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General Introduction
Chapter 1

Parenting an infant is not easy. It is a process that requires correct perception of an infant’s signals, followed by a timely and appropriate response to relieve the infant from discomfort or distress (Ainsworth et al., 1978). However, individuals differ in their perception of infant signals and in their ability to provide appropriate responses (Montoya et al., 2012). In the present thesis, we studied individual differences in the perception of infant signals due to adverse childhood experiences. Moreover, we tested whether experimental interventions, more specifically social reward training and administration of oxytocin, might change the perception of infant signals, to be perceived as more positive or less negative.

Infant signals

Preverbal infants use a combination of facial expressions and vocalizations to communicate their physical and affective states, such as their need for social engagement, feelings of hunger or anxiety (Vallotton, 2009). However, depending on their temperament, perinatal stress experiences and responses from the caregiver, infants differ in the intensity and frequency of these displayed emotions (Nugent et al., 1996; Schmid et al., 2011; Van der Wal et al., 2007). Both intensity and frequency of the displayed emotions have in their turn been shown to affect the responsiveness and quality of caregiving provided by parents (Dessureau et al., 1998; Zeskind, 1988). More positive behavior of an infant is rewarding for the parent and might therefore lead to more positive responses (Strathearn et al., 2009), whereas frequent infant crying may be stressful for the caregiver and might result in insensitive, harsh, or even maltreating responses (Reijneveld et al., 2004). Besides temperamental cues, infants’ cuteness as perceived by the caregiver might also affect the perception and responses to infants’ signals (Langlois et al., 1995). In the present studies, we used a standard set of infant stimuli to minimize the variations in perception caused by such natural variations in infant related attributes. This was done in order to study individual differences in caregivers’ characteristics in a standardized way, shaping their perception of infant facial expressions and vocalizations.

Individual characteristics

Individual differences between caregivers, possibly brought upon by differences in genetic makeup and life experiences, may affect the perception of infant cues (Crouch et al., 2008; Out et al., 2010). Early life experiences, life stressors, hormone levels such as testosterone and oxytocin, social support, and socio-economic status have all been related to differences in perception of infant signals, thereby affecting the quality of caregiv-
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...ing responses (Crockenberg, 1988; Crowe and Zeskind, 1992; Donovan et al, 1978). For example, fathers with lower testosterone levels show higher empathy and responsiveness to infant crying than fathers with higher testosterone levels (Fleming et al, 2002; but also see Van Anders et al, 2012); and mothers who experience more social support are more positive towards their infants and provide more sensitive caregiving (Crockenberg, 1988; Lee et al, 2009a). In the present thesis, we examined the influence of early experiences of emotional maltreatment on the perception of infant cues. We tested how experiences of childhood emotional maltreatment and experienced maternal use of love withdrawal as a discipline strategy might affect individuals’ perception of infant cues such as smiling and crying.

Childhood emotional maltreatment and maternal love withdrawal

Emotional abuse and neglect and excessive use of love withdrawal may be considered psychological maltreatment (Euser et al, 2010). Experiencing this in childhood has been shown to affect individual’s psychological development and to influence social behavioral outcomes (Egeland et al, 2002; Shenk et al, 2013; Sroufe, 2005; Van Harmelen et al, 2010). For instance, experiences of childhood emotional maltreatment have been associated with processing biases during recognition of emotional states such as fear and anger (Cicchetti and Curtis, 2005; Curtis and Cicchetti, 2011; Masten et al, 2008), and experiencing love withdrawal from parents has been associated with heightened processing of emotional stimuli (Huffmeijer et al, 2011). Moreover, these adverse early life experiences also affect parenting and perceptions of self and others (Belsky and Von dra, 1989; Crawford and Wright, 2007). We studied the effects of childhood experiences with emotional maltreatment or with love-withdrawal on individuals’ evaluation of infant emotional facial expressions and infant temperamental cues. Sensitive parenting is of great societal importance and intergenerational transmission of caregiving behaviors has been noted (Belsky et al, 2009; Van IJzendoorn, 1992). However, the underlying biological mechanisms that are responsible for the influence of early life experiences on the perception of infant cues are not well understood. We studied the involvement of the oxytonergic system in affecting infant cue perception to shed light on some of the neurobiological mechanisms.

