Infant's Developmental Trajectories in the First Year of Life

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UMinho | 2009

Universidade do Minho
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Doctoral thesis in Psychology
Area of knowledge in Clinical Psychology

Supervised by
Professora Doutora Bárbara Figueiredo

September, 2009

DECLARAÇÃO

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Número do Bilhete de Identidade: 10760826

Título da Tese de Doutoramento:
Infant's developmental trajectories in the first year of life

Orientador(es): Professora Doutora Bárbara Figueiredo

Ano de conclusão: 2009

Ramo de Conhecimento do Doutoramento:
Psicologia, Área de Conhecimento em Psicologia Clínica

Universidade do Minho, _____ de _____ de _____

Assinatura: _____

This study was financed by the Portuguese Foundation for Science and Technology (Grant with the reference SFRH/BD/18249/2004). Ministry of Science, Technology and Higher Education in the scope of POCI 2010. Advanced training for science – measure IV.3. Reimbursed by the European Social Fund and by national funds of MCTES.

FCT Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR


European Union


Portuguese Republic

ACKNOWLEDGEMENTS

I adress my first words to Prof. Dra. Bárbara Figueiredo. Our journey has begun long before PhD work has started. Her professionalism, intelligence, criativity and enterprising spirit have guided me in my first steps in the professional field. In key moments, she was persistent, and had provided me with insights and inspiration to go on with security and confidence. In the very last steps of this journey she has provided me with essential assertive critics and thinking to this work. Her pertinent commentaries, dedication, support and strength has helped me for several times along these years in such a way that it is difficult, if not impossible to express my recognizant by words.

To my very good friends Dra. Alexandra Pacheco, Dra. Ana Conde, Dr. César Teixeira, Dra. Iva Tendais, Dra. Mariana Bianchi de Aguiar and Dra. Sónia Brandão for the growing friendship, support, availability, companionship, catharses, advices and important, unforgettable shared moments. A special thank to Dra. Alexandra Pacheco for the time she spent quoting the "strange situation" video recordings. A special thank to Dra. Ana Conde and Dra. Iva Tendais for revising part of this work and providing reflexive and critic thinking. A special thank to Dra. Mariana Bianchi de Aguiar for revising the English in part of this work.

To Dra. Catarina Magalhães and Dra. Filomena Louro for the availability in revising the English in part of this work.

To Dra. Carla Martins for the sincere availability and for allowing me to assist to the statistical classes.

To my family, especially my parents for all the support, love, comprehension and tolerance.

To my husband for the support, the strength provided throughout these years, understanding and for the growing love. To my daughters for the wonderful experience of motherhood.

I am are especially indebted to the mothers and children who took part of this study, they spared their time and availability to this project and I am very grateful for that.

To the Primary Health Care Center of Espinho for receiving this work with enthusiasm and for providing the infrastructure essential for the research to take place. A special thank to Dr. Joaquim Barbosa, Maria José Quinta and chief nurse Conceição. The kind sympathy, support and availability were extremely important to me.

To the Primary Health Care Center of Santa Maria da Feira for receiving this work and for providing the infrastructure essential for the research to take place. A special thank to Dr. Nunes de Sousa for his support throughout the process.

To Weleda for the support to this project.

To the Fundação para a Ciência e Technologia for believing and providing financial support to this project. I am grateful for the grant support provided to this research.

INFANT'S DEVELOPMENTAL TRAJECTORIES IN THE FIRST YEAR OF LIFE

ABSTRACT

Objective: This study aims to (1) identify and profile groups of infants according to their psychophysiological characteristics, considering neurobehavior organization, social withdrawal behavior and neuroendocrine reactivity to stress, and (2) analyze group differences on the quality of mother-infant interaction, temperament and attachment. **Method**: Over the first year of life, 94 infants and their mothers participated in this study. Employing a longitudinal prospective design eight weeks-old infants were assessed with the Neonatal Behavioral Assessment Scale (NBAS, Brazelton & Nugent, 1995) and the Alarm Distress Baby Scale (ADBB, Guedeney & Fermanian, 2001). Saliva samples were collected at 8 to 12 weeks old, both before and after routine inoculation for measuring cortisol levels. Mothers' reports of infant temperament at 3 and 12 months were collected using the Infant Behavior Questionnaire (IBQ, Rothbart, 1981). Mother infant interaction was evaluated at 12 to 16 weeks, using the Global Rating Scales (GRS, Murray, Fiori-Cowley, Hooper, & Cooper, 1996). The strange situation procedure (Ainsworth, Blehar, Waters, & Wall, 1978) was performed to assess infant attachment style at 12 months. **Results**: Three groups of infants were identified: (1) "Withdrawn"; (2) "Extroverted"; (3) "Underaroused". Differences between them were found regarding both infant and mother behaviors in the interaction and the overall quality of mother-infant interaction. Significant differences between groups were found on temperament at both 3 and 12 months. Stability was observed in most temperament dimensions from 3 to 12 months old, nonetheless mothers' perception of infant temperament changed in terms of level of distress, cuddliness, sadness and approach. Both infant psychophysiological profile and mother-infant interaction interfered on the pattern of those changes. Additionally, infants' psychophysiological profile had also a significant effect on the probability of having a secure attachment. The quality of mother-infant interaction differed in secure vs. insecure attached infants. Furthermore, the overall quality of mother-infant interaction mediated the association between infant's psychophysiological profile and infant attachment, whereas mother behaviors in the interaction moderate this association. **Conclusion**: This study provides new data

regarding the impact of infant characteristics early in life and the role of mother-infant interaction on developmental trajectories in the first year of life.

TRAJECTÓRIAS DESENVOLVIMENTAIS DA CRIANÇA NO PRIMEIRO ANO DE VIDA

RESUMO

Objectivo: Neste estudo pretendemos (1) identificar e descrever o perfil de grupos de crianças de acordo com as suas características psicofisiológicas, considerando a organização do neurocomportamento, retraimento social e reactividade neuro-endócrina ao stress e (2) analisar diferenças entre os grupos ao nível da qualidade da interacção, temperamento e vinculação. **Método**: Foi implementado um design prospectivo longitudinal ao longo do primeiro ano de vida com 94 crianças e as suas mães. As crianças foram avaliadas às 8 semanas de vida com o Neonatal Behavioral Assessment Scale (NBAS, Brazelton & Nugent, 1995) e o Alarm Distress Baby Scale (ADBB, Guedeney & Fermanian, 2001). Amostras de saliva foram recolhidas entre as 8 e as 12 semanas de vida, antes e depois da vacinação de rotina para medição dos níveis de cortisol. As mães preencheram o Infant Behavior Questionnaire (IBQ, Rothbart, 1981) aos 3 e aos 12 meses de vida. A qualidade da interacção foi avaliada entre as 12 e as 16 semanas através das Global Rating Scales (GRS, Murray, Fiori-Cowley, Hooper, & Cooper, 1996). O procedimento Situação Estranha (Ainsworth, Blehar, Waters, & Wall, 1978) foi realizado para avaliação do estilo de vinculação aos 12 meses. **Resultados**: Foram identificados três grupos de crianças: "Retraidos"; (2) "Extrovertidos"; (3) "Sub-activados". Foram encontradas diferenças entre os grupos no que respeita aos comportamentos do bebé, da mãe e da qualidade global da interacção. Diferenças significativas ao nível do temperamento foram encontradas aos 3 e aos 12 meses. Na maior parte das dimensões do temperamento observa-se estabilidade entre os 3 meses e os 12 meses, no entanto existem mudanças em termos do nível de distress, aconchego, tristeza e aproximação. Tanto o perfil psicofisiológico da criança como a interacção mãe-bebé interferem no padrão destas mudanças. O perfil psicofisiológico tem um efeito significativo na probabilidade de ter vinculação segura. A qualidade da interacção mãe-bebé difere nas crianças seguras comparativamente com as inseguras. Verificou-se ainda que a qualidade da interacção mãe-bebé medeia a associação entre o perfil psicofisiológico da criança e a vinculação enquanto o comportamento materno na interacção modera esta associação. **Conclusão**: Este estudo proporciona novos dados

relativos ao impacto das características da criança e o papel da interacção mãe-bebé nas trajectórias desenvolvimentais da criança no primeiro ano de vida.

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ABREVIATIONS LIST

ADBB – Alarm Distress Baby Scale
ANOVA – Univariate Analysis of Variance
BSID – Bayley Scales of Infant Development
GRS – Global Rating Scales
HPA axis – Hypothalamic-Pituitary-Adrenal Axis
IBQ - Infant Behavior Questionnaire
IBQ-R – Infant Behavior Questionnaire-Revised
ICQ – Infant Characteristic Questionnaire
MANOVA – Multivariate Analysis of Variance
MRM – Mutual Regulation Model
NBAS – Neonatal Behavioral Assessment Scale
STAI – State Trait Anxiety Inventory

> "There is widespread agreement that the periods of infancy and childhood are more important than any other stages of development in determining the intensity and character of adult fears and anxieties." (Campbell & Campbell, 2000, p.1)

During infancy humans develop their abilities, individuality and first relationships. Research during this period may be central to the understanding of socioemotional growth features such as emotional expression, sociability, self-understanding, social awareness and self-management (Thompson, Easterbrooks, & Padilla-Walker, 2003). This is central for the comprehension of healthy/maladaptative development.

Infants are capable of organized behavior very early in life and play a role in the pathway of their own development through the influence they have on the quality of earliest and closest relationships. But exactly what specific infant characteristics are associated with difficulties in this process? Under what conditions do individual differences in interactive and regulatory capacities have enduring effects on developmental pathways? Our study intends to explore infants' psychophysiological functioning early in life and it's impact in developmental trajectories in the first year, namely regarding temperament, the quality of mother-infant interaction, and attachment style. We are focused in analyzing behavioral profiles associated with easy/difficult temperament, good/difficult interactions, and secure/insecure attachments. Furthermore, the role of mother-infant interaction on this association was also questioned. What specific features of the interaction are important to the infant development? Do these features have the same impact on developmental pathways independently of the infants' characteristics or is there a differential impact of the infants' individual differences at birth?

In this study individuals are seen as integrated systems of biological, psychological, and social functioning. We intend to follow the infant developmental pathways leading to secure or insecure attachments and try to understand the web of factors that may be in the origin of this patterns.

Chapter 1 is dedicated to psychophysiological functioning and temperament. Major temperament theories and measures during infancy are adressed. We will review the research on infant psychophysiological functioning and temperament, including studies that look at prenatal influences, parental and infant influences on temperament. Issues of stability and change over the first years and variables that interfere on stability/change are reviewed. Additional attention is placed on infant temperament and developmental outcomes.

In chapter 2 infants' development in the context of mother-infant interaction is discussed. Special features of parent-child relationships as bidirectional and co-constructed processes are addressed. Consideration is given to the child's contribution with emphasis placed on her/his active role in the interaction. Issues of definition and conceptualization are considered. Of particular interest are the potential effects of the infant temperament and neurodevelopment on the evolving mother–infant relationship, and alternately, the effects of mother interaction patterns on infant neurobehavior development.

Chapter 3 concerns infant attachment, namely Bowlby's theory on the development of infant attachment and the work of Ainsworth. The notion of infant attachment behaviors is addressed. The focus throughout the chapter is mainly on infant temperament and parent-child relationships' impact on the development of secure attachment. Of particular interest are the potential mediator effects of mother-infant interaction on the relationship between infant characteristics and later patterns of attachment.

In chapter 4, we address to the empirical studies developed in order to better understand the impact of both infant characteristics and the quality of mother-infant interaction on infant developmental outcomes in the first year of life.

Finally in the 5th chapter the main results of the empirical study are discussed in the light of theory and recent research.

CHAPTER 1

INFANT'S PSYCHOPHYSIOLOGICAL FUNCTIONING AND TEMPERAMENT

This chapter addresses to infant's psychophysiological functioning and major temperament theories. Existing measures of temperament as well as their strengths and weaknesses are revised. Consideration is given to the review of research on infant temperament, including studies that look at prenatal influences, parental and infant influences on temperament. Issues of stability and change over the first years and variables that interfere with temperament stability/change are reviewed. Additional attention is placed on infant temperament and developmental outcomes. We conclude the chapter with an integrative and reflexive thinking on evidences provided by empirical studies that confirm/disconfirm different temperament theories.

> "Temperament concepts are a way of talking about personal qualities salient from very early in life. Thus temperament is a way of seeing the child as bringing unique social contributions to the world"
> Bates (1987, p.1101)

The first theories on temperament were based on theories of personality and were formulated in the 50's, with the pioneering work of Chess and Thomas (1959). Five decades of studies were not enough to establish a clear consensus between researchers concerning the nature of the temperament construct. Nonetheless, there are points of consensus, which include the fact that temperament has early biologic developmental roots, and refers to individual differences. It is conceived not as a trait itself but as a group of related traits such as irritability, emotionality, activity level or fearfulness that reflect individual behavioral tendencies (Goldsmith et al., 1987). Almost complete agreement exists that temperament dimensions may change over time and that temperament is a component of personality. Studies on temperament come from different disciplines from psychology to physiology, medicine, genetics and education research (Campos, Barrett, Lamb, Goldsmith, & Stenberg, 1983). Several authors have focused their efforts on the analysis of this construct and from their studies different theories have emerged.

In the 60's, Thomas, Chess, and Birch (1968) argued that infants begin to express themselves as individuals from the time of birth, show distinct individuality in temperament in the first weeks of life, and as early as from the age of two or three months there is a discernible behavioral profile or temperament defined essentially by nine characteristics (Chess & Thomas, 1986, 1996). Temperament exists in the newborn as a result of both innate brain attributes and intrauterine environment. Temperament is an independent psychological attribute that interacts with other attributes such as cognition, arousal, motivation or emotionality in a transactional system over time. The interaction of temperament with motivation, abilities and personality determines behavior (Thomas & Chess, 1977). After childbirth an interactional process begins between temperament traits, other psychological dimensions and the environment, so

that as a result of this process, changes or modifications may occur in one or more temperamental traits. So, the authors argue that temperament is not absolutely stable over time, depending on the environmental circumstances. It is expressed as a response to an external stimulus, opportunity, expectation, or demand. Temperament mediates and shapes the influence of the environment on the individual's psychological structure and must always be rated in terms of the social context in which it occurs, because temperament is affected and affects the context in a bidirectional influence (Chess & Thomas, 1986). The original characteristics of temperament tend to remain constant in quality over the years, although in the course of development, the environmental circumstances may influence the infants' reactions and behavior (Thomas & Chess, 1977).

The authors have developed nine characteristics from a survey of parents' interview and the content analysis of those interviews: rythmicity of biological functions, activity level, approach/withdrawal from new stimulus, adaptability, sensory threshold, quality of mood, intensity of mood expression, distractibility and persistence/attention span. Clinically three patterns of temperament derived from the constellation of the nine characteristics: "Easy", "Difficult", and "Slow to warm up" (Chess & Thomas, 1986, 1996). The "easy" children are characterized by positive mood, regularity, low/moderate intensity of reaction, adaptability and approach. The "difficult" children are irregular, have intense reactions, withdrawn from stimulus, have difficulties to adapt and negative mood. The "slow to warm up" have low activity level, withdrawn only to the first exposure to stimuli, are slow to adapt, have some negative mood and low intensity of reactions. These characteristics have been relevant to the estimation of the ontogenesis of behavior disorders and in the analysis of those disorders evolution over time (Chess & Thomas, 1986). These authors personological construct hypothesized that personality is shaped by the constant interplay of temperament and environment (Thomas & Chess, 1977): If infant characteristics and environment are harmonized a healthy development of the child is to be expected (goodness of fit). Behavioral disorder appears when there is a conflict between a child's temperament and environmental demands (poorness of fit), and so, at higher risk for the development of behavior problems are the infants with difficult temperament (Chess & Thomas, 1986, 1996).

