Does infant attention bias to threat relate to parental stress?

B.M. Verweij

1865595

Master thesis Clinical Psychology

Supervisor: C. Nimphy

Institute of Psychology

Universiteit Leiden

01-07-2020

Abstract

Parental stress can have a negative impact on attentional bias in infants, which is an emotion processing construct. The present study investigated if parental stress is positively related to attentional bias towards fearful over happy faces in infants aged 5 to 19 months. The sample consisted out of 220 infants (male: 48,2%, female: 51,2%) and their 229 primary caregivers (male: 32,3%, female: 67,7%). The research has a cross-sectional experimental design. Attentional bias was measured with an eye-tracker, which measured dwell times in infants when looking at happy and fearful faces. Parental stress was measured with the stress-scale of the DASS. The analyses suggested that parental stress was not positively related to attentional bias of their infants, whereas other studies found that parental stress was positively related to attentional bias. These differences in findings may be due to the fact that SES-variables were not taken into account in the present study. Besides, attentional bias differs across age groups, but also age was not taken into account. Therefore, attentional bias is a dynamic construct, which needs to be further examined with respect to variables that influence the link between parental stress and attentional bias.

Keywords: attentional bias, parental stress, happy faces, fearful faces, infants, emotional processing

1. Introduction

Parental stress is associated with less optimal outcomes for infants later in life. Infants of parents with more stress are at greater risk for developing internalizing and externalizing problems (Larkin & Otis, 2019; Wu, Slesnick, & Murnan, 2018). A reason could be that there exists less effective interaction between stressed parents and their infants. This means that parents respond less accurately to their infant's needs. For instance, when an infant needs attention the parent ignores the infant (Keenan, Newman, Gray, Rinehart, & Gray, 2016). As a consequence, for the infant, there might be adverse outcomes such as lower social competence and a less effective socio-emotional, cognitive, and language development (Gartstein et al., 2019; Larkin & Otis, 2019; Wu et al., 2018). First, parental stress is associated with higher negative emotionality and sadness in infants. Second, it is associated with lower initial ratings of smiling and laughter, high-intensity pleasure, approach, vocal reactivity, and a diminished activity level in infants (Gartstein et al., 2019). Taken together, parental stress results in a less optimal parenting style and this can result in adverse outcomes for the infant (Maria, Ortiz, & Barnes, 2019).

Parental stress might influence emotion processing in infants (Dayton, Huth-bocks, & Busuito, 2016; Loop et al., 2018). Infants learn about emotions in early phases in life whereby the infant watches the mother's face to see if a situation is threatening (Perizzolo et al., 2019). This is the concept of social referencing. Social referencing occurs when an infant encounters a novel situation or object and looks at his parents for information about how to respond (Walden, 1991). This concept of social referencing is not only used in infants, but people use it throughout their lives. It helps the individual to interpret the situation when it is complex or ambiguous (Walle, Reschke, & Knothe, 2017). A possible mechanism that explains why parental stress can lead to adverse outcomes for infants, is that parents with more stress react less responsive to their infant's emotional signals than when they are less stressed. Consequently, the emotions of the infant can be ignored or misinterpreted by the parent (Crnic, Gaze, & Hoffman, 2005). As a result, the basic needs of an infant, such as affective and behavioral responses from their parents, may not be met and this can have a negative impact on emotional development (McElwain & Booth-laForce, 2006; Thompson-booth et al., 2016). This is a problem, especially when the infant is in a sensitive period for learning fear-related information (from 7 to 11 months of age). When parents are not responsive to

their infant's needs in that period, the infant does not learn to process fear-related information accurately (Nakagawa & Sukigara, 2019). By accurately reading the emotional signals of the infant and thus accurately responding to them, the infant learns to self-regulate and this lays the foundation for healthy emotional development (Dayton et al., 2016).

One emotion-processing construct is attentional bias. There is an attentional bias when infants look relatively longer to specific emotional faces compared to other emotional faces (Nakagawa & Sukigara, 2019; M. J. Peltola & Yrttiaho, 2018). Attentional bias is part of the normal development of infants. It lays the foundation for more complex emotional capacities and can be measured by the dwell time of infants to different emotional faces. Infants, in their first months of life, tend to pay more attention to positive emotions (Vaish, Grossman, & Woodward, 2008). This has probably to do with familiarization. Infants have seen more positive emotions in their lives than negative emotions and as a consequence, they look longer to happy faces (Ruba & Repacholi, 2019). Infants aged 5 to 7 months can discriminate between faces with different emotional expressions. When they are 7 months old their attention is drawn longer to fearful instead of happy and neutral faces (Lobue & Deloache, 2010). By 8 to 14 months, they preferential look at angry versus happy faces (Mastorakos & Scott, 2019). As a consequence, infants detect threat-related faces more quickly than happy or neutral faces. A reason for this is that it is more relevant to be aware of threat-related faces because they reveal threats in the environment. Such important information is not given by happy or neutral faces (Nakagawa & Sukigara, 2019). However, there is also evidence that did not find this shift in attention from positive to negative emotional faces. For example, one study found that infants always pay more attention to fearful faces instead of happy faces, due to their novelty effect (Heck, Hock, White, Jubran, & Bhatt, 2016). Therefore, attentional bias exists in every infant, but the specific emotional faces to which attention is biased may differ (Heck et al., 2016; Lobue & Deloache, 2010; Vaish et al., 2008).

