental factor	1
Denham, S. (1991). Socialization of emotion: Pathway to preschoolers' affect regulation and emotion knowledge? Paper presented at the Biennial Meeting of the Society for Research in Child Development, Seattle: Washington.	Excluded reference type	1
Denham, S., Renwickdebardi, S., & Hewes, S. (1994). Emotional communication between others and preschoolers- relations with emotional competence Merrill-Palmer Quarterly-Journal of Developmental Psychology, 40(4), 488-508.	Neither measured	1
Diamond, L. M., Fagundes, C. P., & Butterworth, M. R. (2012). Attachment style, vagal tone, and empathy during mother–adolescent interactions. Journal of Research on Adolescence, 22(1), 165-184. doi:10.1111/j.1532-7795.2011.00762.x	Physiological	2
Diamond, L. M., Fagundes, C. P., & Cribbet, M. R. (2012). Individual differences in adolescents' sympathetic and parasympathetic functioning moderate associations between family environment and psychosocial adjustment. Developmental Psychology, 48(4), 918-931. doi:10.1037/a0026901	No parental factor	1
DiCorcia, J. A., & Tronick, E. (2011). Quotidian resilience: Exploring mechanisms that drive resilience from a perspective of everyday stress and coping. Neuroscience and Biobehavioral Reviews, 35(7), 1593-1602. doi:10.1016/j.neubiorev.2011.04.008	Review without relevant papers	1
Dix, T., & Meunier, L. N. (2009). Depressive symptoms and parenting competence: An analysis of 13 regulatory processes. Developmental Review, 29(1), 45-68. doi:10.1016/j.dr.2008.11.002	No child factor	1

Paper Reference	Reason	Stage
Dix, T., Moed, A., & Anderson, E. R. (2014). Mothers' depressive symptoms predict both increased and reduced negative reactivity: Aversion sensitivity and the regulation of emotion. Psychological Science, 25(7), 1353-1361. doi:10.1177/0956797614531025	Not skill-based emotional competences	2
DonelanMcCall, N., & Dunn, J. (1997). School work, teachers, and peers: The world of first grade. International Journal of Behavioral Development, 21(1), 155-178. doi:10.1080/016502597385036	No parental factor	1
Duclos, J., Dorard, G., Berthoz, S., Curt, F., Faucher, S., Falissard, B., & Godart, N. (2014). Expressed emotion in anorexia nervosa: What is inside the "black box"? Comprehensive Psychiatry, 55(1), 71-79. doi:10.1016/j.comppsych.2013.10.002	Clinical populations	2
Dunn, J., Maguire, M., & Brown, J. R. (1995). The development of children's moral sensibility: Individual differences and emotion understanding. Developmental Psychology, 31(4), 649-659. doi:10.1037/0012-1649.31.4.649	No parental factor	1
Durme, K., Goossens, L., Bosmans, G., & Braet, C. (2017). The role of attachment and maladaptive emotion regulation strategies in the development of bulimic symptoms in adolescents. Journal of Abnormal Child Psychology, 46, 1-13. doi:10.1007/s10802-017-0334-1	No parental factor	1
Edwards, E. S., Holzman, J. B., Burt, N. M., Rutherford, H. J. V., Mayes, L. C., & Bridgett, D. J. (2017). Maternal emotion regulation strategies, internalizing problems and infant negative affect. Journal of Applied Developmental Psychology, 48, 59-68. doi:10.1016/j.appdev.2016.12.001	No child factor	1
Edwards, N. M. (2014). Number of children associated with mothers' perceived need for behavior support: Implications for parenting interventions. Journal of Child and Family Studies, 23(3), 527-536. doi:10.1007/s10826-013-9712-7	Neither measured	1
Eisenberg, N. (1994). The relations of emotionality and regulation to children's anger-related reactions. Child Development, 65(1), 109-128. doi:10.1111/j.1467-8624.1994.tb00738.x	No parental factor	1
Eisenberg, N., Duckworth, A. L., Spinrad, T. L., & Valiente, C. (2014). Conscientiousness: Origins in childhood? Developmental Psychology, 50(5), 1331-1349. doi:10.1037/a0030977	Review without relevant papers	1
El-Sheikh, M., & Cummings, M. E. (1997). Marital conflict, emotional regulation, and the adjustment of children of alcoholics. New Directions for Child Development, 77, 25-44. doi:10.1002/cd.23219977703	Review without relevant papers	1
Emde, R. N. (1999). Moving ahead: Integrating influences of affective processes for development and for psychoanalysis. International Journal of Psychoanalysis, 80, 317-339. doi:10.1516/0020757991598738	Neither measured	1
Ensink, K., Begin, M., Normandin, L., & Fonagy, P. (2016). Maternal and child reflective functioning in the context of child sexual abuse: Pathways to depression and externalising difficulties. European Journal of Psychotraumatology, 7. doi:10.3402/ejpt.v7.30611	Neither measured	1

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Paper Reference	Reason	Stage
Ensink, K., Normandin, L., Target, M., Fonagy, P., Sabourin, S., & Berthelot, N. (2015). Mentalization in children and mothers in the context of trauma: An initial study of the validity of the Child Reflective Functioning Scale. British Journal of Developmental Psychology, 33(2), 203-217. doi:10.1111/bjdp.12074	Neither measured	1
Ensor, R., Spencer, D., & Hughes, C. (2011). 'You feel sad?' emotion understanding mediates effects of verbal ability and mother–child mutuality on prosocial behaviors: Findings from 2 years to 4 years. Social Development, 20(1), 93-110. doi:10.1111/j.1467-9507.2009.00572.x	No parental factor	1
Escolano-Perez, E. (2013). Maternal brain and its implications for the human development. Revista De Neurologia, 56(2), 101-108.	No full text in English	1
Ewing, E. S. K., Diamond, G., & Levy, S. (2015). Attachment-based family therapy for depressed and suicidal adolescents: theory, clinical model and empirical support. Attachment & Human Development, 17(2), 136-156. doi:10.1080/14616734.2015.1006384	Neither measured	1
Fasche, A., Gunzenhauser, C., Friedlmeier, W., & von Suchodoletz, A. (2015). Regulation of positive and negative emotions as mediator between maternal emotion socialization and child problem behavior. Praxis Der Kinderpsychologie Und Kinderpsychiatrie, 64(5), 334-350. doi:10.13109/prkk.2015.64.5.334	No parental factor	1
Favez, N. (2011). Elaboration and regulation of lived emotion in preschoolers' autobiographical narratives The role of maternal conversational cooperation. Narrative Inquiry, 21(1), 1-23. doi:10.1075/ni.21.1.01fav	No parental factor	1
Feldman, R. (2012). Physiological measures of emotion from a developmental perspective: State of the science: Parent–infant synchrony: A biobehavioral model of mutual influences in the formation of affiliative bonds. Monographs of the Society for Research in Child Development, 77(2), 42-51. doi:10.1111/j.1540-5834.2011.00660.x	Neither measured	1
Feldman, R., Singer, M., & Zagoory, O. (2010). Touch attenuates infants' physiological reactivity to stress. Developmental Science, 13(2), 271-278. doi:10.1111/j.1467-7687.2009.00890.x	Physiological	2
Fernandez, C., & Melzi, G. (2008). Evaluation in spanish-speaking mother-child narratives: The social and sense-making function of internal-state references Spanish-Language Narration and Literacy: Culture, Cognition, and Emotion (pp. 92-118): Cambridge: Cambridge University Press.	Excluded reference type	1
Ferrer, R. A., Green, P. A., Oh, A. Y., Hennessy, E., & Dwyer, L. A. (2017). Emotion suppression, emotional eating, and eating behavior among parent–adolescent dyads. Emotion, 17(1), 1052-1065. doi:10.1037/emo0000295	Missed duplicate	1
Field, A. P., Cartwright-Hatton, S., Reynolds, S., & Creswell, C. (2008). Future directions for child anxiety theory and treatment. Cognition & Emotion, 22(3), 385-394. doi:10.1080/02699930701842270	Review without relevant papers	1