In 1975, Buss and Plomin (1975, 1984) developed a temperament theory of personality development under a personological position. These authors define temperament as a set of inherent personality traits of genetic origin that appear during the first year of life (Buss, 1989). Traits of temperament are emotionality/distress, activity and sociability (Buss & Plomin, 1984). Emotionality involves emotional and behavioral arousal and varies from lack of emotional response to intense emotional responses. Activity involves behavioral arousal and its components are tempo and vigor, varying from lethargy to energetic behavior. Sociability refers to the desire/need of being with someone or alone.

Temperament has biological origins and traits derive from genes, so stability is expected during development, making them among the more stable personality traits. Nonetheless, they argued, as did Thomas et al. (1968), that temperament traits are expected to vary according to developmental and environmental conditions (Buss & Plomin, 1984). These traits are the basis of later personality. Difficult temperament is defined as hard to handle children for both parents and other caregiver, either because they are emotional or very active (Plomin & Daniels, 1984).

Goldsmith and Campos (1982, 1986) conceptualized temperament within an emotion-based framework and confined their definition of temperament to the behavioral level alleging that it is the most relevant in social contexts and enables immediate empirical research. Nonetheless they recognize temperament as determined by both genes and physiology (Goldsmith, 1984). For the authors, temperament is emotional in nature and refers to individual differences in the probability of experiencing and expressing the primary emotions and arousal. Emotions are defined as having four characteristics: they regulate internal psychological processes as well as social and interpersonal behaviors; they can be specified as facial, vocal and gestural expressions and they use an innate based noncodified communication process. The temperamental development is a multifaceted process and its dimensions constitute the emotional substrate of some later personality characteristics (Goldsmith, 1986).

Changes on primary emotions are expected to occur over time, including emotional receptive abilities and the effectiveness of specific eliciting stimuli, improvements in coordination of emotional expression and feeling states across infancy and the socialization of emotional expression during childhood. Emotional reactions

may be transformed by developing motor and cognitive coping responses (Goldsmith, 1988). Individual differences in emotions are the result of variability in timing and the strength of these patterns of change. Temperamental characteristics become stable when the various facets of feeling states, action tendencies, and response systems become integrated into a functional system. Acknowledging the fact that temperament is defined as individual differences in emotionality and emotions have communicative functions, research focuses mainly on emotional communication that is a relevant social process in the interaction between the infant and the caregiver (Goldsmith et al., 1987).

Rothbart's (1981) psychobiologically oriented approach to temperament emphasizes primarily biologically based individual differences in reactivity and self-regulation. Reactivity refers to characteristics of individual's reactions to stimulus change that include behavioral, endocrine, and nervous system responses, while self-regulation refers to processes that modulate reactivity such as approach, avoidance, attentional orientation and selection (Rothbart & Posner, 1985; Rothbart, Derryberry, & Posner, 1994).

Behaviorally, temperament is relatively stable and can be observed as individual differences in patterns of emotionality, activity, and attention. Temperament influences behavior and experience and provides the primarily biological basis for the development of personality. This definition stresses the importance of temperament as a construct that allows the association of psychological and neurophysiological research (Goldsmith et al., 1987).

Several dimensions including approach, high and low intensity pleasure, smile and laughter, activity level, perceptual sensitivity, sadness, distress to limitation, fear, falling reactivity, cuddliness, duration of orientation, soothability and vocal reactivity have been the focus of the author's attention. Four major dimensions of temperamental variability were proposed (Rothbart, 1986), each of them with particular development over time: (1) negative emotionality expressed by distress and aversion; (2) positive reactivity expressed by affect and approach; (3) behavioral inhibition to new and intense stimuli; (4) ability to direct attention.

Temperament characteristics are relatively stable over time, with periods of instability and stability according to maturational transitions (Rothbart, 1989). It can happen that while some characteristics change, others remain stable. The expression of

temperament is influenced by the extent of stimuli and regulation provided by the environment and vice versa in an interactional model (Rothbart & Derryberry, 1981).

Infant Temperament Measurement

A variety of methods were developed to measure temperament. Parental ratings and observation in laboratory or naturalistic environments were used to measure infant temperament over time. Both methods have advantages and cons. Observation-based methods reduce bias by relying on standardized procedures and using trained observers who are not influenced by a relationship with the child, but these methods are confined to the children behavior in a novel situation and in response to elicited tasks in a limited period of time (Bates & Bayles, 1984). This can enhance in the children atypical behaviors that usually they do not express in response to everyday situations. Moreover it only catches the infant behavior in a given moment and consequently it is confined to the infant state at that given moment (Strelau, 1983). On the other hand, parents can observe the infant in naturalistic environment across a variety of situations every day (Rothbart & Goldsmith, 1985).

A debate on the validity of parental reports have emerged mainly because although some studies found significant association between parental temperament ratings and observational ratings (either naturalistic or laboratorial) others did not found that association (Stiffer, Willoughby, Towe-Goodman, & the family life project key investigators, 2008). So a critique to this method is the doubtable accuracy of parents as reporters of their sons/daughters temperament. The lack of accuracy may be due to social desirability or other circumstances such as parental emotional characteristics, including anxiety and depression or parental expectancies about their child (Goldsmith & Hewitt, 2003; Mebert, 1991; Seifer, Sameroff, Barrett, & Krafchuk, 1994; Vaughn, Taraldson, Crichton, & Egeland, 1981).

Several studies emerged to understand parental characteristics associated with divergence between parental and observational methods. Early childhood experiences and depression (Forman et al., 2003; Leerkes & Crockenberg, 2003) are highly associated with low concordance between methods. Moreover, parents personality, psychopathology, parental expectancies, and stress are related to temperament ratings,

indicating a possible alteration in the capacity of identifying and interpreting infant behaviors (Goldsmith & Hewitt, 2003; Mebert, 1991; Sameroff, Seifer, & Elias, 1982; Seifer et al., 1994; Vaughn et al., 1981). Although parent report measures do contain some subjective parental components, some studies have demonstrated that they also contain a substantial objective component that enables the accurately assessment of children's individual characteristics (Wachs & Bates, 2001).

Probably the problem of lack of agreement between parents and observers relies in that we are comparing the incomparable. Observers and parents measures are radically different so that observers are usually confined to an artificial situation in a limited period of time, whereas parents have access to the infant behavior in an array of situations within familiar and unfamiliar environments to the child. Eventually, laboratory observations and parental reports serve different purposes, being that parental reports of infant temperament may be more relevant to the understanding of child developmental outcomes. Parental perceptions of infant behavior shape their own behavior and interaction with the infant (Crockenberg & McCluskey, 1986). Considering the importance of parental-infant interaction for infant development, the way parents (mis)interpret infants' cues may be a relevant issue for understanding child development outcomes.

Prenatal Influences on Infant Temperament

Some studies were performed in order to determine prenatal influences on infant temperament. Maternal psychopathology has been the focus of some studies. Maternal anxiety in the third trimester of pregnancy has been related to difficult temperament at 10 weeks and 7 months (Van den Bergh, 1990) and at 4 and 6 months (Austin, Hadzi-Pavlovic, Leader, Saint, & Parker, 2005), and with high cry reactivity at 4 months old (Werner et al., 2007). Depression has been related to higher cry reactivity to novelty at 4 months old (Werner et al., 2007). Antenatal stress was related to problems in adaptation to novelty and to difficult temperament at 3 months (Buitelaar, Huizink, Mulder, de Medina, & Visser, 2003; Huizink, de Medina, Mulder, Visser, & Buitelaar, 2002), while in another study antenatal stress assessed retrospectively was associated with reduced

infant crying at 4 months (Mohler, Parzer, Brunner, Wiebel, & Resch, 2006). Higher prenatal cortisol levels were associated with more crying, fussing and negative facial expressions and difficult temperament (de Weerth, van Hees, & Buitelaar, 2003)

These studies are in concordance with Thomas et al. (1968) arguments on the influence of the intrauterine environment on the biological basis of temperament. A possible explanation for these findings is that maternal psychopathology implies hormonal changes that pass through the placenta and affect the intrauterine environment in which the fetus develops (Gitau, Cameron, Fisk, & Glover, 1998; Glover, Teixeira, Gitau, & Fisk, 1999; Wadhwa, Garite, & Sandman, 2001). According to the fetal programming hypothesis there are specific sensitive periods of development during which adverse environmental factors may influence fetal and child neurobehavioral development and have long term effects on organ size and function or on the set point of different physiological systems (Monk et al., 2004; O'Connor, Heron, Golding, & Glover, 2003; Van den Bergh, Mulder, Mennes, & Glover, 2005). So, according to this hypothesis, the intrauterine environment may affect the prenatal differentiation of the brain structures of the limbic system involved in temperament (Rothbart et al., 1994; Steinmetz, 1994).

Infant Factors, Psychophysiological Functioning and Temperament

The study of the association between infant characteristics and temperament has been focused almost exclusively on prematurity, gender and physiological functioning. Prematurity has been associated with maternal perception of infant temperament in some studies (Hughes, Shults, McGrath, & Medoff-Cooper, 2002; Kerestes, 2005) but not in other studies (Larroque et al., 2005). In the same way, gender was also found to influence paternal and maternal perceptions of infant temperament in some studies (Campbell & Eaton, 1999; Carey & McDevitt, 1978; Eaton & Enns, 1986; Hsu, Soong, Stigler, Hong, & Liang, 1981; Martin, Wisenbaker, Baker, & Huttunen, 1997; Maziade, Boudreault, Thivierge, Caperaa, & Cote, 1984; Parade & Leerkes, 2008; Rothbart, 1988) but not in others (Austin et al., 2005; Bates, 1987; Plomin & DeFries, 1985).

Studies on infant physiological functioning and temperament have provided evidence regarding the association of both basal adrenocortical activity (Gunnar, Mangelsdorf, & Hertsgaad, 1989; Kagan, Reznick, & Snidman, 1987) and cortisol responses (Gunnar et al., 1989; Gunnar, Brodersen, Nachmias, Buss, & Rigatuso, 1996; Ramsay & Lewis, 2003) with temperament.

Hughes et al. (2002) examined the temperamental characteristics of premature infants (born between 24 and 32 weeks of gestation) compared with full-term infants. At 6 weeks (adjusted for prematurity) premature infants were significantly less rhythmic (regular), more distractible (soothable), less approaching (more withdrawing), and less intense than standardized norms for full-term infants. From this data the authors conclude that premature infants may be initially more challenging to their parents.

In a larger sample of 224 infants (120 full-term and 104 low-term), Kerestes (2005) analyzed whether prematurity itself (not accompanied with serious medical risks) interferes with early temperamental dimensions. Mothers reported infant temperament at 6 and 12 months old (corrected for prematurity for premature infants) using the Infant Behavioral Questionnaire. Significant differences were found between groups, regarding the infant activity level: mothers of premature infants reported them as been more active than mothers of full-term infants.

Contrary to the results of previously mentioned authors, Oberklaid, Prior, and Sanson (1986) concluded that prematurity *per se* does not affect observed temperament at 4 to 8 months. The authors assessed the temperament of 126 infants using the Infant Temperament Questionnaire at 4 to 8 months corrected age, and compared the data of the preterm (< 37 weeks gestation) with the term infants (37 to 41 weeks). No significant group differences were found regarding individual dimensions or clinical categories of temperament nor on mothers' global rating of temperament, sociodemographic variables, reported incidence of colic, sleep problems, and excessive crying.

Larroque et al. (2005) also reported that prematurity *per se* does not affect mother´s ratings of infant temperament at 9 months. The sample was composed of 266 singleton very preterm infants born before 29 weeks' gestation and 546 full-term singleton infants. Very preterm infants had a slightly higher dull scale score on the Infant Characteristics Questionnaire (ICQ) than term infants. Nonetheless, this

difference was no longer significant after taking into account the mothers' age, duration of hospitalization, and cerebral lesions. Additionally, very preterm infants with neurological problems were rated by their mothers with higher scores on the dull, unadaptable, and unpredictable scales of the ICQ compared with preterm infants with no neurological problems.

Some studies were carried out with the aim of analyzing gender differences on infant temperament. Austin et al. (2005) in study with 1,562 dyads found no differences between girls and boys between the 4^{th} and 6^{th} month of life on parental reports of infant temperament using the Short Infant Temperament Questionnaire.

Nonetheless, most studies have reported temperamental differences between boys and girls. Martin et al. (1997) studied gender differences in infant temperament at 6 months, measured with the Carey Infant Temperament Questionnaire. The sample was composed of 1,996 dyads. The authors found significant gender differences in infant temperament with girls exhibiting higher levels of distress to novelty, more biological irregularity, and lower threshold (higher distress at wet or soiled diapers) than boys.

Benenson, Philippoussis, and Leeb (1999) examined whether full-term, healthy female and male neonates could be differentiated on cuddliness. The sample was composed of 31 infants (16 female and 15 male) that interacted briefly with a female and a male adult. The degree of cuddliness and activity level was assessed during the interaction. Female infants were found to be significantly cuddlier than male infants.
Eaton and Enns (1986) integrated the results from 90 citations encompassing 127 independent gender differences contrasts and found male infants to be more active compared to female infants. The results of this study match the results of a meta-analytic study of 46 infancy researches performed by Campbell and Eaton (1999) that found that male infants are more active compared with females.

Recently, Parades and Leerkes (2008) found no significant differences in maternal ratings of female vs. male infants, nonetheless, the authors found that fathers' reports of females vs. males infants differed significantly on some dimensions of infant temperament: males have higher scores on smiling/laughter, high intensity pleasure, low intensity pleasure, soothability and falling reactivity scales of the Infant Behavior Questionnaire (IBQ) compared to females.

Other issue in study is the association between the infant physiological functioning, specially the neuroendocrine system, and temperament. The HPA system is activated by endogenous and exogenous stressful stimuli (Gunnar & Donzella, 2001; Shore, 1997), and cortisol is its primary hormonal product in humans (Alink et al., 2008). In response to activation by limbic, cortical and other afferent inputs, the paraventricular nucleus (PVN) of the hypothalamus produces corticotrophin-releasing hormone (CRH). The CRH activates and regulates the production of adrenocorticotrophic hormone (ACTH) by the anterior pituitary, which binds to receptors on adrenocortical cells of the adrenal glands and triggers the production and release of cortisol into the general circulation (Chrousos & Gold, 1992; Gunnar & Davis, 2002). When cortisol secretion reaches a certain level, it binds to glucocorticoid receptors (GRs) distributed throughout the brain. This inhibits the production of CRH, ACTH and cortisol in order to return the system to a pre-stress or basal state (DeKloet, 1991; Sapolsky, Romero, & Munk, 2000).

Research has shown that differences in infant HPA axis functioning may be related to individual differences in temperament. Evidence has been provided regarding both high basal adrenocortical activity and high cortisol responses: the first one is associated with high shyness and inhibition (Kagan et al., 1987) and infants with easy temperament (Gunnar et al., 1989) while the later one is related to high emotionality (Ramsay & Lewis, 2003), proneness to distress (Gunnar et al., 1989) and fearfulness (Talge, Donzella, & Gunnar, 2008).

Kagan et al. (1987) performed a longitudinal study with two groups of infants: inhibited and uninhibited to unfamiliar events. The authors reported that these infants maintained these characteristics from 2/3 years old until they were 6 years old. Furthermore, inhibited children were found to have more sensible limbic and hypothalamic structures to unfamiliarity and challenge.