Oxytonergic system

Oxytocin is a nona-peptide which apart from its peripheral actions in facilitating vaginal birth and milk ejection (Lee et al, 2009b) has been widely studied for its actions...
on central nervous system controlled behaviors (Guastella and MacLeod, 2012; Heinrichs et al, 2009; MacDonald and MacDonald, 2010). It has been shown to affect behaviors such as mate recognition, sensitive parenting, memory of conspecifics, and other social behaviors such as trust and empathy (Baumgartner et al, 2008; Churchland and Winkielman, 2012; De Dreu, 2012; Feldman, 2012). In parenting, serum and salivary oxytocin levels are associated with parent and child social engagement, positive communication and affect synchrony (Feldman et al, 2011). We studied whether endogenous oxytocin levels as assessed in saliva were associated with the perceived mood from infant facial pictures. Next to the endogenous levels of oxytocin, single nucleotide polymorphisms on the oxytocin receptor gene are shown to moderate the relation between oxytocin and social behaviors (Feldman et al, 2012; Marsh et al, 2012), and to affect sensitive parenting (Bakermans-Kranenburg and Van IJzendoorn, 2008; Riem et al, 2011b), although a recent meta-analysis did not confirm any main effect of oxytocin receptor polymorphism on human behavior (Bakermans-Kranenburg and Van IJzendoorn, 2013). In the present thesis we assessed the potentially moderating influence of oxytocin receptor gene polymorphism rs53576 on the relation between early life adverse experiences and salivary oxytocin levels.

In humans, intranasal administration has become a commonly used method for experimentally increasing the oxytocin level in order to study its causal effects (Baumgartner et al, 2008; Domes et al, 2007; Heinrichs et al, 2009; Kirsch et al, 2005). Brain activity and behavioral changes after nasal spray administration provide evidence for the efficacy of this method. Intranasal administration of oxytocin increases salivary levels for seven hours post nasal spray, giving an indication of time-line of its bioavailability (Van IJzendoorn et al, 2012). Moreover, using intranasal administration, oxytocin seems to enhance sensitive caregiving in fathers towards their toddlers (Naber et al, 2013; Naber et al, 2010). Oxytocin may also decrease aversion to infant stimuli such as infant crying (Riem et al, 2011a) and affect the neural connectivity in response to infant laughing (Riem et al, 2012). Oxytocin has been implicated in emotion processing such as early detection of positive or negative emotion in adult faces, and better reading of the mind in the eyes (Guastella et al, 2012; Guastella et al, 2008a; Marsh et al, 2010; Petrovic et al, 2008). It increases recognition of both positive emotions such as happy facial cues and negative emotions such as angry and fearful facial cues (Domes et al, 2012; Marsh et al, 2010). However, emotion recognition has so far been studied using adult facial cues. Even though oxytocin has been highly implicated in the initiation and quality of caregiving behaviors, recognition of infant emotion and temperament remained largely unexplored.
In the present thesis we studied the association of endogenous oxytocin levels with the perception of infant stimuli. Moreover, we conducted a double-blind, randomized experiment to see how increased levels of oxytocin affect the memory for infant temperamental cues.

**Baby Social Reward Task (BSRT)**

Infant temperament is associated with maternal sensitivity and (indirectly) with attachment security (Van IJzendoorn and Bakermans-Kranenburg, 2012). It refers to the basic characteristics of a trait and shows stability over time, as opposed to mood which reflects the current state of mind and is transient (Gray et al., 2001). In order to study the effect of perceived temperament on individuals’ perception of infant cuteness and amount of expended effort towards the infant, we developed a novel learning task together with a team of researchers from Oxford University, UK (Chapter 3). The BSRT is a probabilistic task in which infant mood information is experimentally manipulated, making some infants more happy or more sad than other infants. During the task participants get information about the mood of various infants, which can range from very happy - moderately happy - moderately sad - very sad. We tested whether experimental manipulation of infant mood affected perception of infant cuteness and other dimensions such as easy and difficult temperament. We also tested whether intranasal administration of oxytocin modulated the recognition memory of these manipulated temperaments.

**Thesis outline**

In the present thesis we studied the individual differences associated with differences in perception of infant signals. Chapter 2 and 5 focus on the relation between experiences of childhood psychological maltreatment and perceived mood of infants with happy and sad facial expression or infant crying (using the infant simulator; described in chapter 5). As childhood maltreatment has been associated with altered levels of oxytocin (Heim et al., 2008; Pierrehumbert et al., 2010), and with enhanced recognition of various emotions (Van IJzendoorn and Bakermans-Kranenburg, 2012), we tested whether oxytocin mediated the relation between childhood emotional maltreatment and perceived positivity of infant mood from pictures of happy and sad infants (Chapter 2).

As perception affects the quality of caregiving (Out et al., 2012), in Chapter 3 we describe the novel BSRT to experimentally manipulate mood of infants and study the changes in perceived cuteness and perceived easiness of infants in terms of positive versus negative temperaments.
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Oxytocin has been implicated in emotion recognition memory and sensitive parenting (Feldman et al, 2007; Guastella et al, 2008b). In Chapter 4 we report on a study testing whether intranasal oxytocin administration affected the memory for infant temperament and whether experiences of childhood emotional maltreatment moderated these effects. In the Discussion we elaborate on our findings in the broader context of a search for neurobiological mechanisms explaining variations in parenting.
References


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