Paper Reference	Reason	Stage
Finger, B., Schuetze, P., & Eiden, R. D. (2014). Behavior problems among cocaine exposed children: Role of physiological regulation and parenting. Neurotoxicology and Teratology, 42, 51-59. doi:10.1016/j.ntt.2014.01.001	No parental factor	1
Ford, J. D., Steinberg, K. L., & Zhang, W. L. (2011). A randomized clinical trial comparing affect regulation and social problem-solving psychotherapies for mothers with victimization-related PTSD. Behavior Therapy, 42(4), 560-578. doi:10.1016/j.beth.2010.12.005	Neither measured	1
Foubert, K., Collins, T., & De Backer, J. (2017). Impaired maintenance of interpersonal synchronization in musical improvisations of patients with borderline personality disorder. Frontiers in Psychology, 8. doi:10.3389/fpsyg.2017.00537	Neither measured	1
Fox, N. A. (1994). The development of emotion regulation: Biological and behavioral considerations (Vol. 59). Chicago: University of Chicago Press.	Excluded reference type	1
Frank, T. J., Keown, L. J., Dittman, C. K., & Sanders, M. R. (2015). Using father preference data to increase father engagement in evidence-based parenting programs. Journal of Child and Family Studies, 24(4), 937-947. doi:10.1007/s10826-014-9904-9	Neither measured	1
Friedlmeier, W., & Trommsdorff, G. (1999). Emotion regulation in early childhood - A cross-cultural comparison between German and Japanese toddlers. Journal of Cross-Cultural Psychology, 30(6), 684-711. doi:10.1177/0022022199030006002	No parental factor	1
Friedlmeier, W., & Trommsdorff, G. (2001). Development of emotion regulation of 2-and 3-year-old girls. Zeitschrift Fur Entwicklungspsychologie Und Padagogische Psychologie, 33(4), 204-214. doi:10.1026//0049-8637.33.4.204	No full text in English	1
Garner, P. W., Jones, D. C., Gaddy, G., & Rennie, K. M. (1997). Low-income mothers' conversations about emotions and their children's emotional competence. Social Development, 6(1), 37-52. doi:10.1111/j.1467-9507.1997.tb00093.x	Missed duplicate	1
Garrett-Peters, P. T., Castro, V. L., & Halberstadt, A. G. (2017). Parents' beliefs about children's emotions, children's emotion understanding, and classroom adjustment in middle childhood. Social Development, 26(3), 575-590. doi:10.1111/sode.12222	No parental factor	1
Garrett-Peters, P., Mills-Koonce, R., Adkins, D., Vernon-Feagans, L., Cox, M., & Family Life Project Key, I. (2008). Early environmental correlates of maternal emotion talk. Parenting-Science and Practice, 8(2), 117-152. doi:10.1080/15295190802058900	Neither measured	1
Gavita, O. A., David, D., & DiGiuseppe, R. (2014). You are such a bad child! Appraisals as mechanisms of parental negative and positive affect. Journal of General Psychology, 141(2), 113-129. doi:10.1080/00221309.2013.874971	Neither measured	1
Gavita, O. A., David, D., Bujoreanu, S., Tiba, A., & Ionutiu, D. R. (2012). The efficacy of a short cognitive-behavioral parent program in the treatment of externalizing behavior disorders in Romanian foster care children: Building parental emotion-regulation through unconditional self- and child-acceptance strategies. Children and Youth Services Review, 34(7), 1290-1297. doi:10.1016/j.childyouth.2012.03.001	Missed duplicate	1

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Paper Reference	Reason	Stage
Gaviţa, O. A., David, D., Bujoreanu, S., Tiba, A., & Ionuţiu, D. R. (2012). The efficacy of a short cognitive–behavioral parent program in the treatment of externalizing behavior disorders in Romanian foster care children: Building parental emotion-regulation through unconditional self- and child-acceptance strategies. Children and Youth Services Review, 34(7), 1290-1297. doi:10.1016/j.childyouth.2012.03.001	Missed duplicate	1
Gee, D. G. (2016). Sensitive periods of emotion regulation: Influences of parental care on frontoamygdala circuitry and plasticity. In H. J. V. R. L. C. Mayes (Ed.), Maternal brain plasticity: Preclinical and human research and implications for intervention. New Directions for Child and Adolescent Development (pp. 87-110). Massachusetts: Wiley Periodicals.	Excluded reference type	1
Gerhardt, S. (2016). A good beginning. Journal of Public Mental Health, 15(1), 19-24. doi:10.1108/jpmh-01-2016-0005	Review without relevant papers	1
Gini, M., Oppenheim, D., & Sagi-Schwartz, A. (2007). Negotiation styles in mother-child narrative co-construction in middle childhood: Associations with early attachment. International Journal of Behavioral Development, 31(2), 149-160. doi:10.1177/0165025407074626	Neither measured	1
Giuliano, R. J., Skowron, E. A., & Berkman, E. T. (2015). Growth models of dyadic synchrony and mother-child vagal tone in the context of parenting at-risk. Biological Psychology, 105, 29-36. doi:10.1016/j.biopsycho.2014.12.009	Clinical populations	2
Gonzalez, A., Levitan, R., Pereira, J., Goldberg, S., & Atkinson, L. (2008). Early maternal experience, maternal sensitivity, infant emotion regulation and HPA function. European Neuropsychopharmacology, 18, S587-S588. doi:10.1016/s0924-977x(08)70900-3	Excluded reference type	1
Granic, I., O'Hara, A., Pepler, D., & Lewis, M. D. (2007). A dynamic systems analysis of parent-child changes associated with successful "real-world" interventions for aggressive children. Journal of Abnormal Child Psychology, 35(5), 845-857. doi:10.1007/s10802-007-9133-4	Neither measured	1
Gratz, K. L., Kiel, E. J., Latzman, R. D., Elkin, T. D., Moore, S. A., & Tull, M. T. (2014). Maternal borderline personality pathology and infant emotion regulation: Examining the influence of maternal emotion-related difficulties and infant attachment. Journal of Personality Disorders, 28(1), 52-69. doi:10.1521/pedi.2014.28.1.52	Clinical populations	2
Gratz, K. L., Kiel, E. J., Latzman, R. D., Moore, S. A., Elkin, T. D., Megason, G. C., & Tull, M. T. (2015). Complex interrelations of trait vulnerabilities in mothers and their infants. Infancy, 20(3), 306-338. doi:10.1111/infa.12075	Not skill-based emotional competences	2
Graziano, P. A., & Hart, K. (2016). Beyond behavior modification: Benefits of socio-emotional/self-regulation training for preschoolers with behavior problems. Journal of School Psychology, 58, 91-111. doi:10.1016/j.jsp.2016.07.004	No parental factor	1

Paper Reference	Reason	Stage
Grimbos, T., Granic, I., & Pepler, D. (2013). The relation between co-rumination, maternal depressive symptoms and child psychopathology. Journal of Psychopathology and Behavioral Assessment, 35(3), 335-345. doi:10.1007/s10862-013-9342-9	Neither measured	1
Grusec, J. E., & Davidov, M. (2010). Integrating different perspectives on socialization theory and research: A domain-specific approach. Child Development, 81(3), 687-709. doi:10.1111/j.1467-8624.2010.01426.x	Review without relevant papers	1
Gulley, L. D., Oppenheimer, C. W., & Hankin, B. L. (2014). Associations among negative parenting, attention bias to anger, and social anxiety among youth. Developmental Psychology, 50(2), 577-585. doi:10.1037/a0033624	No parental factor	1
Guttmann-Steinmetz, S., & Crowell, J. A. (2006). Attachment and externalizing disorders: A developmental psychopathology perspective. Journal Of The American Academy Of Child And Adolescent Psychiatry, 45(4), 440-451. doi:10.1097/01.chi.0000196422.42599.63	Review without relevant papers	1
Habersaat, S., Pierrehumbert, B., Forcada-Guex, M., Nessi, J., Ansermet, F., Muller-Nix, C., & Borghini, A. (2014). Early stress exposure and later cortisol regulation: Impact of early intervention on mother-infant relationship in preterm infants. Psychological Trauma-Theory Research Practice and Policy, 6(5), 457-464. doi:10.1037/a0033878	No parental factor	1
Haley, D. W., Handmaker, N. S., & Lowe, J. (2006). Infant stress reactivity and prenatal alcohol exposure. Alcoholism-Clinical and Experimental Research, 30(12), 2055-2064. doi:10.1111/j.1530-0277.2006.00251.x	No parental factor	1
Hallquist, M. N., Hipwell, A. E., & Stepp, S. D. (2015). Poor self-control and harsh punishment in childhood prospectively predict borderline personality dymptoms in adolescent girls. Journal of Abnormal Psychology, 124(3), 549-564. doi:10.1037/abn0000058	No parental factor	1
Ham, J., & Tronick, E. (2006). Infant resilience to the stress of the still-face: Infant and maternal psychophysiology are related. Annals Of The New York Academy Of Sciences, 1094, 297-302. doi:10.1196/annals.1376.038	Physiological	2
Havighurst, S. S., Harley, A., & Prior, M. (2004). Building preschool children's emotional competence: A parenting program. Early Education and Development, 15(4), 423-447. doi:10.1207/s15566935eed1504_5	No parental factor	1
Healy, K. L., & Sanders, M. R. (2017). Antecedents of treatment resistant depression in children victimized by peers. Child Psychiatry & Human Development, 48(1), 107-119. doi:10.1007/s10578-016-0658-z	No parental factor	1
Herbers, J. E., Cutuli, J. J., Supkoff, L. M., Narayan, A. J., & Masten, A. S. (2014). Parenting and coregulation: Adaptive systems for competence in children experiencing homelessness. American Journal of Orthopsychiatry, 84(4), 420-430. doi:10.1037/h0099843	Neither measured	1
Herman-Stahl, M., Saavedra, L. M., Morgan-Lopez, A. A., Novak, S. P., Warner, T. D., & Fishbein, D. H. (2017). Maternal depressive symptoms and adolescent alcohol use: The mediating role of youth depressive symptoms. Journal of Early Adolescence, 37(4), 453-474. doi:10.1177/0272431615617290	No parental factor	1