Gunnar et al. (1989) examined 75 infants at both 9 and 13 months. At 9 months the infant temperament was assessed at home and measures of socio-emotional behavior were obtained. The Louisville Laboratory Temperament Assessment was also used, and saliva samples were collected during the laboratory assessment for cortisol measurement At 13 months the mothers fulfilled the Toddler Temperament Scale. The strange situation procedure was carried out at 13 months. The authors reported that the

infants with more positive emotional temperaments showed less of an increase in salivary cortisol during testing at 9 and 13 months.

Later in 1992, Gunnar et al. performed two experiments involving a separation of a 9 month-old infant and his/her the mother. In the first experiment, the substitute caregiver although sensitive to infants' distress, was busy and noninteractive and in the second experiment the substitute caregiver was warm, responsive and interactive. Thirty eight infants and mothers participated in the study. Saliva samples were collected from the infant before and after separation and mothers completed the IBQ. The authors found that maternal reports of infant distress to limitation (but not report of fearfulness) predict the infant adrenocortical responses to separation.

Talge et al. (2008) analyzed the potential association between physiological stress reactivity and temperamental fearfulness. The sample was composed of 162 preschool-aged children. Salivary samples for cortisol measurement were collected, the risk room paradigm was performed in laboratory and EMG sensors were placed and an emotion-evoking video-clip was shown for 15 minutes. The LabTAB empty box vignette and the LabTAB stranger approach vignette were performed. The results showed that greater cortisol reactivity was associated with fearful temperament.

Parental Factors and Infant Temperament

Parental socio-economical status (Jansen et al., 2009; Parade & Leerkes, 2008; Ventura & Stevenson, 1986) was found to interfere with the perception of infant temperament in some studies but not in others (Austin et al., 2005). Convergence of results regarding parents' depression (McGrath, Records, & Rice, 2008; Sameroff et al., 1982; Vaughn, Bradley, Joffe, Seifer, & Barglow, 1987; Whiffen & Gotlib, 1989), anxiety (Galler, Harrison, Ramsey, Butler, & Forde, 2004) and joint attachment style (Pesonen, Raikkonen Keltikangas-Järvinen, Strandberg, & Jarvenpaa, 2003; Priel & Bresser, 2000; Scher & Mayseless, 1997), influence on the perception of infant temperament was obtained in several studies. Temperament has also been related to maternal physical symptoms, feelings of incompetence, negative reinforcement from the infant and negatively associated with spousal emotional support (Clark, Hyde, Essex, & Klein, 1997).

Ventura and Stevenson (1986) examined the association between parental socioeconomic status and psychological states, birth order, and infant gender and the perception of infant temperament in a sample of 95 parents and their 2 to 3 month old infants. The authors found that parents of families with higher socio-economical status perceived their infants to be more difficult: less soothable and more distressed by limitations than did parents of lower socio-economical status.

Similar findings were obtained in a more recent study by Parade and Leerkes (2008). The authors performed a study on the reliability and validity of the Infant Behavior Questionnaire – Revised (IBQ-R) in a sample of 115 mothers and 79 fathers. Parents completed the IBQ-R and the Center for Epidemiologic Studies-Depression Scale and 98 infants participated in a laboratory assessment of temperament at 1 week and 6 months of life. An association between parents' income and perception of infant temperament was found: mothers with lower socio-economical status perceived their infants as showing more pleasure, perceptual sensitivity and approach while fathers reported more distress to limits. Educational level was also found to be related to the perception of infant temperament: a higher level of education was associated with lower activity level, less smiling/laughter, higher intensity of pleasure and vocal reactivity. Additionally, older mothers perceived their infants as expressing less smiling, less pleasure, less perceptual sensitivity, less approach and vocal reactivity.

Contrasting results were obtained very recently by Jansen et al. (2009) who developed a study in the Netherlands with the aim of analyzing the relationship between socioeconomic status and infant temperament. Sociodemographic characteristics, family stress, maternal psychological well-being, maternal smoking during pregnancy and infant birth weight were studied as potential mediators of this relationship. The sample was composed of 4055 dyads. The socioeconomic status was obtained by questionnaire which included maternal and paternal level of education, family income and maternal professional status. Infant temperament was assessed at 6 months using maternal reports of six scales of the IBQ-R: activity level, distress to limitations, duration of orienting, sadness, fear, and recovery from distress. Lower socioeconomic status was associated with more difficult infant temperament at six months. While the effect of the socioeconomic status on distress to limitations, recovery from distress, and duration of orienting scores could be explained by family stress and maternal psychological well-

being, the effect of the socioeconomic status on activity level, fear and sadness scores could not be explained by those covariates.

Austin et al. (2005) in a study conducted with 1562 dyads, failed to find a relationship between maternal age, education, income, marital status, obstetric complications and infant temperament at 4 and 6 months as measured by the Short Infant Temperament Questionnaire.

A possible explanation for the divergent results of these studies could be cultural differences, the instruments used for measuring temperament and/or the disparity of sample sizes.

Maternal postnatal psychopathology and infant temperament has also been the target of some studies. In 1982, Sameroff et al., performed a study to examine the influence of maternal social status, anxiety level and mental health status in 4 months old infants' temperament measured with the Carey's Infant Temperament Questionnaire. The authors found that mothers' variables explained infant temperament dimensions of rythmicity, adaptability, approach, threshold, intensity and mood.

Whiffen and Gotlib (1989) analyzed among other things the association of postpartum depression with the perception of infant temperament in a sample of 50 mothers (25 depressed and 25 non-depressed) of 2 month-old infants. Depressed mothers perceived their infants as more difficult to care for and more bothersome than did the non-depressed mothers. The infants of the depressed women were less competent cognitively and expressed more negative emotions during the Bayley Scales of Infant Development (BSID) compared to infants of non-depressed mothers.

Pauli–Pott, Mertesacker, and Beckmann (2004) also found that infant's negative emotionality and withdrawal/fear (but not positive emotionality) were significantly predictable from maternal characteristics. This longitudinal study was developed with a sample of 101 dyads and assessments were conducted on infants at the ages of 4, 8, and 12 months. Maternal depression was assessed with the Depression scale of the Questionnaire for Assessing Rearing Attitudes of Mothers of Infants and Toddlers and the Hopelessness Scale; anxiety was assessed with the State-Trait Anxiety Scale (STAI), and the social support of the caregiver was assessed with the Questionnaire of Social Support. The results showed that infants with higher withdrawal/fear at 12

months had mothers that described themselves as more depressed/anxious and as having high social and emotional support when their infants were 4 months old.

In a study conducted with 226 Barbadian mothers and their 0 to 6 months old infants, Galler et al. (2004) examined the relationships between feeding practices, postpartum maternal mood and maternal perceptions of infant temperament. Maternal mood was assessed via Zung Depression and Anxiety Scales and a moral scale, while infant temperament was assessed with the Carey-*R* scales. The authors found that maternal depression and anxiety as well as reports of despair at 6 months after childbirth were significantly associated with their perception of infant temperament. Maternal depressive symptoms were related to reduce infant adaptability and approach, negative mood and an increased sensory threshold. Resistance to change and constancy preference was found in infants of depressed and anxious mothers.

Recently, McGrath et al. (2008) analyzed differences in maternal perceptions of infant temperament in women who were depressed during the third trimester of pregnancy or during months 2 and 6 postpartum with maternal perceptions of infant temperament of non-depressed women. One-hundred-thirty-nine women participated in this longitudinal study. The authors reported that depressed mothers perceived their infants as more difficult at 2 and 6 months compared to non-depressed mothers.

Studies on mothers' attachment style and infant temperament give some support to a directional link between caregivers' characteristics and infant temperament, including the emotional regulation. Additionally adult intimate attachment representations are relevant in a parenting context, and these interpersonal perceptions are associated with joint attachment dynamics between spouses. Scher and Mayseless (1997) performed a longitudinal study with 93 dyads. Mothers reported their infants' temperament at 3 and 9 months and the influence of mothers' attachment concerns to infant negative emotionality was analyzed. Higher negative emotionality at 9 months was related to mothers' concerns and worries about their personal relationships and to maternal avoidance in close relationships. An inverse association was found between mothers' security in close relationships and negative emotionality.

Priel and Besser (2000) examined the influence of first-time mothers' attachment style on infant difficult temperament. The sample was composed of 115 mothers and the

results showed that security of attachment facilitates antenatal attachment and is related to the perception of 4 month-old infants as less difficult.

Pesonen et al. (2003) tested the relationship between maternal and paternal attachment style dimensions of anxiety and avoidance in close relationships and perceptions of their 6 month-old infants' temperament in a sample size of 180 families. Bboth maternal and paternal anxiety and avoidant attachment style dimensions were related to more negative perceptions of the infants' temperament. No significant relationships were found between secure attachment style and more positive perceptions of the infants' temperament. Parental insecure attachment style was related to higher perceptions of infants' fearfulness, distress to limitations and negative reactivity. Additionally, parental perceptions were more positive or less negative when both parents scored low on avoidance. When in a parental dyad one parent had low and the other parent high avoidance, the parental perceptions of infant temperament were more negative or less positive.

All these studies highlight the impact of parental factors on infant temperament. From socio-demographic to psychopathology, passing through attachment issues, these parental characteristics seem to interfere with different infant temperament dimensions.

Temperament Stability

A major empirical issue in research on infant temperament concerns the stability of individual differences (Bates, 1987). Manifestations of temperament change over time as a child develops, with rapid development during infancy (Rothbart, 1989). Some dimensions of temperament tend to increase throughout the first year of life such as positive emotionality (Rothbart, 1989), level of activity, approach, distress to limitations, and fear (Carranza, Perez-Lopez, Gonzalez, & Martinez-Fuentes, 2000; Rothbart, 1986, 1988), while others like attention orienting develop in a U-shaped (Ruff & Rothbart, 1996). Greater stability has been found for aggregated scores, particularly those reflecting difficultness (Belsky, Rovine, & Fish, 1989; Lee & Bates, 1985) or emotionality (Matheny, Riese, & Wilson, 1985; Riese, 1987).

The continuity of classification of a child as temperamentally difficult is of about 50% from 6 to 24 months (Lee & Bates, 1985; McNeil & Persson-Blennow, 1988). Worobey and Blajda (1989) found that the activity level, responsivity, and irritability remained stable from 2 weeks to 2 months as well as from 2 months to 12 months. Nonetheless, stability from 2 weeks to 12 months was only observed in irritability and IBQ ratings generally increased through the 1st year. Proneness to distress in 2 week-old infants accurately predicted difficult temperament at 6 months old (van den Boom, 1989), and Rothbart, Derryberry, and Hershey (2000) found that distress/anger was stable from 3 to 13.5 months old. This rank-order stability, however, is superimposed on the mean-level increases of some aspects of negative emotionality, such as fear and anger, over the first year of life (Carranza et al., 2000; Gartstein & Rothbart, 2003; Rothbart, 1988, 1994). Neonatal distress predicts observed distress at 1, 3 and 4 months old (Birns, Barten, & Bridger, 1969) while distress at 9 months old is associated with lower levels of attentiveness, more variation on activity level and distress at 24 months old (Matheny, Riese, & Wilson, 1985; Riese, 1987).

Because some temperament traits constitute risk factors for psychopathology in later childhood, their developmental determinates are of great interest, and some researchers attempted to answer the question of what are the conditions of continuity and discontinuity in infant temperament.

Washington, Minde, and Goldberg (1986) for example, studied infant temperament in a sample of 74 low-birthweight preterm infants at ages 3, 6, and 12 months via parents' report. Parents underwent a semi-structured psychiatric interview, and observations of the children at home and of mother-infant interactions were made. One of the aims of this study was to analyze the potential interference of mother-infant interaction on infant temperament. The authors found that mother-infant interaction in the 1st year of life is associated with both the style and stability of temperament reports.

Bridgett et al. (2009) studied the developmental trajectories of infant negative emotions and regulatory capacity from ages 4 to 12 months as well as the maternal and family factors that may affect those trajectories. Mother's reports of infant temperament were completed using the IBQ at 4, 6, 8, 10, and 12 months old in a sample of 156 families. At 4 months measures of maternal relationship stress (spouse scale of the Parenting Stress Index), depression (Beck Depression Inventory-II), and family

demographics were also completed. The authors found that maternal relationship stress and depression influence the infants' negative emotional development. Higher levels of relationship stress are associated with elevated initial levels of negative emotionality. Furthermore more intense/frequent maternal depressive symptoms at 4 months old are associated with higher increases on negative emotionality between 4 and 12 months.

Matheny (1986) also reported that infants, who became less negative, more attentive, and more socially oriented from 12 to 24 months, came from more emotionally cohesive families and had mothers who were more expressive and involved with them.

Engfer (1986) discovered that mothers perceiving their infants as becoming more difficult between 4 and 18 months were less sensitive and experienced more marital problems, while mothers perceiving their infants as becoming less difficult were more relaxed, optimistic and less irritable.

These studies demonstrate the environmental influences on infant temperament continuity claimed in several theories of temperament including Thomas et al. (1968) and Rothbart & Derryberry (1981) theories. The results of these researches show that familiar environment and maternal psychopathology are major factors that interfere in the trajectory of child temperament continuity/discontinuity, and that this relationship may be mediated by negative parenting or patterns of mother/father-infant interaction.

Temperament and Child Development Outcomes

Studies conducted in order to identify temperament dimensions as potential risk factors for developmental outcomes have shown that temperament traits are related to child developmental problems such as psychomotor and mental development (Gorman, Lourie, & Choudhury, 2001), attachment security (Coffman, Levitt, & Guacci-Franco, 1995; Seifer, Schiller, Sameroff, Resnick, & Riordan, 1996; Susman-Stillman, Kalkoske, Egeland, & Waldman, 1996), internalization/externalization behavior problems (Bates, Maslin, & Frankel, 1985; Biederman et al., 2001), hyperactivity (Wolke, Rizzo, & Woods, 2002), depression (Clark, Watson, & Mineka, 1994; Gartstein & Bateman, 2008; Watson & Clark, 1984), anxiety disorders (Biederman et

al., 1993; Biederman et al., 2001; Kagan & Snidman, 1999; Kagan, Snidman, McManis, & Woodward, 2001) and conduct problems (Lahey et al., 2008).

Bates et al. (1985) found that frequent and intense negative affect in infants and toddlers predicted externalizing and internalizing problems from the preschool to middle-childhood periods. Early negative reactivity to novel situations (i.e. fear) predicted internalizing problems, such as depression, more so than externalizing problems, whereas early resistance to control predicted externalizing problems over internalizing difficulties.

Caspi (2000) noted that children who were observed to be shy, fearful, and socially ill at ease at three years old tended to experience internalizing problems later. Positive affectivity, or extroversion, which includes positive emotionality, energy, affiliation, and dominance traits, has been described as inversely related to depression in adults (Clark et al., 1994).

Gartstein and Bateman (2008) conducted a longitudinal study aimed at understanding the influence of infant temperament and maternal depression on toddler depressive problems. The results of this study show an association between low negative affectivity in infancy and low levels of parental depressive symptoms and attenuated early manifestations of depression. Furthermore, high levels of negative emotionality were associated to high levels of depression-like symptoms as toddlers, independently of parental levels of depression.

Higher negative emotionality and reduced regulatory abilities later in life (i.e. beyond the 2nd year) are related to increased risk of internalizing and externalizing behavioral difficulties, such as aggression, oppositional behavior, depression, and anxiety (Anthony, Lonigan, Hooe, & Phillips, 2002; Eisenberg et al., 2001; Gartstein & Fagot, 2003; Jacques & Mash, 2004).