This attentional bias can become maladaptive when there is a heightened bias to threat (Kataja, Karlsson, Parsons, Pelto, & Pesonen, 2019). In this case, infants look longer to threat-related faces when compared to the adaptive attentional bias. Besides, they have more difficulty to look away from threat-related faces (Keil et al., 2018; Morin, Howell, Meyer, & Sanchez, 2019). The reason for this is that threatening emotional information interferes with

cognitive processing and attentional control. In other words, they need more time to process and respond to threat-related faces (Morin, Howell, Meyer, & Sanchez, 2019). Until now, we do not know when an adaptive mechanism such as attentional bias to threat becomes a maladaptive one and how this can have adverse outcomes for emotion processing in infants later in life.

This shift from adaptive to maladaptive attentional bias can be due to parental stress (Loop et al., 2018; Thompson-booth et al., 2016). Research states that mothers with parental stress tend to have less attention to infant facial expressions (Carli, Riem, & Parolin, 2017). This means that parents with high parental stress are less sensitive to the emotional signals of their infants than parents with low parental stress. A possible explanation for this is that parents with high parental stress may have difficulties in processing the emotional cues of their infants, perhaps because of problems in emotion regulation (Thompson-booth et al., 2016). In another experiment where mothers were induced to have a negative mood, they were less successful to elicit positive responses from their child than controls where mothers did not have that induced negative mood (Zekoski, Ohara, & Wills, 1987). Besides, mothers in the negative mood induction condition engaged less in verbal interaction with their child (Jouriles, Murphy, & Oleary, 1989). As a reaction, their child was less responsive to their mothers than controls. This means that the emotional state and consequential behavior of parents have a great impact on infants (Loop et al., 2018).

The mechanism, which underlies this shift from adaptive to maladaptive attentional bias in infants, explains how parental stress and attentional bias are related (Azhari et al., 2019; Keenan, Newman, Gray, Rinehart, & Gray, 2016). We know that parental stress is associated with maladaptive parenting behaviors, which leads to a variety of adverse outcomes for the infant (Wu et al., 2018). However, this mechanism is not fully explained yet. For example, we still do not know how parental stress influences emotional processing in infants (Berryhill, Soloski, & Durtschi, 2016). It is important to investigate how this works in more detail (Berryhill, Soloski, & Durtschi, 2016; Nakagawa & Sukigara, 2019), because we know that parental stress can heighten attentional biases in infants and this, in turn, can have negative consequences for infants for the rest of their lives (Finegood, Raver, Dejoseph, & Blair, 2017).

In this study, I will investigate whether infants show a heightened attentional bias towards fearful versus happy faces. In addition, I will investigate the link between parental stress and infant attentional bias.

Hypotheses

1. Infants have an attentional bias towards fearful versus happy faces.
2. Parental stress is positively related to infants' attentional bias to fearful versus happy faces.

2. Methods

2.1 Research design

This is a cross-sectional experimental research. Participants were tested at one time-point.

2.2 Participants

Participants were recruited via invitation letters sent by the municipality of Amsterdam. Parents were included if they spoke English or Dutch fluently. The original sample was 251 families. The fixation data was not available from 14 infants and 14 parents from the initial sample, due to child fussiness, tracking problems, software/equipment failure, or experimenter errors. Only parents who completed both the questionnaire and eye-tracking are included in the sample of this study. Consequently, 220 infants and 229 primary caregivers participated in this study. The infants were divided into three age groups. The first was from 5 to 7 months, the second from 11 to 13 months, and the third from 17 to 19 months of age. The project has approval by the Ethics Committee Psychology of Leiden University. All participants have written informed consent.

2.3 Procedure

The infants were tested with an eye-tracking device. Hereby the infant was placed in a car seat which was 60 cm away from a computer screen. The parent of the infant seat on his right side. First, the eye-tracker was calibrated for the infants. Then there were dynamic videos showed of two male and two female faces. These faces were happy or fearful. Each trial started with a 500 ms attention-getter and was followed by a blank screen for 1000 ms. After this, there was a presentation of a blurred face for about 1500 ms, and the trial ended with dynamic stimuli. Each block consisted of a neutral expression followed by four emotional stimuli and these were random (happy or fearful). In total there were 40 trials.