Appendix B

Paper Reference	Reason	Stage
Hill, J., Sharp, H., Pickles, A., Marks, K., Sadler, C., Appleton, J., & Tibu, F. (2010). Maternal emotion recognition during pregnancy and infant emotional negativity in early infancy. Infant Mental Health Journal, 31(3), 110-111.	Excluded reference type	1
Hilt, L. M., Armstrong, J. M., & Essex, M. J. (2012). Early family context and development of adolescent ruminative style: Moderation by temperament. Cognition & Emotion, 26(5), 916-926. doi:10.1080/02699931.2011.621932	Neither measured	1
Hirata, M., Ikeda, T., Kikuchi, M., Kimura, T., Hiraishi, H., Yoshimura, Y., & Asada, M. (2014). Hyperscanning MEG for understanding mother-child cerebral interactions. Frontiers in Human Neuroscience, 8, 118. doi:10.3389/fnhum.2014.00118	Neither measured	1
Hirshfeld-Becker, D. R., & Biederman, J. (2002). Rationale and principles for early intervention with young children at risk for anxiety disorders. Clinical Child and Family Psychology Review, 5(3), 161-172. doi:10.1023/a:1019687531040	Review without relevant papers	1
Hoffman, D. M. (2009). How (not) to feel: Culture and the politics of emotion in the American parenting advice literature. Discourse-Studies in the Cultural Politics of Education, 30(1), 15-31. doi:10.1080/01596300802643058	Review without relevant papers	1
Hoffman, E. R., Hodges, E. A., Propper, C., Postage, P. L., Zipkin, E. C., Bentley, M. E., . . . Bulik, C. M. (2013). Behavioral and psychophysiological responsiveness during child feeding in mothers with histories of eating disorders: A pilot study. Journal of Psychopathology and Behavioral Assessment, 35(4), 578-591. doi:10.1007/s10862-013-9357-2	No child factor	1
Hollenstein, T., Allen, N. B., & Sheeber, L. (2016). Affective patterns in triadic family interactions: Associations with adolescent depression. Development and Psychopathology, 28(1), 85-96. doi:10.1017/s0954579415000309	Neither measured	1
Holodynski, M. (2005). At the beginning was the expression - Milestones and mechanisms of emotional development. Psychologie in Erziehung Und Unterricht, 52(4), 229-249.	Excluded reference type	1
Honey, A., Alchin, S., & Hancock, N. (2014). Promoting mental health and wellbeing for a young person with a mental illness: Parent occupations. Australian Occupational Therapy Journal, 61(3), 194-203. doi:10.1111/1440-1630.12111	Neither measured	1
Horton, R. E., Riddell, R. P., Flora, D., Moran, G., & Pederson, D. (2015). Distress regulation in Infancy: Attachment and temperament in the context of acute pain. Journal of Developmental and Behavioral Pediatrics, 36(1), 35-44. doi:10.1097/DBP.0000000000000119	No parental factor	1
Houwen-van Opstal, S. L. S., Jansen, M., van Alfen, N., & de Groot, I. J. M. (2014). Health-related quality of life and Its relation to disease severity in boys with duchenne muscular dystrophy: Satisfied boys, worrying parents-A case-control study. Journal of Child Neurology, 29(11), 1486-1495. doi:10.1177/0883073813506490	Neither measured	1
Huang, K. Y., Cheng, S., Calzada, E., & Brotman, L. M. (2012). Symptoms of anxiety and associated risk and protective factors in young asian american children. Child Psychiatry & Human Development, 43(5), 761-774. doi:10.1007/s10578-012-0295-0	No parental factor	1

Paper Reference	Reason	Stage
Jozefacka-Szram, N. (2016). Fundamentals of emotion regulation and social functioning of children between 0 and 3 years of age. Psychiatria I Psychologia Kliniczna-Journal of Psychiatry and Clinical Psychology, 16(4), 270-273. doi:10.15557/PiPK.2016.0036	No full text in English	1
Kårstad, S. B., Kvello, Ø., Wichstrøm, L., & Berg-Nielsen, T. S. (2014). What do parents know about their children's comprehension of emotions? Accuracy of parental estimates in a community sample of pre-schoolers. Child: Care, Health and Development, 40(3), 346-353. doi:10.1111/cch.12071	Not parent on parent	2
Katz, L. F., Maliken, A. C., & Stettler, N. M. (2012). Parental meta-emotion philosophy: A review of research and theoretical framework. Child Development Perspectives, 6(4), 417-422. doi:10.1111/j.1750-8606.2012.00244.x	Review without relevant papers	1
Kerns, C. E., Pincus, D. B., McLaughlin, K. A., & Comer, J. S. (2017). Maternal emotion regulation during child distress, child anxiety accommodation, and links between maternal and child anxiety. Journal of Anxiety Disorders, 50, 52-59. doi:10.1016/j.janxdis.2017.05.002	No child factor	1
Kim, E., Hong, S., & Rockett, C. M. (2016). Korean american parents' perceptions of effective parenting strategies in the united states. Journal Of Cultural Diversity, 23(1), 12-20.	Not parent on parent	2
Kim, H. K., Pears, K. C., Capaldi, D. M., & Owen, L. D. (2009). Emotion dysregulation in the intergenerational transmission of romantic relationship conflict. J Fam Psychol, 23(4), 585-595. doi:10.1037/a0015935	Above age limit	2
Kim, P., & Bianco, H. (2014). How motherhood and poverty change the brain ZERO TO THREE: Washington.	Excluded reference type	1
Kliewer, W., Cunningham, J. N., Diehl, R., Parrish, K. A., Walker, J. M., Atiyeh, C., . . . Mejia, R. (2004). Violence exposure and adjustment in inner-city youth: Child and caregiver emotion regulation skill caregiver-child relationship quality, and neighborhood cohesion as protective factors. Journal of Clinical Child and Adolescent Psychology, 33(3), 477-487. doi:10.1207/s15374424jccp3303_5	Missed duplicate	1
Kliewer, W., Cunningham, J. N., Diehl, R., Parrish, K. A., Walker, J. M., Atiyeh, C., . . . Mejia, R. (2004). Violence Exposure and Adjustment in Inner-City Youth: Child and Caregiver Emotion Regulation Skill, Caregiver?Child Relationship Quality, and Neighborhood Cohesion as Protective Factor. Journal of Clinical Child and Adolescent Psychology, 33(3), 477-487.	Clinical populations	2
Kliewer, W., Cunningham, J. N., Diehl, R., Parrish, K. A., Walker, J. M., Atiyeh, C., . . . Mejia, R. (2004). Violence exposure and adjustment in inner-city youth: child and caregiver emotion regulation skill, caregiver-child relationship quality, and neighborhood cohesion as protective factor. Journal Of Clinical Child And Adolescent Psychology: The Official Journal For The Society Of Clinical Child And Adolescent Psychology, American Psychological Association, Division 53, 33(3), 477-487. doi:10.1207/s15374424jccp3303_5	Missed duplicate	1

Appendix B

Paper Reference	Reason	Stage
Knutsson, J., Backstrom, B., Daukantaite, D., & Lecerof, F. (2017). Adolescent and family-focused cognitive-behavioural therapy for paediatric bipolar disorders: A case series. Clinical Psychology & Psychotherapy, 24(3), 589-617. doi:10.1002/cpp.2027	Neither measured	1
Kobak, R. R., Cole, H. E., Ferenzgillies, R., Fleming, W. S., & Gamble, W. (1993). Attachment and emotion regulation during mother-teen problem solving: A control theory analysis. Child Development, 64(1), 231-245. doi:10.1111/j.1467-8624.1993.tb02906.x	No independent parent and child measure	2
Kobak, R., & Ferenzgillies, R. (1995). Emotion regulation and depressive symptoms during adolescence: A functionalist perspective. Development and Psychopathology, 7(1), 183-192. doi:10.1017/S0954579400006416	Missed duplicate	1
Kobak, R., & Ferenz-Gillies, R. (1995). Emotion regulation and depressive symptoms during adolescence: A functionalist perspective. Development and Psychopathology, 7(1), 183-192. doi:10.1017/S0954579400006416	Missed duplicate	1
Kogan, N., & Carter, A. S. (1996). Mother-infant reengagement following the still-face: The role of maternal emotional availability in infant affect regulation. Infant Behavior & Development, 19(3), 359-370. doi:10.1016/s0163-6383(96)90034-x	Neither measured	1
Lagattuta, K. H. (2005). When you shouldn't do what you want to do: Young children's understanding of desires, rules, and emotions. Child Development, 76(3), 713-733. doi:10.1111/j.1467-8624.2005.00873.x	No parental factor	1
Lagattuta, K. H., & Wellman, H. M. (2002). Differences in early parent-child conversations about negative versus positive emotions: Implications for the development of psychological understanding. Developmental Psychology, 38(4), 564-580. doi:10.1037//0012-1649.38.4.564	No child factor	1
Lagattuta, K. H., Sayfan, L., & Bamford, C. (2012). Do you know how I feel? Parents underestimate worry and overestimate optimism compared to child self-report. Journal of Experimental Child Psychology, 113(2), 211-232. doi:10.1016/j.jecp.2012.04.001	Neither measured	1
Lambie, J. A., & Lindberg, A. (2016). The role of maternal emotional validation and invalidation on children's emotional awareness. Merrill-Palmer Quarterly-Journal of Developmental Psychology, 62(2), 129-157. doi:10.13110/merrpalmquar1982.62.2.0129	Not parent on parent	2
Laurent, H. K. (2014). Clarifying the contours of emotion regulation: Insights from parent- child stress research. Child Development Perspectives, 8(1), 30-35. doi:10.1111/cdep.12058	Missed duplicate	1
Laurent, H. K. (2014). Clarifying the contours of emotion regulation: Insights from parent–child stress research. Child Development Perspectives, 8(1), 30-35. doi:10.1111/cdep.12058	No parental factor	1
Laureys, S., & Goldman, S. (2004). Imagine imaging neural activity in crying infants and in their caring parents. Behavioral and Brain Sciences, 27(4), 465-467. doi:10.1017/S0140525X04290100	Neither measured	1