Lengua (2006) also found that increases in fear over time lead to subsequent internalizing and externalizing difficulties. Kagan and Snidman (1991, 1999) demonstrated a link between infants' high levels of behavioral inhibition and anxiety disorders in childhood and adolescence; and hyperactivity in the amygdale. Sanson, Prior, Oberklaid, and Smart (1998) have also identified continuities between infant and toddler difficult temperament and subsequent psychosocial adjustment in late childhood.

Susman-Stillman et al. (1996) analyzed the influence of infant characteristics and maternal sensitivity on attachment security. Results showed that maternal sensitivity predicted infant attachment security while temperament predicted the type of insecure attachment as well as subcategory classification.

Mangelsdorf, McHales, Diener, Goldstein, and Lehn (2000) reported that infant temperament at 8 months is associated with attachment style at 12 months. Higher activity level and distress to novelty is associated with insecure attachment style, whereas lower positive affect and higher fearfulness is associated with avoidance.

All these studies give empirical evidence for the idea that temperament plays a role in both attachment security and subsequent mental health outcomes.

In this chapter we had the opportunity to see that independently of the temperament theory, temperament is considered to have developmentally early, biologic roots. It refers to individual differences and is conceived not as a trait itself but as a group of related traits that reflect individual behavioral tendencies (Goldsmith et al., 1987). Almost completely agreement exists that temperament dimensions may change over time, and that temperament is a component of personality. Research developed in this field has shown that prenatal factors influence infant temperament, namely maternal psychopathology and hormonal levels, which has given empirical support not only to the notion of early biological roots of temperament, but also to the role of intrauterine environment on the biological basis of temperament (O'Connor et al., 2003). This may happen by influencing the development of brain structures involved in temperament (Rothbart et al., 1994). Additional evidence has been reported regarding the influence of infant factors such as prematurity and gender on infant temperament and of parental factors such as psychopathology and attachment. Finally studies have pointed out the environmental influences as well as the role of mother/father-infant interaction on infant temperament development in the first years of life.

The major contribution we intend to provide with this study relies on adding evidence regarding the impact of individual differences present early in life, considering the infant psychological and physiological characteristics, on the mother perception of infant temperament. Furthermore, it intends to provide additional knowledge regarding

not only mother-infant interaction on the development of infant temperament but also the role of early psychophysiological differences on that process.

CHAPTER 2

MOTHER-INFANT INTERACTION

In this chapter infants' socio-emotional development is discussed in the context of mother-infant interaction. Special features of parent-child relationships as bidirectional and co-constructed processes are addressed. Consideration is given to the child's contribution with emphasis placed on her/his active role in the interaction. Issues of definition and conceptualization are discussed. The focus throughout the chapter is mainly on parent-child relationships, from birth to 12 months old, and the factors of the broader social context that may influence its quality. Additional attention is given to the influence of early mother-infant interaction on child developmental outcomes. Of particular interest are the potential effects of infant neurodevelopment and temperament on the evolving mother–infant relationship, and alternately, the effects of mother interaction patterns on infant neurobehavior development.

> "The mother, we believe, is right. The infant, though telling her nothing, *is* speaking to her."
> (Trevarthen, 1979, p.346)

Infant developmental processes occur within an array of a large and diverse social network. As such, the feature of sociability is crucial for an optimal adaptation to the environment. There is evidence that infants' sensory and cognitive competencies focus mainly on making sense of their social environment, suggesting that the infant skills and biological structures, including the sensory processes, are at the service of adaptation (Lewis, 1987). From birth infants possess capacities for interacting with the world and have skills for obtaining information about the environment. These capacities include reflexes, motor skills, perceptual abilities and learning abilities that help them to survive and adapt to their new out-of-uterus environment (Stern, 1985, Field, 1990). A range of sensory abilities that detect stimuli coming from the environment are available from birth. The level of functioning of the visual system at birth is still controverse, nonetheless, visual preferences at birth were identified: patterned (vs. nonpatterned), moving (vs. stationary), high contrast (vs. low contrast) and three dimensional (vs. two dimensional) stimuli (Slater, 1995). The visual acuity improves in the first year: infants are attracted to animated and inanimate objects, show visual preferences, can access to contrast, contour and motion and are quite competent at following moving objects with their eyes (Johnson, 2000). They are also able to discriminate odors and human speech sounds from other sounds and distinct languages, additionally they can hear and turn to the source of noise (Owens, 1992). Furthermore, the newborn exhibits preference by their mothers's breast pad (Cernack & Porter, 1985; MacFarlane, 1975), face and voice (DeCasper & Spence, 1986; Field, 1990).

The vast majority of babies do not have to learn to be social, because the sensory abilities described earlier predispose them to be responsive to voices, faces and touches of their parents. Newborn infants are equipped with predispositions to become participant in early social exchanges, provided that their caregiver is responsive (Stern, 1985, Field, 1990). The innate preverbal communicative abilities to express their emotional and physiological needs to others, to feel attracted to and actively seek social stimuli are examples of those predispositions (Grossman, 2000). Early social

expressions are the baby fussing or crying that occurs whenever there is internal distress due to hunger, cold, pain or overstimulation (Paul, 1997). Newborns' cries are purely reflexive; nonetheless they become precursors of a social sign because they move the caregiver to respond to the infants needs (Barr, Hopkins, & Green, 2000). Another predisposition is the ability to detect and respond to contingencies in the environment; for example they can note that their smile produces certain events such as maternal attention or vocalization (Shaffer, 1994). The newborn also feels attracted to social stimuli; their visual system is very sensitive to the stimulation that a human face provides, namely because of the dark/light contrasts and the movement. Finally, babies tend to adapt to the kind of caregiving they receive. So the newborn baby seems to have a range of tendencies and abilities that prepare them to enter the social world rapidly; he is exquisitely attuned to becoming social (Sroufe, Cooper, & DeHart, 1996).

The developmental course of these skills is guided by the conjoint work of heredity and environment. Both heredity and environment contribute to the rapid development that occurs in the cerebral cortex (the control center of many abilities such as voluntary movements, perception, communication, problem solving and thought) in the first months of life. Experience is an important ingredient in the developing organization of the nervous system, but on the other hand the nervous system development is constrained by infants' capacities (Sroufe et al., 1996).

The notion that infants are capable of organized, spontaneous behavior very early in life has important implications for the study of early social behavior and dyadic interaction. The mother's task in the interaction with the infant is to fit her behavior to and already existing organization. Even the earliest interactions two-way affairs in which mutual interchanges are constantly occurring (Shaffer, 1994). For a long time research in the area of parent-child relationship was conceived as the study of the effect of certain parental behaviors or attitudes upon the child. Conceptualizing parent-child relationships as an interactive process has influenced psychological thinking and research strategy. The parent-infant interaction can be interpreted in terms of parent influencing the child or the child influencing the parent, but the degree of mutual influence going on is also relevant (Martin, 1975).

Both maturation and experiences shape the interactions that develop between infants and their caregivers. During interaction both baby and adult are acting on each other in a mutual and reciprocal way, consequently the characteristics of both contribute to the quality of interaction (Slentz & Krogh, 2001). Over the first few months of life, true social interactions emerge involving mutual exchanges or reciprocity between intervenient. The baby's ability to stay alert for longer periods of time increases over time, during which he/she actively engages with the environment. The ability to control attention, coordinate looking and reaching, and turn toward or away from stimuli voluntarily also develops over time. Additionally, babies learn to complement attentive looking with smiles, coos, and actions. In light of these developmental changes, parents can construct longer and more complex chains of interaction with their infants. A sensitive caregiving style is characterized by the parent's ability to fit his/her behavior to the perceived wants and needs of the infant. Reciprocity in social interaction develops gradually as the caregiver becomes aware of the baby's needs and feelings and responds to them promptly and adequately in a sensitive manner. Over time, the infant becomes able to anticipate other actions and deliberately seek them out. They are now partners in a social give-and-take (Sroufe et al., 1996).

Although young infants are equipped with an impressive set of competencies at birth, they still have a considerable task ahead to reach full social status. One of the tasks is to gain the concept of dialogue, through reciprocity and of intentionality. Reciprocity is the role played by the infant in the interaction, whereas intentionality develops with the infants' realization that his behavior has communicative value and that it can be used with the purpose of affecting the behavior of others and to elicit the desired response (Schaffer, 1979).

In the second half of the first year of life developmental changes are even more dramatic. Complex emotions such as joy, anger, fear, or surprise emerge. Stranger distress reactions and separation distress when the primary caregiver temporarily leaves as well as joyous greetings when the caregiver returns become evident. These emotional reactions indicate that the caregiver has become linked to very special and positive feelings (Sroufe et al., 1996).

Of the various contexts in which mother-infant interaction commonly takes place, the face-to-face situation has been the focus of most recent research. Microanalytic studies, based on frame-by-frame analysis of film records, clearly show that maternal sensitivity to the infants' behavioral cues is essential for successful pacing of face-to-face interaction (Craig, 2000).

Chappell and Sander (1979) developed a pioneering exploration of the mechanisms involved in the initial organization of the infant-caregiver system at the immediate post-natal period. The sample was composed of 4 mothers and their female infants. The observations of each infant first full awake period after 8 a.m. on days 2, 5, 6, and 8 and of each infant second full awake period on days 2, 5, 6 and 7 were reported. The authors investigated the change in the infant-caregiver system over the first week of life and found that significant changes occur in the organization of the interactions during that period. In this setting, infants showed significant increases in alertness over days, and, concomitant with the increased alertness, close maternal holding and verbalization co-occurred with alertness increasingly across the week. This provides more frequent opportunity for close face-to-face interaction and facilitates perceptual and affective development in the infant. Furthermore, the authors observed that an increasing coordination of activities developed between infant alertness and maternal behaviors.

Tronick, Als, and Adamson (1979) attempted to understand the structure of the mother-infant communication process using the face-to-face interaction. The sample was composed of 12 mothers and their infants. The authors identified 5 dyadic phases of the mother-infant interaction: (1) initiation, (2) mutual orientation, (3) greeting, (4) play-dialogue and (5) disengagement. Initiation happens either when mother's faces brightens and talks to the baby or when baby vocalizes and smiles to the caregiver. Mutual orientation takes place with neutral or bright faces, with the caregiver talking or the infant making isolated sounds. When mutual smiles and eye contact are observed we are faced with greeting. The play-dialogues occur when the caregiver talks and the infant vocalizes during the pauses. Disengagement may happen when one partner is still oriented and the other looks away. Each one of these phases reflects the current state of communication and the intent of the partners.

Trevarthen's (1979) work lead him to conclude that a complex form of mutual understanding develops even in only 2 and 3 months old infants, which is both naturally accepted and strongly regulated by the infant. Two months-old infants exhibit many different expressions, some highly emotional, and make a variety of attempts to gain the lead in an exchange with another person. They are also sensitive to subtle differences in the mother's expression. The dependent acts of the mother show that she is adapting to the infant, and apparently each pair develops a unique style of communication and a private code. The author developed the concepts of subjectivity and intersubjectivity. He argues that infants are able to exhibit to others at least the rudiments of individual consciousness and intentionality (subjectivity) and, are also able to adapt or fit this subjective control to the subjectivity of others in order to communicate (intersubjectivity).

These studies on patterns of mother-infant interaction lead to the emergence of models in the development of early interactions. The attunement model (Field, 1985, 1989) and the mutual regulation model (Tronick, 1989) both stress that mothers and infants regulate their interactions by contingently responding to each other's behaviors. The mutual regulation model (MRM) sees infants as part of a dyadic communicative system in which the infant and adult mutually regulate and scaffold their engagement with each other and the world by communicating their intentions and responding to them. It sees humans as complex systems, as hierarchical multileveled psychobiological systems that constantly work to gain energy and meaningful information to make sense of their place in the world. This sense-of-oneself in the world equals the totality of meanings, purposes, intentions, and biological goals operating in every moment on every component and process at every level of the system from molecules to awareness. The MRM postulates that infants have self-organizing neurobehavioral capacities that operate to organize behavioral states (from sleep to alertness) and biopsychological processes (e. g. self-regulation of arousal, selective attention, learning and memory, social engagement and communication, neuroception, and acting purposefully in the world) that they use for making sense of themselves and their place in the world. Despite these impressive abilities, infants' competencies clearly have limits. So, an infant can be viewed as a sub-system within a larger dyadic regulatory system that also comprises of another sub-system: the caregiver. This larger system functions to scaffold

the infants' limited regulatory strategies. Mother and infant have an interactive goal and a set of skills to help attain the goal. Their goal is to achieve a state of mutual regulation or reciprocity, and in order to attain it they jointly regulate the interaction with interactive behaviors. Regulation was accomplished by the infants' communication of its regulatory status to the caregiver, who responded to the meaning of the communication. The organization of the infant-mother interaction seemed clear: It was bidirectional, synchronous, and coordinated.

Nonetheless, in many interactions between the infant and the adult a lack of coordination is observed for the most part of the time. This mismatch of the affective states and relational intentions occurs when infant and adult convey non-matching meanings. Re-achieving a matching state from a non-matching state is a mutually regulated reparatory process.

The MRM claims that the infant affective responses have an important interpersonal function and that the intervenient have a goal of achieving a state of reciprocity, it emphasizes that such a state is not always achieved. Imperfection occurs for a number of reasons: mistimed behavior, a misreading by one partner of the other partner's signals, producing behavior that does not match the expectation of the other partner's signals; differences in each partner's immediate goal; or the older partner's attempt to encourage the infant to expand his capabilities (Tronick, Als, Adamson, Wise, & Brazelton, 1978). The MRM takes account of the imperfections inherent in the interactive process by proposing that a "normal disruption" – referred to here as a mismatch (Stern, 1977; Als, Tronick, & Brazelton, 1980) motivates the infant to adjust to it or modify it by employing his interactive skills. To do this the infant employs the same affective displays and interactive behaviors that allow him to initiate, modify, and maintain the well-regulated interaction, since this will also enable him to repair, avoid, or terminate a mismatched exchange.

Infant and mother affective communicative capacities make mutually coordinated infant-adult interactions possible. Researchers have typically talked about mother-infant interaction in terms of synchrony, reciprocity, matching, coherence and attunement. These terms are attempts to capture the quality of the interaction when it is going well. Nonetheless, Tronick (2007) argues that infants were in social play only 15% of the observation time at 3 months, 13% at 6 months, and 25% at 9 months.

Additionally, the proportion of time that infants and mothers were in matching behavioral states were 28% at 3 months, 30% at 6 months and 34% at 9 months. Infants and mothers spend a large amount of time not displaying positive emotions and in 70% of the time that mothers and infants are not in matching state they are not in synchrony. These mismatches stress the infant by generating negative emotions, but the infant has coping behaviors for repairing them to turn a mismatch into a match and the negative emotions into positive emotions. Developmentally, the experience of repairing these mismatches has several positive benefits for the infant. First, the infants' sense of effectiveness or mastery is increased. Second, his coping capacities are elaborated. With the reiteration and accumulation of the experience of successfully repairing mismatches in his daily interactions with his mother, the infant internalizes a pattern of interactive coping that he brings to interactions with other partners. Indeed, according to the extent that the infant successfully copes with these mismatches, will he experience positive emotions and establish a positive affective core. However, the infant who employs his coping strategies unsuccessfully and repeatedly fails to repair mismatches will begin to feel helpless. This infant eventually gives up attempting to repair the mismatches and increasingly focuses his coping behavior on self-regulation in order to control the negative emotion generated.