2.4 Material

In this experiment, an eye-tracking device was used to measure attentional bias in infants. Besides, to measure parental stress the depression, anxiety, and stress scales (DASS) have been used.

Depression, anxiety, stress scales (DASS). This is a self-report questionnaire and gives us the depression, anxiety and stress scores of parents, as measured by 14 items each (Lee, Hyun, Seung, & Moon, 2019). For this research, I will only use the stress scale of the DASS. The test-retest reliability coefficient was .99 and the split-half reliability coefficient was .96 for this questionnaire (Akin & Çet, 2007). The validity was also high (Beurs, Dyck, Lange, & Blonk, 2001; Lee et al., 2019; Lovibond, 1995).

2.5 Statistical analysis

The hypotheses will be tested by analyzing the scores of the eye-tracking experiment and the scores of the DASS. SPSS version 24 will be used for this. First I will perform some descriptive analyses to analyze the distribution if there are outliers, and to see what the mean is from the variables I use in the descriptive tables and in the analyses. I will check if there are outliers by inspecting the boxplots of the variables I use in the analyses. If there are outliers I will check in the data whether the outliers are within the range of possible scores of that variable. If it is not just a measurement error I will include this outlier in the analysis. To test hypothesis one I will perform a paired samples t-test, but first I will check the assumptions of this test: the variable has to be measured at interval or ratio level, random sampling has to be used, there has to be independence of observations, the population from which the sample comes from has to be normally distributed and the variability of the scores for each of the groups is similar. If these conditions are met I will perform a paired samples t-test with the dwell time to happy faces as a first group and the dwell time to fearful faces as a second group. If all of the assumptions are not met, I will execute a Wilcoxon Signed Rank Test.

For hypothesis two I will do a linear regression if the following assumptions are met: the dependent and independent variables have to have a linear relationship, the independent variable can be discrete or continuous and the dependent variable has to be continuous, the dependent variables have to be measured just once, there has to be a normal distribution and the distributions of the dependent variable has to have the same variance or standard deviation for every independent variable. If these conditions are met, I will do a linear regression with the difference score between dwell time to happy versus fearful faces as the dependent variable and parental stress as the independent variable. If these conditions are not met I will transform the data so that the linear regression can still be executed.

Hypothesis one will be supported by the findings when the paired samples t-test is significant, indicating that infants have an attentional bias towards fearful versus happy faces. Hypothesis two will be supported when parental stress is significantly related to increasing dwell times towards fearful faces compared to happy faces.

3. Results

3.1 Preliminary analyses

The data discovered two outliers in the difference score between looking time to fear and happy faces. I checked whether they had a low number of trials completed in the eye-tracker task, but they actually had a relative high number of trials. One of the outliers completed 39 out of 40 trials and the other completed 40 out of 40 trials. This is possible, as there were a lot more participants who completed all or almost all of the trials. For this reason, I included them in the analysis.

When analysing the stress-scale of the DASS, it appeared that there were eight outliers. Their score fell in between the possible scores of the DASS, where all of them scored a moderate stress level (19-25), except for one that scored 36, which indicates an extremely severe stress level (34+). Therefore, I decided to include all of the outliers.

Table 1
Family characteristics

	Percentages	**Mean**	***SD***	***N***
Gender infants				
Male	48.2%			106
Female	51.8%			114
Birth date infants				
5-7 months	34.7%	6.08	0.52	73
Male				40
Female				33
11-13 months	32%	12.08	0.60	78
Male				34
Female				44
17-19 months	26.4%	17.88	0.64	69
Male				34
Female				35
Gender parents				
Male	32.3%			74
Female	67.7%			155
Age parents		35.05	4.71	219
Relationship time in years		8.11	3.95	209
Marital status				
Married or living together	93.6%			205
Living apart / LAT	0.9%			2
Single parent	4.1%			9
Other	1.4%			3
Highest level of completed education				

Primary school	0.9%			2
Lower vocational education (LBO)	0.5%			1
Secondary general secondary education (MAVO)	0.9%			2
Higher general secondary education (HAVO)	3.2%			7
Preparatory science education (VWO)	1.8%			4
Secondary vocational education (MBO)	7.3%			16
Higher professional education (HBO)	23.3%			51
Scientific education (University)	61.2%			134
Other	0.9%			2

Note. N = amount of participants, SD = standard deviation.