Paper Reference	Reason	Stage
Leibowitz, J., Ramos-Marcuse, F., & Arsenio, W. F. (2002). Parent-child emotion communication, attachment, and affective narratives. Attachment & Human Development, 4(1), 55-67. doi:10.1080/14616730210123157	Neither measured	1
Lemche, E., & Stöckler, L. (2002). On the outer and inner reality of the father and its significance for the development of affect regulation: Perspectives from research on early attachment and emotion. Psychoanalysis & Contemporary Thought, 25(2), 115-163.	No parental factor	1
Lemche, E., Lennertz, I., Orthmann, C., Ari, A., Grote, K., Hafker, J., & Klann-Delius, G. (2003). Emotion-regulatory process in evoked play narratives: Their relation with mental representations and family interactions. Praxis Der Kinderpsychologie Und Kinderpsychiatrie, 52(3), 156-171.	No parental factor	1
Li, H., & Chang, L. (2007). Paternal harsh parenting in relation to paternal versus child characteristics: The moderating effect of paternal resemblance belief. Acta Psychologica Sinica, 39(3), 495-501.	No parental factor	1
Lotzin, A., Schiborr, J., Barkmann, C., Romer, G., & Ramsauer, B. (2016). Maternal emotion dysregulation is related to heightened mother–infant synchrony of facial affect. Development and Psychopathology, 28(2), 327-339. doi:10.1017/S0954579415000516	No child factor	1
Lougheed, J. P., & Hollenstein, T. (2017). Arousal transmission and attenuation in mother–daughter dyads during adolescence. Social Development. doi:10.1111/sode.12250	Physiological	2
Lougheed, J. P., Hollenstein, T., Lichtwarck-Aschoff, A., & Granic, I. (2015). Maternal regulation of child affect in externalizing and typically-developing children. Journal of Family Psychology, 29(1), 10-19. doi:10.1037/a0038429	No child factor	1
Lougheed, J. P., Koval, P., & Hollenstein, T. (2016). Sharing the burden: The interpersonal regulation of emotional arousal in mother-daughter dyads. Emotion, 16(1), 83-93. doi:10.1037/emo0000105	Missed duplicate	1
Lougheed, J. P., Koval, P., & Hollenstein, T. (2016). Sharing the burden: The interpersonal regulation of emotional arousal in mother−daughter dyads. Emotion, 16(1), 83-93. doi:10.1037/emo0000105	Physiological	2
Luby, J. L. (2009). Early childhood depression. American Journal of Psychiatry, 166(9), 974-979. doi:10.1176/appi.ajp.2009.08111709	Review without relevant papers	1
Lunkenheimer, E. S., Albrecht, E. C., & Kemp, C. J. (2013). Dyadic flexibility in early parent-child interactions: relations with maternal depressive symptoms and child negativity and behaviour problems. Infant and Child Development, 22(3), 250-269. doi:10.1002/icd.1783	Missed duplicate	1
Lunkenheimer, E. S., Albrecht, E. C., & Kemp, C. J. (2013). Dyadic flexibility in early parent–child interactions: Relations with maternal depressive symptoms and child negativity and behaviour problems. Infant and Child Development, 22(3), 250-269. doi:10.1002/icd.1783	No parental factor	1

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Paper Reference	Reason	Stage
Lunkenheimer, E. S., Olson, S. L., Hollenstein, T., Sameroff, A. J., & Winter, C. (2011). Dyadic flexibility and positive affect in parent-child coregulation and the development of child behavior problems. Development and Psychopathology, 23(2), 577-591. doi:10.1017/s095457941100006x	No independent parent and child measure	2
Lunkenheimer, E., Kemp, C. J., Lucas-Thompson, R. G., Cole, P. M., & Albrecht, E. C. (2017). Assessing biobehavioural self-regulation and coregulation in early childhood: The parent-child challenge task. Infant and Child Development, 26(1). doi:10.1002/icd.1965	Physiological	2
Lunkenheimer, E., Lichtwarck-Aschoff, A., Hollenstein, T., Kemp, C. J., & Granic, I. (2016). Breaking down the coercive cycle: How parent and child risk factors influence real-time variability in parental responses to child misbehavior. Parenting-Science and Practice, 16(4), 237-256. doi:10.1080/15295192.2016.1184925	Neither measured	1
Lunkenheimer, E., Tiberio, S. S., Buss, K. A., Lucas-Thompson, R. G., Boker, S. M., & Timpe, Z. C. (2015). Coregulation of respiratory sinus arrhythmia between parents and preschoolers: Differences by children's externalizing problems. Developmental Psychobiology, 57(8), 994-1003. doi:10.1002/dev.21323	Physiological	2
MacLean, P. C., Rynes, K. N., Aragón, C., Caprihan, A., Phillips, J. P., & Lowe, J. R. (2014). Mother–infant mutual eye gaze supports emotion regulation in infancy during the Still-Face paradigm. Infant Behavior & Development, 37(4), 512-522. doi:10.1016/j.infbeh.2014.06.008	No parental factor	1
Macuka, I., & Buric, I. (2015). School success of early adolescents: The role of personal and family determinants. Drustvena Istrazivanja, 24(4), 487-507. doi:10.5559/di.24.4.02	No full text in English	1
Mais, L. A., Warkentin, S., Latorre, M. d. R. D. d. O., Carnell, S., & Taddei, J. A. A. d. C. (2017). Parental feeding practices among brazilian school-aged children: Associations with parent and child characteristics. Frontiers In Nutrition, 4, 6-6. doi:10.3389/fnut.2017.00006	No child factor	1
Malin, J. L., Cabrera, N. J., Karberg, E., Aldoney, D., & Rowe, M. L. (2014). Low-income, minority fathers' control strategies and their children's regulatory skills. Infant Mental Health Journal, 35(5), 462-472. doi:10.1002/imhj.21467	No parental factor	1
Manczak, E. M., McLean, K. C., McAdams, D. P., & Chen, E. (2015). Physiological reactivity during parent-adolescent discussions: Associations with scaffolding behaviors and relationship quality. Annals of Behavioral Medicine, 49(4), 522-531. doi:10.1007/s12160-014-9680-1	Physiological	2
Martini, T. S., & Busseri, M. A. (2012). Emotion regulation and relationship quality in mother–young adult child dyads. Journal of Social and Personal Relationships, 29(2), 185-205. doi:10.1177/0265407511431056	No child factor	1

Paper Reference	Reason	Stage
Martins, E. C., Soares, I., Martins, C., Tereno, S., & Osorio, A. (2012). Can we identify emotion over-regulation in infancy? Associations with avoidant attachment, dyadic emotional interaction and temperament. Infant and Child Development, 21(6), 579-595. doi:10.1002/icd.1760	No parental factor	1
Martins, E., Soares, I., Freire, M., Amendoeira, M., & Martins, C. (2010). Emotion regulation: Importance of father's emotional availability (EA) and infant temperament.	Excluded reference type	1
McDowell, D. J., & Parke, R. D. (2000). Differential knowledge of display rules for positive and negative emotions: Influences from parents, influences on peers. Social Development, 9(4), 415-432. doi:10.1111/1467-9507.00136	No parental factor	1
McDowell, D. J., & Parke, R. D. (2005). Parental control and affect as predictors of children's display rule use and social competence with peers. Social Development, 14(3), 440-457. doi:10.1111/j.1467-9507.2005.00310.x	No parental factor	1
McMakin, D. L., Burkhouse, K. L., Olino, T. M., Siegle, G. J., Dahl, R. E., & Silk, J. S. (2011). Affective functioning among early adolescents at high and low familial risk for depression and their mothers: A focus on individual and transactional processes across contexts. Journal of Abnormal Child Psychology, 39(8), 1213-1225. doi:10.1007/s10802-011-9540-4	Neither measured	1
Minegawa-Kawai, Y., Matsuoka, S., Dan, I., Naoi, N., Nakamura, K., & Kojima, S. (2009). Prefrontal activation associated with social Attachment: Facial-emotion recognition in mothers and infants Cerebral Cortex, 19(4), 992-992. doi:10.1093/cercor/bhp014	Missed duplicate	1
Moed, A., Gershoff, E. T., Eisenberg, N., Hofer, C., Losoya, S., Spinrad, T. L., & Liew, J. (2016). Parent–child negative emotion reciprocity and children's school success: An emotion-attention process model. Social Development. doi:10.1111/sode.12217	No parental factor	1
Moed, A., Gershoff, E. T., Eisenberg, N., Hofer, C., Losoya, S., Spinrad, T. L., & Liew, J. (2017). Parent-child negative emotion reciprocity and children's school success: An emotion-attention process model. Social Development, 26(3), 560-574. doi:10.1111/sode.12217	Missed duplicate	1
Moilanen, K. L., Shaw, D. S., & Fitzpatrick, A. (2010). Self-regulation in early adolescence: Relations with mother-son relationship quality and maternal regulatory support and antagonism. Journal of Youth and Adolescence, 39(11), 1357-1367. doi:10.1007/s10964-009-9485-x	No parental factor	1
Moore, G. A. (2009). Infants' and mothers' vagal reactivity in response to anger. Journal of Child Psychology and Psychiatry, 50(11), 1392-1400. doi:10.1111/j.1469-7610.2009.02171.x	Physiological	2
Morelen, D., Menke, R., Rosenblum, K. L., Beeghly, M., & Muzik, M. (2016). Understanding bidirectional mother-infant affective displays across contexts: Effects of maternal maltreatment history and postpartum depression and PTSD symptoms. Psychopathology, 49(4), 305-314. doi:10.1159/000448376	Neither measured	1