Gianino (1982, in Tronick, 2007) described six coping behaviors: (1) signals to mother in order to modify her behavior, (2) alternate focus to something other than the mother, (3) self-comforting stimulation with own body or object, (4) withdrawal from social engagement using motor, attention and perceptual processes, (5) escape physical contact with mother, (6) avert/scan occurs when the infant looks away from the mother without successfully focusing attention to something else. Mismatches causes stress and stress may occur for several reasons – mistiming of emotional signals, unclear signals, misreading signals, differences in goals and overloading and underloading of stimulation. These stresses occur because it is impossible for mother or infant to maintain mutual regulation over the course of an entire interaction. These stresses are normal, typical and inherent to an interaction.

Gianino and Tronick (1988) argue that the normal, often-occurring miscoordinated interactive state is an interactive error, and that the transition from this miscoordinated state to a coordinated state is an interactive repair. The achievement of a coordinated state successfully fulfills the infants' interactive goal and engenders

positive affect, whereas an interactive error fails to fulfill that goal and engenders negative affect. In normal interactions, the infant experiences periods of interactive success and interactive error with frequent reparations of those errors. Emotionally, the infant experiences periods of positive affect and negative affect and frequent transformations of negative to positive affect; hence, experiences of negative emotion are brief. In abnormal interactions, the infant experiences prolonged periods of interactive failure and negative affect, few interactive repairs, and few transformations of negative to positive affect. Gianino and Tronick also noted that the experience of success and reparation of interactive errors and negative affect that typifies normal interactions has several developmentally enhancing affects that lead to positive outcomes. The experience of interactive reparation and the transformation of negative affect into positive affect allow the infant to elaborate his or her other-directed affective communication and self-directed regulatory capacities and to use them more effectively, that is, to be able to maintain engagement with the external environment in the face of stress (Tronick, 1989). With the accumulation of success in reparation, the infant develops a representation of himself or herself as effective, of his or her interactions as positive and reparable, and of the caretaker as reliable and trustworthy. These infants, on the basis of their experience of normal interactions, have a representation of the interaction as reparable and of themselves as effective in making that repair. Infants who experience few repairs are less likely to solicit their mothers and more likely to turn away and become distressed. By contrast, in abnormal interactions the chronic experience of failure, non-reparation, and negative affect has several detrimental effects on developmental outcome. The infant establishes a self-directed style of regulatory behavior to control negative affect and its disruptive effects on goal-directed behavior (Tronick, 2007). Furthermore, regulation of negative affect becomes the infants' primary goal and preempts other possible goals. This self-directed style of regulatory behavior precludes the infants' involvement with objects, potentially compromising cognitive development, and distorts the infants' interactions with other people. With the reiteration and accumulation of failure and non-reparation, the infant develops a representation of himself or herself as ineffective and of the caretaker as unreliable (Tronick, 1989, 2007). From this perspective the pathways leading to varieties of normality and psychopathology derive from the divergent experiences infants have with success, reparation of failure, and the transformation of negative emotions into positive

emotions. These experiences may constitute the origins of a developmental trajectory for insecure vs. secure attachments.

The relationship established between the infant and the caregiver is the earliest and closest among the many relationships that individuals experience throughout their life. These interactions are central to the lives of both parents and infants, and provide one of the most important environments in which children develop as individuals and as a member of their culture (Russell, Mize, & Bissaker, 2002). When discussing parent-child relationships, attention must be directed to the individuals as participants in the relationship, to the interpersonal aspects of the relationship, and to the broader social context and systems that influence parent-child relationships. Parent-child relationships are complex and multidimensional. They vary over time, differ from the perspective of the parent and of the child, and differ from one situation to another, and so on. Interaction problems at this time are associated with later developmental difficulties and attachment organization (Evans & Porter, 2009).

The idea that both mother and infant characteristics influence the quality of their behavior in the interaction is consistent with a transactional model of development (Bell, 1974; Sameroff, 1975). From the transactional perspective, infants and caretakers characteristics exert a mutual and reciprocal influence, leading to unique patterns of behavior. Further focus will be placed on the infant and parental characteristics that have been considered in recent research studies and the impact of those characteristics on the quality of mother-infant interaction.

Infant Factors and Mother-Infant Interaction

Research on the influence of infant characteristics on the quality of mother-infant interaction has been showing the impact of several dimensions including perinatal risk (Muller-Nix, Forcada-Guex, Pierrehumbert, Jaunin, Borghini, & Ansermet, 2004) neurobehavior (Murray, Stanley, Hooper, King, & Fiori-Cowley, 1996), prematurity (Feldman & Eidelman, 2007; Murray et al., 1996), twins (Feldman & Eidelman, 2004), neonatal behavior (e.g. Nugent, Greene, Wieczorek-Deering, Mazor, Hendler, & Bombardier, 1993), infant temperament (Campbell, 1979; van den Boom & Hoeksma,

1994), adrenocortical response to stimuli (e.g. Kerbel, Mertasacker, & Pauli-Pott, 2004) and infant withdrawal (e.g. Puura, Guedeney, Mantymaa, & Tamminen, 2007).

Prematurity has been the focus of study of several investigators. Crnic, Ragozin, Greenberg, Robinson, and Basham (1983) studied the social interaction and developmental competence of preterm and full-term infants during the first year of life. The psychosocial functioning of the families was assessed at 1 and 8 months by interview. In addition, infant developmental assessments were performed at 4 and 12 months, and mother-infant interactions were observed at 4, 8, and 12 months. Significant differences were found in mother-infant interaction in preterm compared to term dyads across the first year of life. Furthermore, preterm infants performed significantly worse than full-term infants on measures of cognitive and language development.

Schermann-Eizirik, Hagekull, Bohlin, Persson, and Sedin (1997) examined the effects of preterm birth and the perinatal infant health condition on mother-infant interactions in a sample of 278 dyads. The sample was divided into four groups according to infants' gestational age at birth and health status: group 1, 23-31 weeks; group 2, 32-36 weeks; group 3, 37-42 weeks in need of neonatal intensive care; and group 4, a control group of healthy full-term infants. The infants were observed during undressing of the infant and face-to-face interaction at 2, 4 and 6 months of infants' corrected age. No significant differences on interactional behavior were identified between preterm (group 1 and 2) and healthy term infants (group 4). A negative effect of health problems in full-term infants on maternal and infant interactive behavior and on stability of interactive behaviors was observed.

Feldman and Eidelman (2007) compared the association between maternal postpartum behavior and the emergence of parent-infant relatedness as a function of infant autonomic maturity in 56 premature dyads (1000g<birthweight<1500g) and 52 full-term dyads. In the neonatal period maternal behavior, mother depressive symptoms, and infant cardiac vagal tone were evaluated. At 3 months, infant-mother and infant-father synchrony, maternal and paternal affectionate touch, and the home environment were observed. The authors reported an association between prematurity and higher maternal depression, less maternal behaviors, decreased infant alertness, lower coordination of maternal behavior with infant alertness in the neonatal period, and with

lower synchrony in mother-infant and father-infant interaction. Additionally, preterm infants with low vagal tone have the lowest amounts of maternal behavior in the postpartum and the least maternal touch at 3 months. Cardiac vagal tone and maternal postpartum behavior predicted infant-mother and infant-father synchrony in both the preterm and full-term groups. In the preterm group, maternal depression (mother only) and the home environment (mother and father) are also predictive of parent-infant synchrony.

Muller-Nix et al. (2004) examined the relationship of the quality of mother-infant interaction with both infant perinatal risk factors (Perinatal Risk Inventory) and maternal perinatal traumatic experience (Perinatal Posttraumatic Stress Disorder Questionnaire). A sample of 47 preterm infants dyads (Gestational age<34 weeks) and 25 full-term infants dyads was recorded during a play interaction in infants at 6 and 18 months old. The Care Index was used to assess the quality of interaction. In this instrument maternal interactional characteristics were rated according to sensitivity, control and unresponsiveness and infants' interactional characteristics were rated according to cooperation, compliance-compulsiveness, difficulty and passivity. Mothers of high-risk infants and mothers who had experienced traumatic stress in the perinatal period were less sensitive and more controlling at 6 months. At 18 months old the interactional behavior of the preterm infant differed from that of the full-term infant, and was correlated with maternal traumatic stress but not with perinatal risk factors.

Some studies focused on the effect of multiple gestations on the quality of mother-infant interaction. Feldman and Eidelman (2004), for example, noted lower parent-infant synchrony at 3 months for triplets compared to twins or singletons.

Neurobehavior at birth can influence mother-infant interaction as it is reported by the following studies. Nugent et al. (1993) studied the relationship between neonatal behavior and the quality of mother-infant interaction and found that the orientation and range of state clusters of the NBAS were the best predictors of mother-child play.

Murray et al. (1996) studied a group of infants of primiparous women with high (N=188) and low (N=43) risk for developing postnatal depression. The Standard Obstetric Optimality Scoring System was used to obtain detailed information on the

pregnancy, labour and delivery and the infant's status at birth. The Maternity Blues scale was completed on the third day after childbirth and the Mother and Baby Scale was administered when the infants were one week old. The Neonatal Behavioral Assessment Scale was performed between the day 10 and 15 postpartum, and at that time the Structured Clinical Interview for DSM-III-R was used to interview the mothers. The authors noted that poor motor scores and high levels of infant irritability in the neonatal period predicted worse infant behavior in face-to-face interactions with the mother at two months postpartum, although it did not predict the quality of maternal behavior in interaction with the infant.

Temperament has also received some attention from researchers. Campbell (1979) reported that mothers of 4 month-old difficult infants had less contact with them at 8 months, even when the infants were no longer perceived as difficult. Nonetheless, infant temperament ratings at 4 months may be affected by maternal behavior, confounding the causal direction of that relationship.

van den Boom and Hoeaksma (1994) examined similarities and differences in the change in mother-infant interactive behavior in infants with high vs. low negative emotionality. They found that irritable infants display less positive social behavior and are more interested in their surroundings than non-irritable infants, suggesting that irritable are more passive than non-irritable babies. Irritable infants start off with a high level of fussing and crying that decreases gradually during the first 6 months, while non-irritable infants almost never cry during the first few months, but later on they show a slight increase. Differences between the groups are also evident with regard to maternal interactive behavior: maternal interactive behavior toward irritable infants is characterized by less visual and physical involvement from the outset, a very low level of effective stimulation, and rapidly decreasing relief of distress, and low responsiveness to positive infant signals.

The association between infant's adrenocortical activity and maternal behavior has been reported in stressfull and non-stressfull situations. Spangler, Schieche, Ilg, Maier, and Ackerman (1994) discovered that intrusive, non-sensitive caregiver behavior was associated with heightened adrenocortical activity in 3, 4 and 6 month old infants during free play with their parents at home and in a laboratory playroom.

However, Lewis and Ramsay (1999) performed two longitudinal studies with 55 and 74 infants with 2 to 6 months old. The first study analyzed the relation between maternal soothing after inoculation and infant cortisol and behavioral reactions to this stressor. The second study examined the association between maternal soothing in everyday situations and after inoculation and stress responses. Saliva samples were collected at 2, 4 and 6 months old while attending to routine inoculation. The first sample was collected short after arriving to the pediatric office, while the second sample was collected 20 minutes after inoculation. The infant behavioral response after inoculation was observed, namely vocal and facial expression, while maternal soothing was rated. The results show no evidence that maternal soothing during inoculation and/or everyday distress was associated with infant cortisol and behavioral stress responses. The authors conclude that maternal soothing alone is not sufficient to explain individual differences in cortisol and behavioral stress responses.

Haley and Stansbury (2003) examined the infant's response and recovery from a social distressing event (modified still-face procedure). Forty three infants with 5 to 6 months old participated in this study. The authors noted that parental responsiveness was related to greater emotional and physiological recovery during an experimental laboratory stressor. The authors conclude that infants of more responsive parents have better regulation than infants of less responsive parents, namely considering heart rate and negative affect. Kerbel et al. (2004) also found that infants with lower adrenocortical response to a stress induced situation had more sensitive mothers. These findings suggest important links between parent behavior and infant stress reactivity and regulation.

Albers, Riksen-Walraven, Sweep, and deWeerth (2008) explored the association between 3-month-olds' cortisol responses (reactivity and recovery) to being taken out of the bath and the quality of maternal behavior as observed over the bathing episode. The participants were 64 infants (34 boys and 30 girls) and their mothers. Maternal behavior, namely sensitivity and cooperation towards the infant during the bathing routine was rated from videotapes. Salivary cortisol was obtained from the infants during the bath routine in three distinct moments: before the bathing (pre-stressor), 25 minutes (post-stressor reactivity) and 40 minutes (post-stressor recovery) after the infants were taken out of the bath. The authors reported that there was no association between the quality of maternal behavior and the infant cortisol reactivity to the bath

routine. This shows that regardless the quality of maternal behavior there is an adrenocortical response. When recovery was considered, the results showed that the higher the quality of maternal behavior the better the cortisol recovery from the stressor. Thus, infants of less sensitive and more intrusive mothers retained higher cortisol levels for a longer period of time after the stressor. Insensitivity and intrusiveness may constitute an obstacle to the external regulation of the infants' adrenocortical responses. Sensitive and non-intrusive caregiving is more effective in reducing the infants' discomfort or distress, and this might have an indirect effect in helping the child regulate the cortisol response. This study alerts for the fact that although the mother can't prevent an adrenocortical response, her behavior can help the infant to recover from cortisol increases. These findings indicate the potential importance of social processes for physiological recovery from stressful situations in infants.

In one study the association between infant social withdrawal and the quality of mother-infant interaction was reported (Puura et al., 2007). One hundred and twenty seven dyads participated in the study. An initial semi-structured interview was performed and mother-infant interaction was assessed when the infants were 8 to 11 weeks old. At this time, the infant social behavior was evaluated using the Alarm Distress Baby Scale. The authors noted that infant deviant ratings on the quality of eye contact between the infant and the caregiver and on the assessment of the sense of relationship between the infant and the caregiver, were the items most strongly associated with poor interaction skills of the infant on the mother-infant interaction. Furthermore, mothers of withdrawn infants performed more poorly in the interaction with their infants when compared to mothers of non-withdrawn infants.

Parental Factors and Mother-Infant Interaction

Studies on parental characteristics affecting the quality of mother-infant interaction have demonstrated the differential effect of several circumstances including parity (Dunn, 1977; Thomas, Barnett, & Leiderman, 1971; Thomas, Barnett, Leiderman, & Turner, 1970), antenatal maternal representations (Thun-Hohenstein, Wienerroither, Schreuer, Seim, & Wienerroither, 2008), risk of physical abuse (Cerezo, Pons-Salvador, & Trenado, 2008) and maternal mental health, namely depression

(Boyd, Zayas, & McKee, 2006; Herrera, Reissland, & Sheperd, 2004), anxiety (Nicol-Harper, Harvey, & Stein, 2007), psychotic disorders (Riordan, Appleby, & Faragher, 1999) and personality disorders (Newman, Stevenson, Bergman, & Boyce, 2007).

Parity studies report that mothers of firstborn babies tended to stick more closely to feeding schedules, and their babies cried more (Dunn, 1977). Mothers of first-borns spent more time feeding their infants and stimulated them more (Jacobs & Moss, 1976; Lewis & Kreitzberg, 1979), nonetheless they are less responsive to their infants' cues (Thoman, Barnett, & Leiderman, 1971; Thomas, Barnett, Leiderman, & Turner, 1970).