Table 2

Work characteristics

	Percentages	**Mean**	***SD***	***N***
Occupational level				
Never worked	0.2%			1
Predominantly manual labor without vocational training	0.9%			2
Predominantly manual labor requiring vocational training	1.4%			3
Predominantly principal work requiring vocational training	12.7%			6
Predominantly main work at LBO or MBO level and not managerial	3.7%			8
Independent entrepreneur with a maximum of 4 employees	11.9%			26
Independent entrepreneur with more than 4 employees	3.2%			7
Salaried at LBO or MBO level and not managerial	3.2%			7
Salaried at HBO level and not managerial	25.1%			55
Salaried at HBO level and managerial	8.7%			19
Salaried employment requiring scientific training	39.3%			86
Current working status				
Housewife/husband	7.3%			16
Student	1.8%			4
Working fulltime	29.2%			64
Working parttime	51.6%			113
Furlough	0.9%			2
Unemployed	5.5%			12
Other	3.7%			8
Hours of work per week		30.39	13.77	207
Own gross income per month in euros				
<500	6.4%			14
500-1000	7.8%			17
1000-2000	14.6%			32
2000-3000	23.3%			51
3000-4000	20.5%			45
4000-5000	10%			22

>5000	10%	22

Note. N = total amount of participants, SD = standard deviation.

3.2 Main analyses

I wanted to test whether infants have an attentional bias towards fearful versus happy faces. Do infants have a longer looking time towards fearful versus happy faces? The answer is yes. Infants' looking time to fearful faces (M = 3273.2, SD = 1102.5) compared to happy faces (M = 3149.7, SD = 1124.3) differed significantly, $t(410) = 3.1$, $p < .05$. Thus, the hypothesis that infants have an attentional bias towards fearful versus happy faces receives support.

There is an attentional bias towards fearful versus happy faces, but is this positively related to parental stress? The answer is no. It appears that parents' stress level did not predict infants attentional bias, $F(1, 189) = .52$, $p = .47$, $R2 = .003$. This means that the hypothesis that parental stress is positively related to attentional bias towards fearful versus happy faces is not supported.

4. Discussion

The aim of this research was to test whether there exists an attentional bias towards fearful, compared with happy faces in infants aged 5 to 19 months, and if parental stress is positively related to this attentional bias. As the results suggest, an attentional bias towards fearful, compared with happy faces has been found. However, parental stress did not appear to be positively related to this.

The present research discovered that there is an attentional bias towards fearful, compared to happy faces in infants aged 5 to 19 months. This is supported by other researchers that investigated this attentional bias (Aktar et al., 2018; Leppänen & Nelson, 2009; Peltola & Forssman, 2015). One study found that this attentional bias exists in infants' looking preferences towards fearful, compared to happy faces, although they did not find this attentional bias when measuring pupil dilation, which indicates arousal (Aktar et al., 2018). If they do have a looking preference towards fearful versus happy faces, this may indicate that they know that this specific emotional face is more important, probably due to its novelty effect. Besides, the finding that infants do not show arousal when looking at fearful faces could be evidence that they do not understand the meaning of them. In other words, infants may know fearful faces are more important to look at, but they do not know why (Leppänen & Nelson, 2009).

Others, who also found an attentional bias towards fearful versus happy faces, found a smaller attentional bias towards fearful versus happy faces in insecurely attached infants when compared to securely attached infants (Peltola & Forssman, 2015). This attentional bias towards fearful faces increases at the age of 5 to 7 months but was more pronounced in securely versus insecurely attached infants. This indicates that there are individual differences in the development of the attentional bias (Leppänen & Nelson, 2012). Evidence for this could also be that more negative emotions in fathers are related to an attentional bias towards fearful over happy faces in infants with a negative temperament. Temperament is a biologically-based set of individual differences in emotional, motor, and attentional responses to self-regulation. This can be seen in infants and predicts later personality (Rothbart, 2007). Thus, temperament influences how an infant responds to his environment and in turn, how others in the environment respond to the infant (Goldsmith et al., 1987). A negative temperament is one in which the child has an exaggerated amount of, for example,

emotionality. In that case, the infant responds more emotionally to his environment when compared to an infant with a positive, less emotional temperament (Buss & Plomin, 1984). For example, an infant can have a fearful temperament, in which an infant responds more fearful to his environment. Infants with a fearful temperament show a more pronounced attentional bias towards fearful faces (Haan, Belsky, Reid, Volein, & Johnson, 2004). Therefore, attentional bias develops as an interaction with the environment of the infant (Aktar et al., 2018).

Furthermore, attentional bias could be a dynamic construct as suggested by findings about the development of this bias. For example, attentional bias becomes more evident when an infant approaches the age of 5 to 7 months, whereas this effect decreases when approaching the age of 9 to 11 months (Peltola, Hietanen, Forssman, & Leppanen, 2013). Others found that 5 month-olds showed an attentional bias to happy over threat-related faces, and this shifts to threat-related versus happy faces at 7 months of age (Vaish et al., 2008). Another study found, however, that 5-month olds did not have any attentional preference for either happy or fearful faces yet (Bornstein & Arterberry, 2003). The current study was looking at infants of 5 to 19 months of age, so it did not take into account the developmental stages at different ages. Thus, it could be that this study did not find parental stress to be positively related to attentional bias, as only a small amount of the infants had an attentional bias, due to age and related developmental differences.