Appendix B

Paper Reference	Reason	Stage
Moretti, M. M., & Obsuth, I. (2009). Effectiveness of an attachment-focused manualized intervention for parents of teens at risk for aggressive behaviour: The Connect Program. Journal of Adolescence, 32(6), 1347-1357. doi:10.1016/j.adolescence.2009.07.013	No child factor	1
Moretti, M. M., Obsuth, I., Craig, S. G., & Bartolo, T. (2015). An attachment-based intervention for parents of adolescents at risk: Mechanisms of change. Attachment & Human Development, 17(2), 119-135. doi:10.1080/14616734.2015.1006383	No parental factor	1
Morgan, J. K., Shaw, D. S., & Forbes, E. E. (2013). Physiological and behavioral engagement in social contexts as predictors of adolescent depressive symptoms. Journal of Youth and Adolescence, 42(8), 1117-1127. doi:10.1007/s10964-012-9815-2	No parental factor	1
Morris, A. S., Criss, M. M., Silk, J. S., & Houltberg, B. J. (2017). The impact of parenting on emotion regulation during childhood and adolescence. Child Development Perspectives. doi:10.1111/cdep.12238	Not parent on parent	2
Morris, A. S., Silk, J. S., Morris, M. D. S., Steinberg, L., Aucoin, K. J., & Keyes, A. W. (2011). The influence of mother–child emotion regulation strategies on children's expression of anger and sadness. Developmental Psychology, 47(1), 213-225. doi:10.1037/a0021021	Not parent on parent	2
Morris, A. S., Silk, J. S., Steinberg, L., Terranova, A. M., & Kithakye, M. (2010). Concurrent and longitudinal links between children’s externalizing behavior in school and observed anger regulation in the mother–child dyad. Journal of Psychopathology and Behavioral Assessment, 32(1), 48-56. doi:10.1007/s10862-009-9166-9	No parental factor	1
Morris, A. S., Silk, J. S., Steinberg, L., Terranova, A. M., & Kithakye, M. (2010). Concurrent and longitudinal links between children's externalizing behavior in school and observed anger regulation in the mother-child dyad. Journal of Psychopathology and Behavioral Assessment, 32(1), 48-56. doi:10.1007/s10862-009-9166-9	Missed duplicate	1
Muller, M., Zietlow, A. L., Tronick, E., & Reck, C. (2015). What dyadic reparation is meant to do: An association with infant cortisol reactivity. Psychopathology, 48(6), 386-399. doi:10.1159/000439225	No parental factor	1
Nixon, C. L., & Watson, A. C. (1999). Family experiences and early emotion knowledge. Paper presented at the Biennial Meeting of the Society for Research in Child Development, New Mexico: Albuquerque	Excluded reference type	1
Oppenheim, D., Nir, A., Warren, S., & Emde, R. N. (1997). Emotion regulation in mother–child narrative co-construction: Associations with children's narratives and adaptation. Developmental Psychology, 33(2), 284-294. doi:10.1037/0012-1649.33.2.284	Not parent on parent	2
Oriol-Granado, X., Filella, G., & Calucho, N. (2013). The influence of interpersonal relationships in cognitive appraisal and regulation of anger in different age groups. Revista De Psicologia Social, 28(1), 73-84.	Neither measured	1

Paper Reference	Reason	Stage
Ostlund, B. D., Measelle, J. R., Laurent, H. K., Conradt, E., & Ablow, J. C. (2017). Shaping emotion regulation: Attunement, symptomatology, and stress recovery within mother–infant dyads. Developmental Psychobiology, 59(1), 15-25. doi:10.1002/dev.21448	Physiological	2
Otterpohl, N., Imort, S., Lohaus, A., & Heinrichs, N. (2012). Anger regulation in children: Effects of contextual factors. Kindheit Und Entwicklung, 21(1), 47-56. doi:10.1026/0942-5403/a000069	No parental factor	1
Papocsek, M. (2011). Resilience, strengths, and regulatory capacities: Hidden resources in developmental disorders of infant mental health. Infant Mental Health Journal, 32(1), 29-46. doi:10.1002/imhj.20282	Not parent on parent	2
Parrigon, K. S., Kerns, K. A., Abtahi, M. M., & Koehn, A. (2015). Attachment and emotion in middle childhood and adolescence. Psihologijske Teme, 24(1), 27-50.	No parental factor	1
Pines, M. (2002). Changing times, changing realities a glimpse of the future: "There is something more.". Croatian Medical Journal, 43(3), 268-273.	No parental factor	1
Pinjatela, R. (2012). Self-regulation in early childhood. Paediatria Croatica, 56(3), 237-242.	No full text in English	1
Qu, J., Leerkes, E. M., & King, E. K. (2016). Preschoolers' distress and regulatory behaviors vary as a function of infant–mother attachment security. Infant Behavior & Development, 44, 144-147. doi:10.1016/j.infbeh.2016.06.008	No parental factor	1
Ramsey, M. A., & Gentzler, A. L. (2015). An upward spiral: Bidirectional associations between positive affect and positive aspects of close relationships across the life span. Developmental Review, 36, 58-104. doi:10.1016/j.dr.2015.01.003	Review without relevant papers	1
Raver, C. C. (2004). Placing emotional self-regulation in sociocultural and socioeconomic contexts. Child Development, 75(2), 346-353. doi:10.1111/j.1467-8624.2004.00676.x	Not parent on parent	2
Remmes, C. S., & Ehrenreich-May, J. (2014). Parental emotion regulation strategy use and responses to youth negative affect. Journal of Cognitive Psychotherapy, 28(1), 34-47. doi:10.1891/0889-8391.28.1.34	Clinical populations	2
Riva Crugnola, C., Gazzotti, S., Spinelli, M., Ierardi, E., Caprin, C., & Albizzati, A. (2013). Maternal attachment influences mother-infant styles of regulation and play with objects at nine months. Attachment & Human Development, 15(2), 107-131. doi:10.1080/14616734.2013.745712	Missed duplicate	1
Riva Crugnola, C., Ierardi, E., Gazzotti, S., & Albizzati, A. (2013). Emotion regulation and maternal attachment in adolescent and young mothers and their infants: Risk assessment and video intervention. Paper presented at the 6th International Attachment Conference, Pavia, Italy. <Go to ISI>://WOS:000335751400004	Excluded reference type	1