Antenatal maternal mental representations about the child were also found to be predictive of the quality of mother-infant interaction at three months after birth, in a recent study (Thun-Hohenstein et al., 2008). Although antenatal representations about the child did not predict maternal interactive behavior, it was predictive of the overall maternal regulatory ability, the infants' overall eye-contact as well as infants' interaction readiness during the still-face period. Antenatal maternal representations about the child also predicted parental regulatory ability and infant interaction behavior especially during the still-face period.

Risk of physical abuse can interfere with the quality of mother-infant-interaction. Cerezo et al. (2008) reported that high-risk mothers were less sensitive, more intrusive and less discriminate on their infants' behavior. Additionally, high-risk mothers' infants were significantly more likely to develop insecure attachment.

Disturbances of dyadic interaction in the case of maternal postpartum depression are well documented (Gunning et al, 2004; Weinberg & Tronick, 1998; Murray & Cooper, 1997a, 1997b; Field, Healy, Goldstein, & Guthertz, 1990). Depressive mothers behavior towards their infants is often described as passive, unresponsive or intrusive: mothers express less emotional involvement or interest and more negative feelings or antagonism (Reck et al, 2004). Beck (1995) performed a meta-analysis of 19 studies to determine the magnitude of the effect of maternal postpartum depression on maternal-infant interaction in the first year of life. The results of the study indicate that postpartum depression has a moderate to large negative effect on the quality of

maternal-infant interaction. Figueiredo (1996) reported that depressed mothers and their infants were less adequate in the interaction compared to non-depressed mothers and their infants. Boyd et al. (2006) discovered that infants of depressed mothers express more gaze aversion behavior compared to infants of non-depressed mothers. Herrera et al. (2004) found that mothers with depressed mood in comparison with non-depressed mothers touched their infants more negatively and their speech was less well adjusted concerning the amount of emotional vs. information-related content which impairs the ability of responding effectively to their infants' developmental needs. Korja et al. (2008) noted that maternal depressive symptoms were associated with lower quality of maternal interaction behavior.

Studies of comorbidity with depression and anxiety show the increased impact of comorbidity on the quality of mother-infant interaction. Field et al. (2005) reported that depressed mothers with anxiety and anger spent less time smiling, showing exaggerated faces, game playing and imitating and more time moving their infants' limbs compared to depressed mothers with low anxious and low anger. Infants of high anxious mothers spent less time smiling and more time in distress brow and crying compared to infants of low anxious mothers. Additionally, infants of high anger mothers spent less time smiling, vocalizing, in motor activity, doing imitation and more time showing distress brow, gaze aversion and crying compared to infants of low anger mothers.

Maternal anxiety *per se* can also interfere with the quality of mother-infant interaction. Nicol-Harper et al. (2007) found that high trait anxiety mothers showed less sensitive responsivity and reduced emotional tone during interaction.

Personality and psychotic disorders have received less attention in this area. Newman et al. (2007) showed that borderline mothers were less sensitive and structuring in the interaction, and their infants were less attentive, interested and eager to interact with their mother. Borderline mothers were less satisfied, considered themselves to be less competent and more distressed. More marked disturbances of dyadic interaction could be demonstrated with psychotic women (Riordan et al, 1999; Snellen, Mack, & Trauer, 1999). In a study developed in a sample of women with

mental disorders, Riordan et al. (1999) found that women with schizophrenia show higher levels of interaction impairment compared with those with affective disorders, they are more remote, insensitive, intrusive and self-absorbed. At 4 months, infants of women with schizophrenia are more avoidant, and the overall quality of mother-infant interaction is poorer.

Mother-Infant Interaction and Child Development Outcomes

As we have seen so far, in the first 3 months after birth, mother and infant establish patterns of reciprocal interaction (Crockenberg & Smith, 2002). Inadequate or unsatisfactory mother–infant interactions during that period have long-term consequences for the child, and have been related to later developmental difficulties, including the child's attachment style (e.g. Ainsworth & Bell, 1969), cognitive and socio-emotional development (Murray & Cooper 1997b; Carter, Garrity-Rokous, Chazan-Cohen, Little, & Briggs-Gowan, 2001; Evans & Porter, 2009; Hay et al., 2001; Luoma et al., 2001), social withdrawal (Bakeman & Brown, 1977; Brazelton, Kowslowski, & Main, 1974; Field, 1977; Massie, 1978; Stern, 1971, 1977), failure to thrive (Greenspan, 1982), and depression (Cohn & Tronick, 1983; Zahn-Waxler, McKnew, Cummings, Davenport, & Radke-Yarrow, 1984). Maternal responsiveness to the infant predicts infant social, emotional, and cognitive competencies (Stern, 1985; Watson, 1979, 1985), including emotional self-regulation and control (Kochanska, 1994; Kopp, 1982; Tronick, 1989), means–ends differentiation (Lewis & Goldberg, 1969), self-efficacy and expectation of environmental control (Gunnar, 1980; Maccoby & Martin, 1983; Maccoby, 1992), language development (Bornstein & Tamis–LeMonda, 1997), and cognitive skills and academic achievement (Bornstein & Tamis–LeMonda, 1989; Coates & Lewis, 1984; Lewis, 1993).

Inappropriate infant–caregiver interaction is also related to difficulties on the development of stress regulation competence (Schore 2001a, 2001b), which may interfere with the reactivity of the hypothalamic-pituitary-adrenal axis and increase the childs' vulnerability to stressful events (Gunnar, 1998). Furthermore, neuro-psycho-biological studies add to the knowledge of the negative influence of poor early interaction on the growth and organization of the maturing brain, affecting both

physiological and psychological development (Gunnar, 1998; Schore 2001a, 2001b). Some studies demonstrate the link between poor early mother–infant interactions on later physical health problems (Mantymaa et al., 2003).

Attachment style may be the link between early interaction and later health problems: appropriate infant–caregiver interactions build up a secure attachment relationship (Braungart-Rieker, Garwood, Powers, & Wang, 2001) which may decrease the physiological consequences of stress (Gunnar et al., 1996).

The association of infant physical health status and previous mother-infant interaction has been reported. Mantymaa et al. (2003) investigated the impact of the quality of mother–infant interaction on the physical health of the child. The sample was composed of mother-infant dyads from families at risk of psychosocial problems (n=57) and from non-risk families (n=63). Mother-infant interaction was assessed in infants between 8 and 11 weeks old using the Global Rating Scale for Mother–Infant Interaction. Two years later the infants' health problems were examined. The physical health of the children during the two-year follow-up was associated with poor dyadic mother–infant interaction and infants' poor interactive behavior. The results suggest that interactional issues between a mother and her infant are related to the child's subsequent physical health.

Studies on the impact of early maternal interaction on infant attachment security have been demonstrating the negative influence of inadequate interaction patterns. For example, Donovan, Leavitt, Taylor, and Broder (2007) examined the contribution of maternal sensory sensitivity to positive and negative infant facial expressions at 6 months, of maternal behavior and affect, infant behavior and affect, and dyadic interaction at 9 months, and of infant attachment status at 12 months to predict maternal, toddler, and dyadic measures at 24 months. The study was performed in a sample of 62 dyads. The authors found that maternal sensory sensitivity to infants' positive expressions at 6 months predicted maternal behavior at 24 months and was associated with later maternal affect.

More recently, Evans and Porter (2009) analyzed the development and stability in emerging patterns of co-regulation in 101 mother-infant dyads between 6 and 12 months old. The association of these patterns of infants' attachment and developmental

status were also studied. Developmental shifts over time were observed in co-regulated patterns of interactions with dyads becoming increasingly more symmetrical and less unilateral in their interaction. Additionally, the authors found symmetrical co-regulation at 6 months to be associated with secure attachment and unilateral patterns to be associated with insecure attachment at 12 months. The authors also observed that symmetrical co-regulation at 6 months was positively related to infants' mental development and psychomotor development at 9 months, while asymmetrical and unilateral patterns of co-regulation at 6 months was negatively related to infants' mental development.

Pauli-Pott and Mertesacker (2009) examined the predictive power of maternal style of affect expression and control on further attachment security. A sample of 89 dyads participated in this study. At 4, 8, and 12 months the authors measured positive and negative affect expression in mothers and infants as well as maternal lack of openness (i.e. attempts to mask negative emotion). Attachment security was assessed at 18 months using Ainsworth's strange situation procedure. Mothers who showed high amount of positive emotion, which were not shared with the infants' in the first months, were linked with insecure dyads at 18 months. These mothers showed a less open emotion communication style, including attempts to hide negative affect and heightening of positive mood at 12 months. Positive maternal affect accompanied by neutral/negative expression in the infant at 4 months was related to insecurity at 18 months. While low maternal openness, low amount of negative affect expression and the coincidence of mother and infants' positive affect expression at 12 months was associated with insecurity at 18 months.

Recent studies have also focused on infant developmental outcomes. For example, Forcada-Guex, Pierrehumbert, Borghini, Moessinger, and Muller-Nix (2006) examined if there were specific dyadic mother-infant patterns of interaction in preterm compared to term mother-infant dyads at 6 months of corrected age. They also analyzed the potential impact of these dyadic patterns on the infants' behavioral and developmental outcomes at 18 months of corrected age. The sample was composed of 47 preterm infants (<34 weeks of gestation) and of 25 term infants In preterm infants several patterns of mother-infant-interaction were identified with 2 dominant ones: a "cooperative pattern" with a sensitive mother and a cooperative-responsive infant (28%)

and a "controlling pattern" with a controlling mother and a compulsive-compliant infant (28%). The remaining interactions (44%) are heterogeneous The controlling pattern was much more prevalent among preterm than term dyads and was related to worse infant outcome. Preterm infants of controlling patterns have worse outcomes (more behavioral symptoms, more eating problems), at 18 months compared to preterm infants of cooperative pattern dyads and to term control infants. These infants also have worse personal-social development than term infants and worse hearing-speech development than infants from cooperative preterm dyads.

In this chapter we had the opportunity to report a impressive dyadic phenomena: mother-infant interaction is bi-directional, synchronous and coordinated. Nonetheless, a mismatch of affective states and relational intentions may occur when the infant and the adult are conveying non-matching meanings (Tronick, 2007). The opportunity to repair effectively and constantly these mismatches in the interaction has positive effects on infant development.

The mother's role is to be sensitive to her infants' behaviors and respond contingently, taking care not to be over-stimulating or under-stimulating. The infant can respond to optimal levels of stimulation but will become disorganized if the mother is under or over-stimulating. As these early interactions form the basis of basic communication skills (Tronick, 1989), disturbed early interactions may contribute to delayed cognitive development and affective disorders (Murray & Cooper, 1997b). Thus, the importance of early interactions cannot be overstated.

The long-term significance of these studies' findings is not known but they raise concerns about the parenting capacity of women with mental disorders and suggest the need for an intervention to improve parenting skills in this group. Additionally, with the increased survival of very preterm infants, there is a growing concern for their developmental and socioemotional outcomes. The quality of the early mother-infant relationship has been noted as one of the factors that may exacerbate or soften the potentially adverse impact of preterm birth, particularly concerning the infants' later competencies and development.

The information provided by these previous mentioned studies pointed out the importance of specific psychological aspects of infants' characteristics on the quality of mother-infant interaction The major contribute of the present study intends to be on providing evidence regarding a more global and broad perspective of the infant, considering the interplay of psychological and physiological features and its impact on mothers' behaviors and on the quality of mother-infant interaction.

CHAPTER 3

INFANT ATTACHMENT

In this chapter we give a general description of Bowlby's theory on the development of infant attachment as well as of the work developed by Ainsworth that enabled the clarification of this theory. The notion of infant attachment behaviors is addressed as well as Ainsworth work that illustrates this notion. Additionally, attention is placed on stability of individual differences during infancy. Then, we look at existing measures of infant attachment with emphasis on Ainsworth' strange situation procedure strengths and handicaps. Consideration is given to infant, parental and relational influences on infant attachment. The focus throughout the chapter is mainly on infant characteristics and parent-child relationship's impact on the development of secure attachment. Of particular interest are the potential mediator or moderator effects of mother-infant relationship on the association between infant characteristics and later attachment.

> "… in a family setting most infants of about three months are already responding differently to mother as compared to other people. (…) Perceptual discrimination, therefore, is present. Yet we can hardly say that there is attachment behavior until there is evidence that the infant not only recognizes his mother but tends also to behave in a way that maintains his proximity to her"
> Bowlby (1969, p.199)

The pioneer in the attachment field was Bowlby (1958, 1960, 1969), whose ideas have been accepted by other theorists such as Ainsworth (1969) and Sroufe and Waters (1977). John Bowlby's (1958, 1960, 1969) ethological/control systems theory of attachment offered a new paradigm that included both affective and behavioral facets of attachment. His approach states that attachment is "a tie that binds individuals together over time and space" (Bowlby, 1969). The child's tie to his mother is a product of the activity of a number of behavioral systems that lead to proximity to mother. The infant is competent, curious, and fully engaged with the environment and, as such, the behavioral systems develop within the infant as a result of the (1) evolutionary adaptedness, (2) interaction with the environment, and especially (3) interaction with the principal caregiver. The attachment behavior occurs when certain behavioral systems are activated and when the infant recognizes the mother and acts in order to maintain proximity to her (Bowlby, 1969).

Attachment behavior aims to increase proximity of the child to the attachment figure (Cassidy, 1999) in order to protect the child from danger (Marvin & Britner, 1999). When the distance from the attachment figure becomes too great, the attachment system is activated and when considerable proximity is achieved the attachment system deactivates. This process is called of behavioral homeostasis/control system (Cassidy, 1999).

Attachment behavior develops in human infants according to 4 phases with no sharp boundaries between them:

1. Orientation and signals with limited discrimination of figure

The infant behaves towards people in characteristic ways but the capacity to discriminate one person from another is limited to olfactory and auditory stimuli. This

phase lasts from birth to 8/12 weeks (although it may continue under unfavorable conditions). The babies' behaviors toward others include orientation towards that person, tracking movements of the eyes, grasping and reaching, smiling and babbling. These infantile behaviors influence the other person's behaviors and they increase with the time the baby is in contact with the other person. These friendly responses increase at about 12 weeks old (Bowlby, 1969).

2. Orientation and signals directed towards one (or more) discriminated figure(s)

During this phase an infant continues to behave in the same friendly way, but now more so towards his mother-figure than towards others. The phase usually lasts until 6 months old, but can be extended according to the circumstances (Bowlby, 1969).

3. Maintenance of proximity to a discriminated figure by means of locomotion as well as signals

The third attachment phase usually begins at 6 months but may be delayed until after the first birthday. The infant uses the mother as a secure base for exploration; follows a departing mother, greets her upon return, and becomes distressed if separated. Certain other people are selected to become subsidiary attachment-figures and strangers become treated with increasing caution, and can evoke alarm and withdrawal (Bowlby, 1969).

4. Formation of goal-corrected partnership

Proximity to attachment-figure begins to be maintained by infant; the mother-figure is conceived as an independent object, persistent in time and space and moving more or less predictably in a space-time continuum. The child is less egocentric and can understand the mother's motives and actions. The attachment relationship becomes less dependent. By observing her behavior and what influences it, a child infers his mother's set-goals and the plans she is adopting to achieve them. The infants' picture of the world becomes more sophisticated and his behavior is potentially more flexible (Bowlby, 1969/1982).