The second hypothesis was not supported, as parental stress did not appear to be related to attentional bias towards fearful over happy faces. However, other researchers found that attentional bias can be associated with variables in the rearing environment of an infant, such as parental stress (Forssman et al., 2014).

Moreover, some studies found that parental stress is related to attentional bias in infants via the behavior of parents towards their infants (Burris et al., 2019; Crnic et al., 2005; Dayton, Huth-bocks, & Busuito, 2016; Schechter et al., 2012). One of them found that when parents have experienced childhood traumas themselves when they were young, they will get stressed easier when raising their own child. This is because they are more easily emotionally triggered and raising their own children is an important responsibility, which can trigger emotions from their past (Dayton et al., 2016). This parental stress that occurs, leads to less sensitive parenting, which is positively related to a maladaptive attentional bias in their

infants (Schechter et al., 2012). Other studies found that attentional biases are developed by specific events during childhood and are the result of direct experiences (Burris et al., 2019). For example, sensitive parenting may result in greater exposure to positive emotions for the infant. Whereas, when infants receive less sensitive parenting, they are more exposed to negative emotions. As a consequence, this influences their looking preferences to specific emotional faces (Taylor-colls & Fearon, 2015). The reason why others did find this relationship between parental stress and attentional bias, although the current study did not, could be due to the fact that the sample of the current study was not representative for the population. More specifically, the current sample did not include many parents who experienced traumas in their childhood or parents who exert less sensitive parenting. In comparing this sample to that of others, it appeared that this sample has more married parents that are highly educated and do have a high occupational level, as presented in table 1 and 2. In samples that found that parental stress was positively related to attentional bias, the parents had more mixed educational levels, occupational levels and more of them were single (Crnic et al., 2005; Dayton et al., 2016; Schechter et al., 2012). This is more representative for the general population. For future research, it is important that the link between parental stress and attentional bias will be investigated in a more representative sample. Besides, it is interesting which SES characteristics have to do with this link.

A second reason why the current study did not find a relationship between parental stress and attentional bias, whereas others did, might be due to the fact that in the current sample most of the parents were mildly stressed. As indicated by the stress scale of the DASS, only a few were moderately and just one was severely stressed. This raises the question if only severe parental stress is related to attentional bias and mild or moderate parental stress are not. Other researchers did find that parental stress was positively related to attentional bias. In these studies, parental stress was higher in more parents compared to the current study. This could be evidence that only severe parental stress is related to attentional bias (Crnic et al., 2005; Dayton et al., 2016).

Another possible explanation for the fact that the current study did not find this link between parental stress and attentional bias is that this study used only one amount of time the emotional faces were shown in the emotional face processing task, whereas other studies examined the effects of different times of presentation. For example, in one article they

measured the initial pupillary light reflex in a subliminal condition (50 ms), a suprasubliminal condition (950 ms), and longer presentations of 3 or 5 seconds (Jessen, Altvater-Mackensen, & Grossmann, 2016). They found that infants' pupils are more dilated when they see happy over fearful faces in the suprasubliminal and subliminal condition, which means they are more aroused by happy over fearful faces when compared to the longer presentations. This indicates that the manner in which attentional bias is measured can have a great impact on the results. Therefore, future studies should examine the best way to measure attentional bias accurately to prevent collecting mixed findings the literature currently reveals.

A strength of the present study was that the task in which attentional bias was measured with an eye-tracker was done very standardized. All infants sat on the same side of their parents, with the same distance from the computer screen and the procedure was the same for every infant. For example, the trial started with an attention-getter and was followed by a blank screen. Then a blurred face was presented and the trial ended with dynamic stimuli. All of these phases were presented the exact same amount of time for every infant. Besides, for measuring stress levels in parents, the DASS was used, which is a well-studied measurement with high psychometric values (Akin & Çet, 2007). As a consequence, the probability that the scores on this questionnaire are representative for the actual stress levels is high.

Another strength of this study was that the sample was quite big. This makes it possible to draw conclusions from this data, as a bigger sample shows more representative results than a study with a smaller sample. Furthermore, the first hypothesis was supported, which adds more evidence to the current literature that attentional bias towards fearful over happy faces exists in infants.