Appendix B

Paper Reference	Reason	Stage
Roben, C. K. P., Moore, G. A., Cole, P. M., Molenaar, P., Leve, L. D., Shaw, D. S., . . . Neiderhiser, J. M. (2015). Transactional patterns of maternal depressive symptoms and mother-child mutual negativity in an adoption sample. Infant and Child Development, 24(3), 322-342. doi:10.1002/icd.1906	Neither measured	1
Rodriguez, C. M., Baker, L. R., Pu, D. F., & Tucker, M. C. (2017). Predicting parent-child aggression risk in mothers and fathers: Role of emotion regulation and frustration tolerance. Journal of Child and Family Studies. doi:10.1007/s10826-017-0764-y	No child factor	1
Salisch, M. v. (2001). Children's emotional development: Challenges in their relationships to parents, peers, and friends. International Journal of Behavioral Development, 25(4), 310-319. doi:10.1080/01650250143000058	Review without relevant papers	1
Salmon, K., Dittman, C., Sanders, M., Burson, R., & Hammington, J. (2014). Does adding an emotion component enhance the Triple P− Positive Parenting Program? Journal of Family Psychology, 28(2), 244. doi:10.1037/a0035997	No parental factor	1
Samuelson, K. W., Krueger, C. E., & Wilson, C. (2012). Relationships between maternal emotion regulation, parenting, and children's executive functioning in families exposed to intimate partner violence. J Interpers Violence, 27(17), 3532-3550. doi:10.1177/0886260512445385	Clinical populations	2
Santona, A., Tagini, A., Sarracino, D., De Carli, P., Pace, C. S., Parolin, L., & Terrone, G. (2015). Maternal depression and attachment: The evaluation of mother-child interactions during feeding practice. Frontiers in Psychology, 6, 1235. doi:10.3389/fpsyg.2015.01235	No parental factor	1
Saritas, D., & Gencoz, T. (2012). Discrepancies between adolescent and mother reports of adolescents' emotion regulation difficulties: A study conducted with Turkish adolescents International Journal of Psychology (Vol. 47, pp. 69).	Excluded reference type	1
Schuetze, P., Molnar, D. S., & Eiden, R. D. (2012). Profiles of reactivity in cocaine-exposed children. Journal of Applied Developmental Psychology, 33(6), 282-293. doi:10.1016/j.appdev.2012.08.002	No parental factor	1
Sethre-Hofstad, L., Stansbury, K., & Rice, M. A. (2002). Attunement of maternal and child adrenocortical response to child challenge. Psychoneuroendocrinology, 27(6), 731-747. doi:10.1016/s0306-4530(01)00077-4	Physiological	2
Sheeber, L., Allen, N., Davis, B., & Sorensen, E. (2000). Regulation of negative affect during mother-child problem-solving interactions: Adolescent depressive status and family processes. Journal of Abnormal Child Psychology, 28(5), 467-479. doi:10.1023/a:1005135706799	No parental factor	1
Sherman, L., Ramos-Marcuse, F., Stupica, B., & Cassidy, J. (2010). Infant-mother attachment status in relation to infant emotion regulation. Paper presented at the Infant Mental Health Journal. <Go to ISI>://WOS:000208611801046	Excluded reference type	1

Paper Reference	Reason	Stage
Shih, E. W., Quinones-Camacho, L. E., Valiente, G., & Davis, E. L. (2014). Children's physiological reactions to disappointment: Social context and parents' emotion regulation relate to RSA reactivity Paper presented at the 54h Annual Meeting of the Society-for-Psychophysiological-Research, Atlanta, GA. <Go to ISI>://WOS:000339479500390	Excluded reference type	1
Shipman, K. L., & Zeman, J. (2001). Socialization of children's emotion regulation in mother–child dyads: A developmental psychopathology perspective. Development and Psychopathology, 13(2), 317-336. doi:10.1017/S0954579401002073	Not parent on parent	2
Skowron, E. A., Loken, E., Gatzke-Kopp, L. M., Cipriano-Essel, E. A., Woehrle, P. L., Van Epps, J. J., . . . Ammerman, R. T. (2011). Mapping cardiac physiology and parenting processes in maltreating mother-child dyads. Journal of Family Psychology, 25(5), 663-674. doi:10.1037/a0024528	Clinical populations	2
Smith, C. L., Calkins, S. D., & Keane, S. P. (2006). The relation of maternal behavior and attachment security to toddlers' emotions and emotion regulation. Research in Human Development, 3(1), 21-31. doi:10.1207/s15427617rhd0301_3	No parental factor	1
Smith, J. D., Woodhouse, S. S., Clark, C. A. C., & Skowron, E. A. (2016). Attachment status and mother-preschooler parasympathetic response to the strange situation procedure. Biological Psychology, 114, 39-48. doi:10.1016/j.biopsycho.2015.12.008	Physiological	2
Snyder, J., Gewirtz, A., Schrepferman, L., Gird, S. R., Quattlebaum, J., Pauldine, M. R., . . . Hayes, C. (2016). Parent–child relationship quality and family transmission of parent posttraumatic stress disorder symptoms and child externalizing and internalizing symptoms following fathers' exposure to combat trauma. Development and Psychopathology, 28(4), 947-969. doi:10.1017/S095457941600064X	Clinical populations	2
Sreekrishnan, A., Herrera, T. A., Wu, J., Borelli, J. L., White, L. O., Rutherford, H. J. V., . . . Crowley, M. J. (2014). Kin rejection: Social signals, neural response and perceived distress during social exclusion. Developmental Science, 17(6), 1029-1041. doi:10.1111/desc.12191	No analysis of the link between parents and children	2
St George, S. M., Pulgaron, E. R., Ferranti, D., Agosto, Y., Toro, M. I., Ramseur, K. C., & Delamater, A. M. (2017). A qualitative study of cognitive, behavioral, and psychosocial challenges associated with pediatric type 2 diabetes in ethnic minority parents and adolescents. Diabetes Educator, 43(2), 180-189. doi:10.1177/0145721717691146	Neither measured	1
Stansbury, K., & Zimmermann, L. K. (1999). Relations among child language skills, maternal socializations of emotion regulation, and child behavior problems. Child Psychiatry and Human Development, 30(2), 121-142. doi:10.1023/A:1021954402840	Not parent on parent	2
Stevenson, R., Oaten, M., Case, T., & Repacholi, B. (2014). Is disgust prepared? A preliminary examination in young children. Journal of General Psychology, 141(4), 326-347. doi:10.1080/00221309.2014.938720	No parental factor	1

Appendix B

Paper Reference	Reason	Stage
Sturrock, B., & Mellor, D. (2014). Perceived emotional invalidation and borderline personality disorder features: A test of theory. Personality and Mental Health, 8(2), 128-142. doi:10.1002/pmh.1249	No parental factor	1
Suveg, C., Shaffer, A., & Davis, M. (2016). Family stress moderates relations between physiological and behavioral synchrony and child self-regulation in mother-preschooler dyads. Developmental Psychobiology, 58(1), 83-97. doi:10.1002/dev.21358	Physiological	2
Symanzik, T., Lohaus, A., & Heinrichs, N. (2016). Joko, you and I - A pilot trial of a preventive approach to promote interaction between parents and their 24-36-month-old children. Kindheit Und Entwicklung, 25(4), 250-260. doi:10.1026/0942-5403/a000208	No full text in English	1
Tang, Y. X., Lin, X. Y., Chi, P. L., Zhou, Q., & Hou, X. N. (2017). Multi-level family factors and affective and behavioral symptoms of oppositional defiant disorder in chinese children. Frontiers in Psychology, 8, 1123. doi:10.3389/fpsyg.2017.01123	Clinical populations	2
Teti, D. M., & Cole, P. M. (2011). Parenting at risk: New perspectives, new approaches. Journal of Family Psychology, 25(5), 625-634. doi:10.1037/a0025287	Clinical populations	2
Thompson, R. A. (1991). Emotional regulation and emotional development. Educational Psychology Review, 3(4), 269-307. doi:10.1007/bf01319934	Review without relevant papers	1
Thomsen, T., Lessing, N., & Greve, W. (2017). Transgenerational emotion regulation. Does the emotional climate of the family moderate the relationship between parents and children's (Dys-) functional emotion regulation? Kindheit Und Entwicklung, 26(1), 7-18. doi:10.1026/0942-5403/a000211	No full text in English	1
Tonyan, H. A. (2013). All by myself? Independence and coordination during distress episodes from 14 to 24months among latino children. Infant and Child Development, 22(2), 133-150. doi:10.1002/icd.1772	Not parent on parent	2
Topham, G. L., Wampler, K. S., Titus, G., & Rolling, E. (2011). Predicting parent and child outcomes of a filial therapy program. International Journal of Play Therapy, 20(2), 79-93. doi:10.1037/a0023261	Clinical populations	2
Trickett, P. K. (1998). Multiple maltreatment and the development of self and emotion regulation. Journal of Aggression, Maltreatment & Trauma, 2(1), 171-187. doi:10.1300/J146v02n01_10	Review without relevant papers	1
Usher, A. M., & McShane, K. E. (2016). Supporting children of substance abusing families: Preliminary outcomes of the renascent children's program. Journal of Groups in Addiction & Recovery, 11(4), 282-295. doi:10.1080/1556035x.2016.1211498	No child factor	1
Van Puyvelde, M., Loots, G., Vanfleteren, P., Meys, J., Simcock, D., & Pattyn, N. (2014). Do you hear the Same? Cardiorespiratory responses between mothers and infants during tonal and atonal music. PLoS ONE, 9(9), e106920. doi:10.1371/journal.pone.0106920	Physiological	2