The work developed by Ainsworth (1963, 1967) with African dyads corroborated Bowlby's theory in several ways. Ainsworth reported that both crying and attempts to follow occurred in infants as early as 15 and 17 weeks respectively. At six months old both behaviors were common among infants. Additionally, the attachment behavior in Ganda children was clearly present by 6 months old, including the child's

crying when the mother leaves the room and then on her return greeting her by smiling at her, lifting of the arms, and crows of delight. From 6 to 9 months, all these behaviors were exhibited more regularly and with more vigorousness. These patterns of behavior continued throughout the second year of life. In only four infants of this study no attachment behavior of any kind was noted.

Schaffer and Emerson (1964) found attachment behavior to develop in Scottish children at approximately the same age. In the Scottish investigation infant's attachment behaviors were observed a little later: in 1/3 of the infants by 6 months old and in 3/4 of the infants by 9 months. In two infants the attachment behavior was still not observed at 12 months. According to Bowlby's theory, much of the child's attachment behavior is mediated by behavioral systems which have proximity to the mother as their set-goal. The notably advanced motor development of the Ganda infants may explain the advancement in the development of their attachment behavior compared to Scottish infants.

Bowlby (1969/1980) saw infants as active, competent explorers, using their primary caregiver as a secure base from which to explore the environment and to try their new emerging skills. Some infants were better at this kind of relationship: more confident in the mother's availability (that she would always be there if needed) and consequently more confident to explore. These infants were called securely attached. The other infants who lacked this confidence in their mother were called insecurely attached. These variations reflect individual differences in the quality of attachment relationships that arise after a history of infant-caregiver interactions (Weinfield, Sroufe, Egeland, & Carlson, 1999). Confidence comes from experience. Infants' whose mothers were always there, expected them to be there the next time. Infants whose mothers were always letting them down when they needed them didn't know what to expect the next time (Waters, 2004). As a result "…in contrast to secure infants, who showed the predicted attachment behaviors upon reunion with their mothers in the strange situation, some infants simply avoided their mothers, and others behaved with manifest ambivalence toward them." (Grossman, 2000, p.89). The "secure" and "insecure" terms describe the infants' perception of their caregiver availability for providing confort and protection in case of need as well as the infant responses to the caregiver (Weinfield et al., 1999).

These individual differences are the result of the direct influence of the quality of care and can be reflected in attachment assessments. A sensitive mother is aware of her infants' cues and can interpret and respond to them correctly. Consequently, the infant learns that he can trust the mother to relieve distress effectively and fulfill his needs. Under these conditions of confidence, the infant gradually grows in a more autonomous way and is satisfied by his confidence that the mother will respond if needed. On the other hand, when the infant does not trust that the mother will respond to his/her needs, we are faced with an insecure attachment relationship (Ainsworth, 1982; Ainsworth, Blehar, Waters, & Wall, 1978).

Both secure and insecure organizations of attachment constitute adaptative strategies to deal with stressful situations. Secure infants strategy to organize their attachment system is to use their parents as secure base from which to explore (Ainsworth, 1984; Main & Solomon, 1986). These infants assess the environment and the mother's availability; if the environment or the mothers' availability becomes threatened they seek proximity (Main, 1990). The knowledge that the caregiver will be available in case of need provides confidence for independent exploration of the environment.

Insecure infants are anxious about the caregivers' availability. They fear that the caregiver will be unresponsive or ineffective when needed. In response to a parent minimally or inconsistently responsive, the infant develop a resistant strategy of emphasizing the attachment behavior and increasing bids of attention. On the other hand in response to a rejecting parental behavior, the infant develops an avoidant strategy of ignoring cues that might activate the attachment system (Bowlby, 1980; Main, 1981). Although insecure attachment organization is an adaptative strategy to deal with the caregiver behavior, it compromises exploration. These infants are not free to explore without worry, and consequently they do not have the same self-confidence nor mastery of their environments (Weinfeld et al., 1999)

A major empirical issue in research on infant attachment concerns stability of individual differences. Connell (1978) reported 80% stability between infant-mother attachment classification at 12 months and later classification at 18 months. Waters (1978) found 96% stability at 12 and 18 months. 80% of stability of attachment toward the mother at 12 and 20 months was observed by Main and Weston (1981). Stability of

infant-mother attachment secure/anxious classification in the strange situations between 18 and 20 months was also found in a middle-class sample (Waters & Valenzuela, 1999). Nonetheless, environmental circumstances might interfere with the continuity of the attachment style over time. Thompson, Lamb, and Estes (1982) have shown that strange situation classifications can change markedly under changes in family circumstances. When mothers of one-year-old infants are returning to work after spending the child's first year at home, reported stability was 53% for overall classification of children seen at 13 and 20 months old. Vaughn, Egeland, Sroufe, and Waters (1979) have also reported substantial change in strange situation classification from 12 to 18 months in a low socioeconomic sample.

In a longitudinal study, Waters, Merrick, Treboux, Crowell, and Albersheim (2000) found 72% stability on secure versus insecure attachment classification in early adulthood in a sample of 50 participants assessed at 12 months with the strange situation and then 20 years later with the Berkeley Adult Attachment Interview. In accordance with the attachment theory, negative life events, such as loss of a parent, parental divorce, life threatening illness of parent or child, parental psychiatric disorder, and physical or sexual abuse by a family member were an important factor in change. Of the infants whose mothers reported negative life events 66% changed attachment classifications from infancy to early adulthood. Only 28% participants who reported no such events changed classification. Becker-Stoll, Fremmer-Bombik, Wartner, Zimmermann, and Grossmann (2008) also found that instability of attachment organization is linked to a higher number of experienced risk factors.

The results of all these mentioned studies corroborate Bowlby's theory in that attachment security can be stable across long periods of a lifetime and can still remain open to change in light of environmental factors.

Infant Attachment Measurement

The Ainsworth's "strange situation" procedure (SS, Ainsworth et al., 1978) has been largely used in research studies to assess the security of the mother-infant attachment relationship through the observation of the infants' reactions toward the

mother during a series of brief separations and reunions. The strange situation involves the caregiver, the infant and a stranger to the infant and consists of eight episodes that each last approximately 3 min. The procedure involves a series of increasingly stressful events that culminate in the highest stress episode, during which the child is left alone. Both stranger and parents are instructed to respond to the infant as they would normally do but to avoid initiating interaction unless intervention is clearly necessary (e.g., the baby is distressed).

The procedure consists of eight video-taped episodes (Connell & Goldsmith, 1982; Ainsworth et al., 1978): (1) Parent and infant are introduced to the experimental room, (2) parent and infant are alone. Parent does not participate while infant explores, (3) stranger enters, converses with parent, then approaches infant. Parent leaves the room, (4) first separation episode: stranger's behavior is geared to that of infant, (5) first reunion episode: parent enters the room, greets and comforts infant, stranger leaves the room, then parent leaves again, (6) second separation episode: infant is alone, (7) continuation of second separation episode: stranger enters and gears behavior to that of infant, (8) second reunion episode: parent enters the room, greets and comforts infant; stranger leaves.

The infants' behavior during separations and reunions with the mother are thought to measure the degree to which the mother provides her or him with feelings of security or trust. The infants' behavior upon the parent's return is therefore, the basis for classifying the infant into one of three attachment categories: (1) *secure (B)* – these infants may or may not be distressed in the separation episodes, nevertheless they share an obvious interest in gaining proximity to and contact (or at least interaction) with their mothers in the reunion episodes, without evidence of avoidance or resistance. These babies are more easily comforted by the presence of their mothers and are able to return to normal levels of exploration and play more quickly than the other babies. (2) *Insecure-resistant (C)* – these infants show distress in the separation episodes and have a strong interest in proximity to and contact with the mother in the reunion episodes, as well as a tendency to manifest angry resistance to the mother upon reunion. They tend to demonstrate both proximity seeking and resistant behavior toward the mother and appear to be fairly inept in handling the stresses presented by the strange situation. (3) *Insecure-avoidant (A)* – these infants show minimal crying in the separation episodes

and avoid the mother upon her return in the reunion episodes. In general, they tend to ignore the mother's overtures throughout the strange situation.

These three groups were further divided into eight subgroups (Al, A2, BI, B2, B3, B4, C1, C2), that correspond to different behavioral patterns within the attachment classifications. Due to the fact that some infants were labeled as unclassified within this system, Main and Solomon (1986/1990) developed a criterion for identifying disorganized attachment (D). The infants classified as disorganized do not appear to have an organized strategy for managing arousal in the context of attachment relationships and engage in odd behaviors (Goldberg, 1995).

In order to reach these final categories, four behaviors must be assessed on a 7 point-scale: (1) *proximity and contact seeking* – refers to the intensity and persistence of the baby's effort to (re)gain contact with the caregiver, (2) *contact maintainance* – deals with the degree of activity and persistence in the baby's effort to maintain contact with the adult once he has gained it, (3) *resistant* – intensity and frequency or duration of resistant behavior (e.g. pushing away, throwing away, dropping, batting away, hitting, kicking, squirming to be put down, jerking away, stepping angrily, and resistance to being picked up, moved or restrained) evoked by the person who comes into contact with or in proximity to the baby, or who attempts to initiate interaction or to involve him in play, (4) *avoidant* – intensity, persistence, duration, and promptness of the baby's avoidance of proximity and of interaction even across distance (e.g. increasing distance between self and the person, turning the back on the person, turning the head away, averting the gaze, avoidance of making eye contact, hiding the face or simply ignoring the person) (Ainsworth et al., 1978).

Although the strange situation elicits a rich variety of infant behavior, it has been subjected to critical scrutiny as an assessment technique (e.g., Cornell & Goldsmith, 1982; Lamb, Thompson, Gardner, & Charnov, 1985), due to placing great deals of stress on infants, lack of convergent validation and difficulties in classifying some infants into the Group A, B, or C. Additionally, some authors do not consider it to be very useful for children much older than 2 (Shaffer, 1994) and some researchers question the applicability of the strange situation to all children. They argue that two separations may not be sufficient to activate the attachment system in all children, especially those with high fear or anger thresholds. Alternative methods to assess the

attachment quality are the Attachment Q-Set (Waters & Deane, 1985), the Main and Cassidy (1988) analogue of the strange situation. Nonetheless, the dominance of Ainsworth's strange situation procedure in current research is such that it is difficult to discuss infant attachment independent of it (Goldsmith & Alansky, 1987).

Infant Temperament and Attachment Style

Attachment and temperament theorists have often been involved in controversy and their theories have failed to accommodate one another. Some attachment theorists conceive attachment as a relational construct independent of temperament, while some temperament theorists state that attachment measures are alternative assessments of infant temperament (Rothbart & Ahadi, 1994). Several investigators have proposed that infant characteristics might influence the quality of attachment or, at least, the behavior displayed in the strange situation. Furthermore, temperament theorists agree that caregiving practices can modify the expression of temperament, nonetheless they do not explain exactly how attachment might affect temperamental development. On the other hand, attachment theories argue that the infant temperament variance is overshadowed by the more mature caregiver's success or failure in accommodating it (Goldsmith & Alansky, 1987).

Bowlby (1969) argued that aspects of both the child's state and the novelty of the situation interfere with attachment behavior. On the other hand, individual differences in infant temperament, including distress-prone were reported (Rothbart, 1989). Considering that this distress-proneness influences the infants' state; then the nature of children's experience in situations relevant to attachment will differ (van den Boom, 1989). Contributions of temperament to the individual's state in the development of attachment must therefore be considered (Rothbart & Ahabi, 1994). Temperament might also affect the development of attachment by mediating the course of mother-infant interaction (Goldsmith & Campos, 1986; Goldsmith, Bradshaw, & Rieser-Danner, 1986). Goldsmith et al. (1986) suggested that the attachment system activation, and especially the proximity-seeking behavior, depends on infant fearfulness: in highly fearful child, a lower level of distress leads to fewer opportunities for experiencing the mother as a secure base for exploration.

In this section we will review developmental studies that integrate both temperament and attachment constructs.

Dimensions of temperament have been associated to stranger sociability in several studies (Tavecchio & van IJzendoorn, 1987). Activity level, adaptability, positive mood and high threshold of response (Scarr & Salapatek, 1970) as well as fear at 12 and 19 months (Thompson & Lamb, 1984) were related to stranger sociability. Berbarian and Snyder (1982) found an association between temperament measures and behavior to strangers, over the period from 5 to 9 months. Their study suggests that temperament is related to stranger sociability, especially in older infants.

van den Boom (1989) examined the predictive power of both infants' distress-proneness at 15 days (through behavioral observation) and mothers' sensitivity and responsiveness to the child (home observations conducted during the first year) on attachment classification at 1 year. The author found that temperamental distress-proneness (but not maternal behavior) predicted later attachment classification, especially the avoidant category. Furthermore the author found that mothers of more distress-prone infants, tended to increasingly ignore their children and to play less and less with them over time. So, the author conducted another study in which distress-prone infants and their mothers were assigned to quasi-experimental conditions. In the experimental group, mothers were given a training program (beginning when the infants were 6 months old) in which they were taught how to soothe and play with their children. The very interesting results of this study showed that compared with the control groups, infants in the experimental group showed an increased involvement with their mothers as well as in positive affect and decrease of negative affect in the home. These infants were less likely to be categorized as insecurely attached at 12 months (strange situation - 68% secure classification for the experimental infants; 28% for control infants) and exhibited more sophisticated levels of exploratory play with objects, even in the absence of their mothers. van den Boom's studies (1989) are indicative of both the strength of temperament in predicting later attachment and the influence of maternal skills when training is added. They illustrate the interaction between infant predisposition and mother behavior may develop into a trajectory of experience for the child, with important outcomes (Rothbart & Ahabi, 1994).

Goldsmith and Alansky (1987) analyzed the potential predictive power of maternal interaction variables and of infant proneness to distress on infant-mother attachment. They performed a meta-analysis and demonstrated that sensitive, responsive maternal interaction predicted the security of attachment measured by the strange situation procedure. Proneness to distress (a temperamental variable) predicted resistance (a behavioral pattern) in the strange situation that is thought to indicate one variety of insecure attachment. In fact, Soares, Silva, Costa, and Cunha (1999) reported that insecure infants had a higher cardiac activity during the strange situation compared to secure infants, which attests their difficulty to deal with new/stressful situations.

Calkins and Fox (1992) analyzed the association between infant reactivity, attachment style at 14 months, and behavioral inhibition to the unfamiliar at 24 months. The authors found that anxious-ambivalent infants at 14 months were significantly more inhibited at age 24 months than avoidant infants. Kochanska (1998) found an association between avoidant attachments at 13–15 months and lower fearful behavior in the laboratory (when compared with resistant/ambivalent attachment). Avoidant attached infants were rated by their parents as having significantly lower fear than the resistant infants at 8–10 months old. Stevenson-Hinde and Shouldice (1993) discovered a significant association between inhibition and attachment at 2.5 years old, but not at 4.5 years: at 2.5 years old anxious-ambivalent children were the behaviorally most inhibited. In a posterior study, Stevenson-Hinde and Marshall (1999) found that in 4.5 year-old children behavioral inhibition was significantly higher for ambivalent than for avoidant attached children, and this association was found to be stronger in boys.

Contrary to previous studies, Nachmias, Gunnar, Mangelsdorf, Parritz, and Buss (1996) found no significant differences between attachment groups on behavioral inhibition among 18 month-old children.

Susman-Stillman et al. (1996) performed a study designed to analyze the influence of infant irritability, sociability, and maternal sensitivity on attachment security in a high-risk sample of 267 poor and primiparous mothers. After childbirth and during the infant hospital stay, nurses rated infant temperament; at 3 and 6 months temperament was rated by mothers using the Carey Infant Temperament Questionnaire and maternal sensitivity was rated during a feeding situation. At 12 months the strange situation procedure was performed. The results show that maternal sensitivity predicted

infant attachment security while temperament predicted the type of insecure attachment as well as subcategory classification.