One limitation of this study is that parental stress was measured with a self-report questionnaire. In these kinds of questionnaires, biases such as the social desirability bias can influence scores. As parents knew they were in a study with their child, they may have felt the urge to fill in the questionnaire in a way that they seem to be good parents. Thus, they may have filled in the questionnaire with less honesty. Future research could make use of another measure of parental stress besides a self-report questionnaire, to avoid biases like the social desirability bias. Another limitation is that, in this study, SES-variables were not included in the analyses. As it seems that these variables can have an impact on parental stress and on attentional bias, it is important for future research to take these into account. Besides, age was

not taken into account as the study did not distinguish between age groups and took all of the infants, aged 5 to 19 months, together as one group. However, as already mentioned, there are age differences in attentional bias due to development. Future research should take into account age differences as well as SES-variables that may relate to attentional bias and parental stress.

In conclusion, the current data demonstrated that there is an attentional bias towards fearful over happy faces in infants aged 5 to 19 months of age. This finding suggests that infants look longer to fearful over happy faces. This could be due to the fact that they are more used to see happy over fearful faces. Another reason, from an evolutionary perspective, could be that infants have to notice threats in their environment and they do this by their preference for fearful over happy faces.

The current data did not reveal that parental stress is positively related to this attentional bias, whereas other studies did (Burris et al., 2019; Crnic et al., 2005; Dayton et al., 2016; Schechter et al., 2012). These differences in findings may be due to choices in measurements, the non-representative sample, or the fact that the current study did not take into account SES-variables, as well as the age of the infants. Therefore, we can suggest that it is important which variables are included in the investigation of attentional bias and parental stress, and to be careful with interpreting findings, as there are many inconsistencies between findings.

References

Akin, A., & Çet, B. (2007). The Depression Anxiety and Stress Scale (DASS): The study of Validity and Reliability. *Kuram Ve Uygulamada Egitim Bilimleri*, *7*(1), 241–268.

Aktar, E., Mandell, D. J., Vente, W. De, Majdand, M., Oort, F. J., Renswoude, D. R. Van, … Bögels, S. M. (2018). Parental negative emotions are related to behavioral and pupillary correlates of infants' attention to facial expressions of emotion. *Infant Behavior and Development*, *53*, 101–111. https://doi.org/10.1016/j.infbeh.2018.07.004

Azhari, A., Leck, W. Q., Gabrieli, G., Bizzego, A., Rigo, P., Setoh, P., & Bornstein, M. H. (2019). Parenting stress undermines mother-child brain-to-brain synchrony: A hyperscanning study. *Scientific Reports*, *9*, 1–9. https://doi.org/10.1038/s41598-019-47810-4

Berryhill, M. B., Soloski, K. L., & Durtschi, J. A. (2016). Family process: Early child emotionality, parenting stress, and couple relationship quality. *Personal Relationships*, *23*(1), 23–41. https://doi.org/10.1111/pere.12109

Beurs, E. De, Dyck, R. Van, Lange, A., & Blonk, R. W. B. (2001). De DASS: een vragenlijst voor het meten van depressie, angst en stress. *Gedragstherapie*, *34*, 35–53.

Bornstein, M. H., & Arterberry, M. E. (2003). Recognition, discrimination and categorization of smiling by 5-month-old infants. *Developmental Science*, *6*(5), 585–599. https://doi.org/10.1111/1467-7687.00314

Burris, J. L., Oleas, D., Reider, L., Buss, K. A., Pérez-edgar, K., & Lobue, V. (2019). Biased attention to threat: answering old questions with young infants. *Current Directions in Psychological Science*, *28*(6), 534–539. https://doi.org/10.1177/0963721419861415

Buss, A. H., & Plomin, R. (1984). Temperament: Early developing personality traits. Hillsdale: Lawrence Erlbaum Associates.

Carli, P. De, Riem, M. M. E., & Parolin, L. (2017). Infant behavior and development approach-avoidance responses to infant facial expressions in nulliparous women: associations with early experience and mood induction. *Infant Behavior and Development*, *49*, 104–113. https://doi.org/10.1016/j.infbeh.2017.08.005

Crnic, K. A., Gaze, C., & Hoffman, C. (2005). Cumulative parenting stress across the preschool period: relations to maternal parenting and child behaviour at age 5. *Infant and Child Development*, *14*(2), 117–132. https://doi.org/10.1002/icd.