Paper Reference	Reason	Stage
Wang, Q. (2003). Emotion situation knowledge in American and Chinese preschool children and adults. Cognition & Emotion, 17(5), 725-746. doi:10.1080/02699930244000156	No independent parent and child measure	2
Whittle, S., Yap, M. B. H., Yucel, M., Fornito, A., Simmons, J. G., Barrett, A., . . . Allen, N. B. (2008). Prefrontal and amygdala volumes are related to adolescents' affective behaviors during parent-adolescent interactions. Proceedings Of The National Academy Of Sciences Of The United States Of America, 105(9), 3652-3657. doi:10.1073/pnas.0709815105	No parental factor	1
Williams, M. E. (2016). Integrating early childhood mental health and trauma-informed care for homeless families with young children. Pragmatic Case Studies in Psychotherapy, 12(2), 113-123. doi:10.14713/pcsp.v12i2.1968	Excluded reference type	1
Winsler, A., Diaz, R. M., McCarthy, E. M., Atencio, D. J., & Chabay, L. A. (1999). Mother-child interaction, private speech, and task performance in preschool children with behavior problems. Journal of Child Psychology and Psychiatry and Allied Disciplines, 40(6), 891-904. doi:10.1017/s002196309900428x	No parental factor	1
Woltering, S., Lishak, V., Elliott, B., Ferraro, L., & Granic, I. (2015). Dyadic attunement and physiological synchrony during mother-child interactions: An exploratory study in children with and without externalizing behavior problems. Journal of Psychopathology and Behavioral Assessment, 37(4), 624-633. doi:10.1007/s10862-015-9480-3	Physiological	2
Yaroslavsky, I., Rottenberg, J., & Kovacs, M. (2014). Atypical patterns of respiratory sinus arrhythmia index an endophenotype for depression. Development and Psychopathology, 26(4), 1337-1352. doi:10.1017/s0954579414001060	Physiological	2
Yoo, Y. S., Adamsons, K. L., Robinson, J. L., & Sabatelli, R. M. (2015). Longitudinal influence of paternal distress on children's representations of fathers, family cohesion, and family conflict. Journal of Child and Family Studies, 24(3), 591-607. doi:10.1007/s10826-013-9870-7	Neither measured	1
Zeanah, C. H., Boris, N. W., & Scheeringa, M. S. (1997). Psychopathology in infancy. Journal of Child Psychology and Psychiatry and Allied Disciplines, 38(1), 81-99. doi:10.1111/j.1469-7610.1997.tb01506.x	No parental factor	1
Zimmermann, P. (2007). Attachment and parenting - Similar or complementary relationship factors? Associations between parental support of autonomy, and competence, attachment representation, and selfregulation in late adolescence. Psychologie in Erziehung Und Unterricht, 54(2), 147-160.	No parental factor	1

Note. Reason refers to the reason for exclusion, and stage for the stage of rejection (1=before query, 2= after query)

Appendix C Quality Assessment Scores for the Included 16 studies

Study number:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Introduction																
Were the aims/objectives of the study clear	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Method																
Was the study design appropriate for the stated aim (s)?	0	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1
Was the sample size justified?	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Was the target/reference population clearly defined (was it clear who the research was about?)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Was the sample frame taken from an appropriate population base so that it closely represented the target/reference population under investigation?	1	1	1	1	1	0	1	1	0	1	1	0	1	0	0	0
Was the selection process likely to select subjects/participants that were representative of the target/reference population under investigation?	0	1	0	1	1	0	1	0	0	1	1	1	1	1	0	1
Were measures undertaken to address and categorise non-responders?	0	1	0	0	1	0	1	1	N/A	1	1	0	0	0	0	1

Study number:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Were the risk factor and outcome variables measured appropriate to the aims of the study?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Were the risk factor and outcome variables measured correctly using instruments/measurements that had been trialled, piloted or published previously?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Is it clear what was used to determine statistical significance and/or precision estimates (e.g. p values, Cis)	1	1	1	1	1	1	1	1	N/A	1	1	1	1	1	1	1
Were the methods (including statistical methods) sufficiently described to enable them to be repeated?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Results																
Were the basic data adequately described?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Does the response rate raise concern about non-response bias?	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1
If appropriate, was information about non-responders described.	0	1	0	N/A	0	1	0	N/A	N/A	0	1	0	1	0	0	1
Were the results internally consistent?	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1
Were the results for the analyses described in the methods presented?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Discussion																

Appendix C

Study number:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Were the authors' discussions and conclusions justified by the results	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Were the limitations of the study discussed?	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1
Other																
Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Was ethical approval or consent of participants attained?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Longitudinal design																
Was the sample size justified?						0										
Was follow-up described?						1										
Was follow-up long enough for outcomes to occur?						1										
Was the selection process likely to select representative sample?						0										
Did the study use a precise definition of the outcome?						1										
TOTAL SCORE	15 /20	18 /20	16 /20	17 /19	17 /20	19 /25	18 /20	17 /19	13/ 17	18 /20	17 /20	17 /20	18 /20	14/ 20	14 /20	18 /20
PROPORTIONAL SCORE	.75	.90	.80	.89	.85	.76	.90	.89	.76	.90	.85	.85	.90	.70	.70	.90
CLASSIFICATION	M	H	H	H	H	M	H	H	M	H	H	H	H	M	M	H

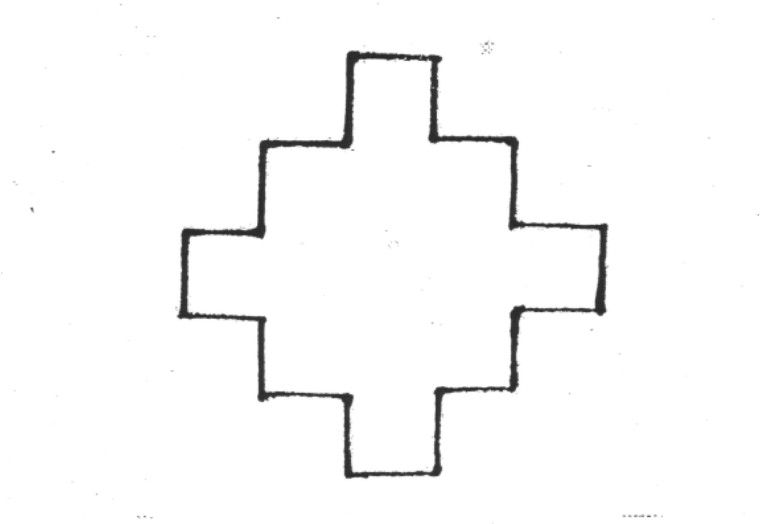
Note. Proportional scores 0-.44 are classed as low (L), 45-.79 as moderate (M), .8-1 high (H)

Appendix D List of T1 and T2 measures

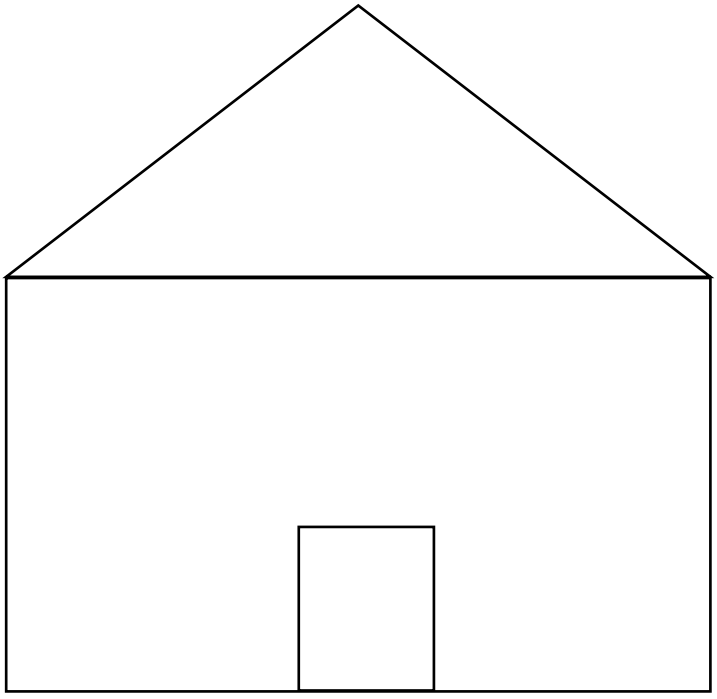
Time 1	Time 2
Mother Emotional Functioning	**Mother Emotional Functioning**
HADS: Anxiety and depression symptoms	HADS: Anxiety and depression symptoms
AEU: Emotion understanding	AEU: Emotion understanding
ERQ: Emotional suppression and reappraisal	ERQ: Emotional suppression and reappraisal
ERP task: Cross-modal emotion processing	
Dyadic Relationship Quality	**Dyadic Relationship Quality**
PFMSS: Expressed emotion	PFMSS: Expressed emotion
Etch-a-sketch task: maternal and child positivity, maternal and child negativity	Etch-a-sketch task: maternal and child positivity, maternal and child negativity
Child Emotional Functioning	**Child Emotional Functioning**
AKT: Emotion knowledge	Emotion knowledge: Complex and mixed emotions
ERC: Emotion regulation and lability	ERC: Emotion regulation and lability
ERP task: Cross-modal emotion processing	
Child Adjustment	**Child Adjustment**
SDQ: Maternal reported internalising symptoms, externalising symptoms and prosocial behaviour	SDQ: Maternal and teacher reported internalising and externalising symptoms. Maternal reported prosocial behaviour. Teacher reported prosocial behaviour
	TRSSA: Teacher reported index of school adjustment
	ANXDOS: Fear reactivity in relation to the spider
Other	**Other**
WPPSI: Receptive vocabulary and block design	WPPSI: Receptive vocabulary and block design
Hearing: Following British Audiology Society guidelines	

Appendix E Etch-a-sketch final drawings

Time 1:



Time 2:



Appendix F Concurrent Associations across all Time 1 Measures

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Maternal Emotional Functioning																								
1.Emotion understanding	-	**.40**	-.10	-.21	-.22	.25	-.02	.05	-.01	.07	.12	.21	-.01	.14	.22	.07	.19	-.05	.15	-.12	.46	.00	.20	-.03
2.Reappraisal		-	.16	-.21	-.14	-.22	-.13	-.18	-.09	.02	-.04	-.06	-.04	-.22	-.05	-.46	.03	.15	.05	.15	-.17	-.05	-.29	.03
3.Suppression			-	.09	.14	-.15	-.13	.24	.29	-.22	-.24	-.04	.23	-.15	.08	-.11	.25	-.20	-.07	-.16	-.26	**.34**	-.22	-.10
4.Anxiety				-	.60**	-.00	-.12	-.10	-.09	-.04	-.09	.05	.43	.30	.31	.23	-.26	.08	-.02	-.02	-.24	.19	.02	**-.47**
5.Depression					-	-.24	-.24	-.07	-.09	-.12	-.04	.17	.32	.12	.34	.11	-.21	-.00	.17	-.12	-.11	-.05	-.03	**-.43**
6.P2 Angry						-	**.66**	**.70**	**.59**	.33	-.19	-.00	.16	.19	.09	.08	.38	.12	-.01	.15	.25	.12	.25	-.11
7.P2 Fearful							-	**.58**	**.76**	.30	.01	.03	-.10	-.14	-.25	-.11	**.50**	-.04	-.35	.07	-.08	-.16	.25	.13
8.P2 Happy								-	**.76**	-.03	-.02	.08	.30	.00	.07	.11	**.49**	-.24	-.15	-.03	-.13	.03	.30	-.05
9.P2 Neutral									-	-.30	-.13	-.11	-.09	-.08	-.24	-.28	**.65**	-.19	-.32	.08	-.29	-.09	.09	.15
Child Emotional Functioning																								
10.Emotional knowledge										-	.04	-.24	-.12	.21	-.13	.32	**-.40**	.17	.04	.03	-.24	.02	.08	-.01
11.Emotion regulation											-	.03	-.11	-.11	-.06	-.06	.12	-.27	-.14	-.29	.02	**-.63**	-.01	.21
12.Lability												-	.06	-.39	.08	-.17	.14	**-.45**	.13	-.33	**.68**	.08	**.67**	-.27
13.LPP Angry													-	**.59**	**.67**	**.60**	-.38	-.26	**.52**	-.46	-.37	.30	.02	-.28
14.LPP Fear														-	**.67**	**.78**	**-.53**	.23	.17	.01	-.21	.27	-.11	-.11
15.LPP Happy															-	**.53**	-.27	-.27	**.54**	-.31	.03	.19	.28	-.48
16.LPP Neutral																-	**-.54**	-.12	.11	-.15	-.22	.14	.02	.04
Relationship Quality																								
17.Mother negativity																	-	-.29	-.13	.04	.40	-.23	.24	.15
18.Mother positivity																		-	.13	**.48**	.13	.09	**-.48**	-.02
19.Child negativity																			-	-.14	.21	-.08	.16	**-.38**
20.Child positivity																				-	-.29	-.09	-.32	.04
21.EE																					-	.18	**.59**	-.16
Child Adjustment																								
22.Internalising symptoms																						-	.07	-.27
23.Externalising symptoms																							-	-.32
24.Prosocial behaviour																								-

Note. Ns= 35 for behavioural, except PFMSS and EU which is 34, 24 for mum ERP, 17 for child, 12 when mum and child ERPs are correlated together. EE coded such that 0=low, 1=high

Appendix G Mediation Results for Maternal P2 Amplitudes on Child Emotional Functioning via Maternal Negativity.

X	Y	Model statistics			Indirect effect			Path coefficients			
Maternal P2 Amplitude to:	Child:	R^2	*F (df)*	*p*	B	SE	95% CIs	a	b	c	c'
Fear (F)	LPP F	.31	2.01 (2,9)	.190	-0.78	1.24	-3.15, 0.87	0.12	-6.66	-0.58	0.20
F	LPP N	.30	1.95 (2,9)	.198	-0.70	1.19	-3.23, 1.08	0.12	-5.89	-0.43	0.27
F	EK+	.49	6.38 (3,20)	**.003**	-0.39	0.23	**-0.94, -0.04**	**0.19**	**-2.11**	-0.10	0.32
Happy (H)	LPP F	.37	2.67 (2,9)	.123	-0.85	1.23	-2.97, 0.66	0.11	**-7.74**	0.00	0.85
H	LPP N	.44	3.48 (2,9)	.076	-0.82	1.18	-3.14, 0.39	0.11	**-7.43**	0.30	1.12
H	EK	.46	5.69 (3,20)	**.005**	-0.23	0.17	-0.63, 0.05	**0.13**	**-2.18**	-0.22	0.01
Neutral (N)	LPP F	.40	2.98 (2,9)	.102	-2.79	1.67	**-7.09, -0.16**	0.31	**-8.91**	-0.49	2.30
N	LPP N	.30	1.93 (2,9)	.201	-1.89	1.43	**-6.14, -0.17**	0.31	-6.03	-1.54	0.35
N	EK	.46	5.71 (3,20)	**.005**	-0.44	0.28	-1.06, 0.05	**0.24**	-1.80	-0.41	0.06

Note. + For models including EK (emotion knowledge), child age was added as a covariate and *N*= 24. N=12 for all other models. Significant indirect effects and coefficients are presented in bold.

Appendix H Concurrent Associations across all Time 2 measures

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Maternal Emotional Functioning																			
1.Emotion understanding	-	-.24	.01	-.22	-.33	.02	.03	**.46**	-.18	.17	-.14	-.18	.27	.27	-.13	-.23	.11	-.03	-.23
2.Reappraisal		-	.14	-.18	-.05	-.30	.07	-.25	**.60**	.06	.22	.23	-.33	.13	-.27	.12	-.11	.26	-.15
3.Suppression			-	-.26	.02	-.32	.19	-.30	-.12	.09	-.12	.00	.01	.09	-.36	.07	-.04	.28	.08
4.Anxiety					.31	.24	-.34	.19	-.13	-.03	-.20	-.27	-.37	-.07	.06	-.15	.20	-.07	-.06
5.Depression					-	-.08	.09	-.12	.21	-.09	.04	-.07	-.13	.33	.12	-.13	.10	.15	**.52**
Child Emotional Functioning																			
6.Emotional knowledge						-	-.11	.28	.11	**.57**	.30	.22	.27	-.09	.27	-.30	.05	-.11	.11
7.Emotion regulation							-	-.19	.19	.28	.19	.32	.11	-.32	.04	.37	-.05	.30	**.47**
8.Lability								-	.14	.08	.23	-.07	.28	-.16	**.41**	-.15	.26	-.02	.03
Relationship Quality																			
9.Mother negativity									-	.32	**.67**	**.39**	-.08	.01	-.09	.11	.32	**.47**	.32
10.Mother positivity										-	.32	**.41**	.29	.03	.04	-.07	-.05	.29	.07
11.Child negativity											-	**.53**	.35	-.06	-.02	-.04	.22	.34	.06

12.Child positivity	-	.15	-.03	.06	-.17	-.23	.03	.08
13.EE		-	-.21	**.55**	-.40	-.27	-.21	.00
Child Adjustment								
14.Internalising symptoms			-	-.15	-.01	-.31	-.08	.06
15.Externalising symptoms				-	-.29	**-.49**	**-.57**	-.05
16.Prosocial behaviour (M)					-	.00	.23	-.08
17.Prosocial behaviour (T)						-	**.89**	.43
18.School adjustment							-	.42
19.Fear reactivity								-

Note. Ns= 29 for behavioural, except EE which is 28, and TRSSA and teacher-reported prosocial behaviour which are 21. Bold coefficients are significant at $p<.05$.

Appendix I Longitudinal Associations between T1 predictors and T2 Child Adjustment

	Child Outcomes *r(p)*					
Predictor	Internalising	Externalising	M Prosocial	T Prosocial	Fear reactivity	School Adjustment
M Suppression	.20 (.305)				-.14 (.523)	.31 (.163)
C Emotion Regulation	**-.41 (.026)**				.23 (.301)	**.50 (.017)**
M positivity		-.11(.57)			.14 (.539)	-.38 (.08)
M EE		.32 (.293)			.09 (.788)	.05 (.879)
C Lability		**.41 (.026)**			-.14 (.523)	.04 (.86)
M anxiety			**-.64 (.035)**	-.38 (.089)	-.15 (.507)	**-.45 (.036)**
M depression			-.59 (.055)	-.34 (.137)	.01 (.964)	-.23 (.297)
C negativity			-.11 (.591)	.12 (.620)	**.43 (.044)**	.19 (.396)
C LPP Happy			**-.61 (.036)**	.04 (.920)	.12 (.774)	-.27 (.511)

Note. M represents a maternal predictor, and C a child predictor. Child age was included as a further covariate for analysis including mother reported prosocial behaviour. Bold coefficients are significant at $p<.05$.

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