Dayton, C. J., Huth-bocks, A. C., & Busuito, A. (2016). The influence of interpersonal aggression on maternal perceptions of infant emotions: Associations with early parenting quality. *Journal of Emotion*, *16*(4), 436–448. https://doi.org/10.1037/emo0000114

Finegood, E. D., Raver, C. C., Dejoseph, M. L., & Blair, C. (2017). Parenting in poverty: Attention bias and anxiety interact to predict parents' perceptions of daily parenting hassles. *Journal of Family Psychology*, *31*(1), 51–60. https://doi.org/10.1037/fam0000291

Forssman, L., Peltola, M. J., Yrttiaho, S., Puura, K., Mononen, N., & Lepp, J. M. (2014). Regulatory variant of the TPH2 gene and early life stress are associated with heightened attention to social signals of fear in infants. *Journal of Child Psychology and Psychiatry*, *55*(7), 793–801. https://doi.org/10.1111/jcpp.12181

Gartstein, M. A., Hancock, G. R., Quarterly, M., Gartstein, M. A., State, W., & Hancock, G. R. (2019). Temperamental Growth in Infancy: Demographic, Maternal Symptom, and Stress Contributions to Overarching and Fine-Grained Dimensions. *Merrill-Palmer Quarterly-Journal of Developmental Psychology*, *65*(2), 121–157. https://doi.org/10.13110/merrpalmquar1982.65.2.0121

Goldsmith, H. H., Buss, A. H., Plomin, R., Rothbart, M. K., Thomas, A., Chess, S., … McCall, R. B. (1987). Roundtable: What is temperament? Four approaches. *Child Development*, *58*(2), 505–529. https://doi.org/10.2307/1130527

Haan, M. De, 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. https://doi.org/10.1111/j.1469-7610.2004.00320.x

Heck, A., Hock, A., White, H., Jubran, R., & Bhatt, R. S. (2016). The development of attention to dynamic facial emotions. *Journal of Experimental Child Psychology*, *147*, 100–110. https://doi.org/10.1016/j.jecp.2016.03.005

Jessen, S., Altvater-Mackensen, N., & Grossmann, T. (2016). Pupillary responses reveal infants' discrimination of facial emotions independent of conscious perception. *Cognition*, *150*, 163–169. https://doi.org/10.1016/j.cognition.2016.02.010

Jouriles, E. N., Murphy, C. M., & Oleary, K. D. (1989). Effects of maternal mood on mother-son interaction patterns. *Journal of Abnormal Child Psychology*, *17*(5), 513–525. https://doi.org/10.1007/BF00916510

Kataja, E., Karlsson, L., Parsons, C. E., Pelto, J., & Pesonen, H. (2019). Maternal pre- and postnatal anxiety symptoms and infant attention disengagement from emotional faces. *Journal of Affective Disorders*, *243*, 280–289. https://doi.org/10.1016/j.jad.2018.09.064

Keenan, B. M., Newman, L. K., Gray, K. M., Rinehart, N. J., & Gray, K. M. (2016). Parents of Children with ASD Experience More Psychological Distress , Parenting Stress , and Attachment-Related Anxiety. *Journal of Autism and Developmental Disorders*, *46*(9), 2979–2991. https://doi.org/10.1007/s10803-016-2836-z

Keil, V., Hepach, R., Vierrath, S., Ca, D., Tuschen-ca, B., Klein, C., & Schmitz, J. (2018). Children with social anxiety disorder show blunted pupillary reactivity and altered eye contact processing in response to emotional faces: Insights from pupillometry and eye movements. *Journal of Anxiety Disorders*, *58*, 61–69. https://doi.org/10.1016/j.janxdis.2018.07.001

Larkin, S. J., & Otis, M. (2019). The Relationship of Child Temperament , Maternal Parenting Stress , Maternal Child Interaction and Child Health Rating. *Child and Adolescent Social Work Journal*, *36*(6), 631–640. https://doi.org/10.1007/s10560-018-0587-8

Lee, J., Hyun, E., Seung, L., & Moon, H. (2019). Systematic review of the measurement properties of the Depression Anxiety Stress Scales – 21 by applying updated COSMIN methodology. *Quality of Life Research*, *28*(9), 2325–2339. https://doi.org/10.1007/s11136-019-02177-x

Leppänen, J. M., & Nelson, C. A. (2009). Tuning the developing brain to social signals of emotions. *Nature Reviews Neuroscience*, *10*(1), 37–47. https://doi.org/10.1038/nrn2554

Leppänen, J. M., & Nelson, C. A. (2012). Early development of fear processing. *Current*

Directions in Psychological Science, *21*(3), 200–204. https://doi.org/10.1177/0963721411435841

Lobue, V., & Deloache, J. S. (2010). Superior detection of threat-relevant stimuli in infancy. *Developmental Science*, *13*(1), 221–228. https://doi.org/10.1111/j.1467-7687.2009.00872.x

Loop, L., Rossignol, M., Galdiolo, S., Roskam, I., Loop, L., Rossignol, M., … Roskam, I. (2018). The improvement of mothers' and children's emotional and behavioral reactions through the modification of attentional bias in mothers: a micro-trial study. *Parenting: Science and Practice*, *18*(1), 9–27. https://doi.org/10.1080/15295192.2018.1405698

Lovibond, P. F. (1995). The structure of negative emotional states: comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy*, *33*(3), 335–343. https://doi.org/10.1016/0005-7967(94)00075-u

Mastorakos, T., & Scott, K. L. (2019). Attention biases and social-emotional development in preschool- aged children who have been exposed to domestic violence. *Child Abuse & Neglect*, *89*, 78–86. https://doi.org/10.1016/j.chiabu.2019.01.001

McElwain, N. L., & Booth-laForce, C. (2006). Maternal sensitivity to infant distress and nondistress as predictors of infant–mother attachment security. *Journal of Family Psychology*, *20*(2), 247–255. https://doi.org/10.1037/0893-3200.20.2.247

Morin, E. L., Howell, B. R., Meyer, J. S., & Sanchez, M. M. (2019). Effects of early maternal care on adolescent attention bias to threat in nonhuman primates. *Developmental Cognitive Neuroscience*, *38*, 2–11. https://doi.org/10.1016/j.dcn.2019.100643

Nakagawa, A., & Sukigara, M. (2019). Attentional bias assessed by a facial expression cuing paradigm in infants. *Scientific Reports*, *9*(68), 1–7. https://doi.org/10.1038/s41598-018-36806-1

Peltola, M., Hietanen, J., Forssman, L., & Leppanen, J. (2013). The Emergence and Stability of the Attentional Bias to Fearful Faces in Infancy. *Infancy*, *18*(6), 905–926. https://doi.org/10.1111/infa.12013

Peltola, M. J., & Forssman, L. (2015). Attention to faces expressing negative emotion at 7 months predicts attachment security at 14 months. *Child Development*, *86*(5), 1321–1332. https://doi.org/10.1111/cdev.12380

Peltola, M. J., & Yrttiaho, S. (2018). Infants' attention bias to faces as an early marker of social development. *Developmental Science*, *21*(6), 1–14. https://doi.org/10.1111/desc.12687

Perizzolo, V. C., Berchio, C., Moser, D. A., Gomez, C. P., Vital, M., Arnautovic, E., … Schechter, D. S. (2019). EEG recording during an emotional face matching task. *Psychiatry Research: Neuroimaging*, *283*, 34–44. https://doi.org/10.1016/j.pscychresns.2018.11.010

Rothbart, M. K. (2007). Temperament, development, and personality. *Current Directions in Psychological Science*, *16*(4), 207–212. https://doi.org/10.1111/j.1467-8721.2007.00505.x

Ruba, A. L., & Repacholi, B. M. (2019). Do preverbal infants understand discrete facial expressions of emotion? *Emotion Review*. https://doi.org/10.1177/1754073919871098

Schechter, D. S., Moser, D. A., Wang, Z., Marsh, R., Hao, X., Duan, Y., … Peterson, B. S. (2012). An fMRI study of the brain responses of traumatized mothers to viewing their toddlers during separation and play. *Social Cognitive and Affective Neuroscience*, *7*(8), 969–979. https://doi.org/10.1093/scan/nsr069

Taylor-colls, S., & Fearon, R. M. P. (2015). The effects of parental behavior on infants' neural processing of emotion expressions. *Child Development*, *86*(3), 877–888. https://doi.org/10.1111/cdev.12348

Thompson-booth, C., Viding, E., Mayes, L. C., Rutherford, J. V, Hodsoll, S., & Mccrory, E. J. (2016). Here's looking at you, kid: attention to infant emotional faces in mothers and non-mothers. *Developmental Science*, *17*(1), 35–46. https://doi.org/10.1111/desc.12090

Vaish, A., Grossman, T., & Woodward, A. (2008). Not all emotions are created equal: The negativity bias in social-emotional development. *Psychological Bulletin*, *134*(3), 383–403. https://doi.org/10.1037/0033-2909.134.3.383.

Walden, T. A. (1991). Infant social referencing. In J. Garber & K. A. Dodge (Eds.), The development of emotion regulation and dysregulation (pp. 69–88). New York: Cambridge University Press. doi:10.1017/ cbo9780511663963.005.

Walle, E. A., Reschke, P. J., & Knothe, J. M. (2017). Social referencing: defining and delineating a basic process of emotion. *Emotion Review*, *9*(3), 245–252. https://doi.org/10.1177/1754073916669594

Wu, Q., Slesnick, N., & Murnan, A. (2018). Understanding Parenting Stress and Children's Behavior Problems among Homeless, Substance-Abusing Mothers. *Infant Mental Health Journal*, *39*(4), 423–431. https://doi.org/10.1002/imhj.21717.

Zekoski, E. M., Ohara, M. W., & Wills, K. E. (1987). The effects of maternal mood on mother-infant interaction. *Journal of Abnormal Child Psychology*, *15*(3), 361–378. https://doi.org/10.1007/BF00916455