Seifer et al. (1996) performed a longitudinal study that included the observation of families at 6, 9, and 12 months. Home Behavior Attachment Q-sorts, laboratory strange situation assessment, home observations of infant temperament behavior, observations of maternal parenting sensitivity, and maternal reports of infant temperament were performed. Observed infant temperament was related to infant security. Two observation measures of infant temperament conducted at 6 and 9 months old were related to infant security: Mood and total difficulty - lower difficulty was related to higher security. The approach, activity, and intensity scales were not related to security at any age. The mothers' ratings of their infants' temperamental difficulty were also related to security. All concurrent mother-report variables were correlated with security when the infants were 12 months old. In addition, difficulty (assessed with the ITQ-R) was related when the infants were 6 months old, while distress to limitation (assessed with the IBQ) was related at all ages, and emotionality (assessed with the EAS) was related when the infants were 9 months old. None of the observed temperament variables, including those aggregated across age, approached significance when related to strange situation classification. Mother-report of fussy/difficult (assessed with the ICQ) at 9 and 12 months old revealed marginal relations with strange situation classification: insecure resistant infants in the strange situation had the highest fussy-difficult ratings by their mothers. This study demonstrates that both directly observed and mother-reported infant temperament was related to infant security. Additionally, each source of infant temperament information had relatively independent contributions to the prediction of security.

Bates et al. (1985) performed a longitudinal study with a sample of 160 dyads from 6 months to 3 year old infants. They found that temperament measures did predict ratings of contact maintenance during the reunion episodes in the strange situation. At 13 months, babies rated by their mothers on the Infant Characteristics Questionnaire as low in social responsiveness (unexcitable and not liking to play with others), tended to have less secure attachments. Unresponsive infants were also more likely to resist contact in the second reunion. Sociability and unresponsiveness to mother (assessed with the Maternal Perception Questionnaire), as well as examiner's impression of fear during the Bayley test, were related to contact maintaining in the strange situation.

Infants perceived as outgoing and fearless (by their mothers and the Bayley examiner) and infants perceived by their mothers as lacking interest in them all made less effort to maintain contact. The authors conclude that these correlations may be due to a temperamental basis in infant emotional reactivity and stress reactions to strangers, but the cause of the correlation might also lie in subtle parent-child interaction processes.

At the beginning of this decade, Mangelsdorf et al. (2000) analyzed the joint contributions of both infant and maternal characteristics to quality of attachment. They found that infant temperament at 8 months was associated with attachment style at 12 months. Higher on activity level and distress to novelty is associated with insecure attachment style, whereas lower positive affect and higher fearfulness is associated with avoidance.

Although the research regarding attachment classification and behavioral inhibition are rather mixed, the findings of these previous mentioned studies suggest a tendency for insecure-ambivalent infants to be inhibited in the face of novelty and for insecure-avoidant infants to be less inhibited (Burgess, Marshall, Rubin, & Fox, 2003).

In unfamiliar situations both the attachment system and the fear behavior system are activate (Stevenson-Hinde & Shouldice, 1993). Considering that avoidant attached children are not behaviorally perturbated by the distress of separation, they tend to be the more sociable with strangers in the strange situation. On the contrary, insecure-ambivalent children who show perturbated behavior by the distress of separation (e.g. negative affect, difficulty settling down, and a lack of exploration) tend to be more fearful in unfamiliar situations (Kochanska, 1998).

Mother-Infant Interaction and Infant Attachment Style

The attachment theory argues that the mother behavior with the infant is an important factor accounting for attachment security (Bowlby, 1969). Some maternal behaviors associated with infant attachment were identified over four decades of research. These include responsiveness to crying, timing of feeding, sensitivity, psychological accessibility, cooperation, and acceptance (Goldsmith & Alanky, 1987).

Ainsworth developed scales that quantify several maternal dimensions such as sensitivity/insensitivity, acceptance/rejection, cooperation/interference, and psychological accessibility/ignoring (Ainsworth et al., 1978). These maternal variables significantly differentiated between secure and insecure attachment relationships. Bearing this in mind, investigators have used similar measures of maternal behavior both before and after the strange situation assessment. This lead to further research that showed that mothers of securely attached infants were more sensitive to their infants' signals of desire of proximity and contact (Ainsworth, 1979, 1982), more responsive and encouraging in face-to-face interaction (Blehar, Lieberman, & Ainsworth, 1977), more affectionate (Bates et al., 1985), gentler (Londerville & Main, 1981), accepting (Main, Tomasini, & Tolan, 1979), positive in their vocalizations (Roggman, Langlois, & Hubbs-Tait, 1987) and showing more positive affect (Malatesta, Culver, Tesman, & Shepard, 1989) compared to mothers of insecurely attached infants. Furthermore, mothers of insecure infants express less negative emotions toward their infants compared to mothers of secure infants (Izard, Haynes, Chisholm, & Baak, 1991).

As we have seen so far, the attachment theory holds that attachment relationships develop within the context of infant-mother interactions (Ainsworth, 1982; Ainsworth et al., 1978; Bowlby, 1969). In line with this theoretical framework, researchers explored the association between general patterns of maternal interactive behavior and later patterns of infant attachment. One of the most pressing issue in contemporary attachment theory is to describe complete causal pathways to explain well replicated correlations between early care and subsequent patterns of secure base behavior. Studies have consistently provided empirical support demonstrating that highly sensitive (Ainsworth, Bell, & Stayton, 1971, 1974; Bates et al., 1985; De Wolff & van IJzendoorn, 1997; Egeland & Farber, 1984; Grossmann, Grossmann, Spangler, Suess, & Unzner, 1985; Isabella, 1993; Kiser, Bates, Maslin, & Bayles, 1986; Smith & Pederson, 1988), responsive (Isabella, Belsky, & von Eye, 1989) and emotionally open mothers (Ainsworth et al., 1978; Pauli-Pott & Mertesacker, 2009) are more likely to have securely attached infants. Maternal responsiveness to infant behaviors was also found to be associated with A, B and C classifications at 12 months old. Additionally, interactions characterized by mutuality, synchrony, and symmetrical co-regulation are related to secure infant-mother attachments (Evans & Porter, 2009; Isabella et al. 1989; Veríssimo & Salvaterra, 2006). Rhythmic coordination in early patterns of vocalization

between the infant and his/her mother is also associated to later attachment organization (Jaffe, Beebe, Feldstein, Crown, & Jasnow, 2001).

Ainsworth et al. (1978) studied 106 dyads behaviors in the first year of life in a naturalistic environment. Twenty three of these dyads were studied more extensively and the authors found that anxious attached infants have been earlier in life angrier, more noncompliant and cryed more compared to secure infants. Their mothers had been more insensitive in the interaction, more intrusive and less accessible to the infant compared to mothers of secure infants.

A meta-analytic study of 66 researches on parental antecedents of attachment security was developed by De Wolff and van IJzendoorn (1997), in order to examine the association between mother sensitivity and infant attachment organization as well as the strength of the association. The authors reported that maternal sensitivity was revealed to be an important condition (although not exclusive) of attachment security.

Isabella et al. (1989) analyzed the interactional antecedents of attachment quality, namely testing the assumption that synchronous interactions can predict the development of secure relationships while insecure interactions can predict the development of insecure relationships. Thirty dyads (10 secure, 10 avoidant, 10 resistant) participated in this longitudinal study. The quality of mother-infant interaction was assessed at 1, 3, and 9 month old and the association to attachment quality at 12 months was examined. Interactions were observed during a 45 min period in naturalistic conditions and information was collected on the frequency of occurrence of determined infant, maternal and dyadic behaviors. Tese included (1) maternal vocalization, direct response to infant vocalization, sooth, leisure, stimulation/arousal and attend to infant (2) infant vocalization, exploration, looking at mother, fuss or cry, sleep/drowsy and response to stimulation/arousal and (3) en face interaction and three-step contingent exchange. The authors noted that secure attachments are fostered by interactions with mothers consistent in their perceptions, using accurate interpretation, and contingent and appropriate responsiveness to their infants' cues. Several aspects of the interaction, including maternal responsiveness to distress and vocal signals differentiated mothers of secure and insecure babies. Moreover, mothers of avoidant infants were overstimulating and intrusive while mothers of resistant infants were underinvolved and unavailable. Additionally synchronous interaction at 1 and 3 months was related to secure attachment.

Evans and Porter (2009) analyzed both development and stability in mother-infant dyads' co-regulation from 6 to 12 months, in a sample of 101 infants and mothers. Additionally they explored links to infants' attachment and developmental status. The authors reported that co-regulation patterns at 6 months predicted infant attachment at 12 months old: higher levels of symmetrical co-regulation with mothers at 6 months old were associated to secure attachment, while unilateral patterns of interactions were associated to insecure attachment. Findings suggest an important antecedent role of early patterns of dyadic co-regulation on attachment organization.

Pauli-Pott and Mertesacker (2009) examined the predictive power of maternal style of affect expression and control on infant attachment security. The sample was composed of 89 dyads: at 4, 8, and 12 months old, the infants' and mothers' positive and negative affect expression and maternal lack of emotional openness were assessed; at 18 months attachment security was assessed using Ainsworth's strange situation Procedure. The results showed that insecurity was associated with a pattern consisting of positive maternal affect expression accompanied by neutral or negative expression in the infant. Low maternal openness, low amount of negative affect expression and the coincidence of mother and infants' positive affect expression at 12 months were linked to insecurity. Mothers of insecurely attached infants show, in the first months, a high amount of positive emotion which is not shared with the infant. At the end of the infants' first year these mothers have a less open emotional communication that includes hiding negative affect and heightening positive mood.

Recent studies provide empirical evidence that not only maternal factors, but the interplay of both environment and biologically-founded child temperament interfere with the development of infant-mother attachment. For example, Barry et al. (2008) developed a study with 88 dyads. Measures of the molecular genetic of the infants (specifically the polymorphism in the serotonin transporter gene 5-HTTLPR, ss/sl vs. ll genotype) were taken. Additionally, mothers' responsiveness to their infants at 7 months was observed in naturalistic interactions and attachment security was assessed at 15 months (strange situation procedure). For infants, variation in mothers' responsiveness was significantly associated with attachment security. For infants with a short allele (ss/sl), low maternal responsiveness predicted high risk for insecure attachment, while high responsiveness was protective of that risk. For infants with long

allele (ll), there was no association between maternal responsiveness and attachment organization. This study demonstrated that the quality of early care serves to amplify or offset the risk for attachment insecurity conferred by 5-HTTLPR genotype (having a short allele, ss/s1). The authors conclude that the link between the genetic risk and maladaptive outcomes is moderated by environmental risk.

Infant Attachment Style and Developmental Outcomes

One of the most pressing issues in contemporary attachment theory is to describe complete causal pathways to explain correlations between secure base behavior in infancy and subsequent behavior with parents and siblings, social competence, self esteem, and behavior problems.

Attachment security and disorganization are seen as major contributors to social adjustment and maladjustment in childhood (Pauli-Pott, Haverkock, Pott, & Beckmann, 2007). Secure attachment is associated with positive development of social competence (Booth, Rose-Krasnor, & Rubin, 1991), competent problem solving (Frankel & Bates, 1990; Matas, Arend, & Sroufe, 1978), complex and creative symbolic play (Pipp, Easterbrooks, & Harmon, 1992; Slade, 1987). Insecure-avoidant attachment is related to higher aggressive behavior in preschool (Renken, Egeland, Marvinney, Mangelsdorf, & Sroufe, 1989; Shaw, Owens, Vondra, Keenan, & Winslow, 1996), while insecure-ambivalent infants are whineier and easily frustrated, less skilled in peer interaction in toddlerhood and considered to be more dependent, tense, and fearful by their teachers (Matas et al., 1978; Pastor, 1981).

Waters, Wippman, and Sroufe (1979) analysed infant's attachment style at 15 months and them observed their behavior at school at 3.5 years old. They found that securely attached infants were later social leaders at school, their social behaviors include initiating play activities and sensitivity to others needs and feelings, additionally they were very popular among their peers. Furthermore they were described as very curious, self-directed and eager to learn. Insecurely attached infants were socially and emotionally withdrawn and hesitant to play with other children. Furthermore they were less curious and less interested in learning.

Burgess et al. (2003) carried out a longitudinal study to analyse the predictive power of both individual child temperament and parent–child relationship quality (independently and/or interactively) on physiological, psychosocial, and behavioral outcomes. The sample was composed of 140 dyads that were submitted to laboratory observational assessments of attachment classification at age 14 months using the strange situation procedure, behavioral inhibition at 24 months, and social behaviors with unfamiliar peers at age 4 years. Cardiac measures of heart rate and respiratory sinus arrhythmia were collected at every point in time. At age 4 years maternal ratings of child temperament and behaviors were also obtained. Infants were grouped according to inhibition (high, moderate, low) and attachment classification (A, B, C). The results show that compared to the moderately and highly inhibited groups, the low inhibited group had significantly higher activity level scores and displayed significantly less reticence at 4 years old. Securely or ambivalently attached infants had less externalizing problems (aggressive behaviors) at age 4 than avoidant attached infants. Furthermore, when considering the interaction of inhibition and attachment style, avoidant attachment and uninhibited temperament together predicted a higher incidence of externalizing behavior problems. Avoidant attachment was predictively associated with lower heart rate and high respiratory sinus arrhythmia at age 4 years old. Therefore, an avoidant mother–child relationship in infancy could influence the development of an underaroused autonomic profile in early childhood.

Pauli-Pott et al. (2007) examined the association between infant negative emotionality and attachment quality and developing behavior problems. The sample was composed of 64 dyads. At 4, 8, and 12 months infant's negative emotionality was assessed using laboratory routines. At 18 months, the infant attachment security and disorganization was assessed (strange situation procedure), and at 30 months, the child's behavior problems were assessed (using a structured clinical interview). The authors found that attachment security and disorganization at 18 months were significantly associated with behavioral problems at 30 months. The association between attachment disorganization and behavior problems in infants was even stronger in high negative emotional infants. The authors conclude that both attachment style and negative emotionality influence social adjustment: disorganized attachment is related to poor adjustment, especially in infants with high negative emotionality.

Becker-Stoll et al. (2008) observed and association between attachment style at ages 1, 6 and 16 years old and autonomy and relatedness behavior in adolescence. The authors found a correlation between adolescent attachment representation and autonomy and relatedness behavior with their mothers. Additionally, significant association between attachment style at ages 1 and 6 and adolescent interaction behavior at age 16 were found. The authors conclude from this longitudinal study that both early attachments in infancy and childhood and attachment representation in adolescence were significantly related to autonomy and the relationship behavior in adolescence. These studies give empirical evidence to the long-term negative effects of insecure attachments early in life.

In this chapter we have looked at the Bowlby's control system theory of attachment on the development of infant attachment and the Ainsworth empirical studies that corroborate that theory. Studies on factors interfering with the quality of attachment were reviewed and the increase concern in integrating both mother-infant interaction and temperament factors is clear on recent research. This seems to indicate an effort to accommodate temperament theories and attachment theories, once it is considered that infant characteristics might influence the quality of attachment while caregiving practices can modify expressions of temperament. This constitutes a more global and integrative way of exploring the pathways that leads to adequate attachments. Considering the impact of disruptive attachments of the infant development, and the fact that the attachment style may be indicative of initial forms of pathology (Soares, 2000), integrative and broad studies are necessary to understand secure/insecure attachment relations.

In our empirical study a focus has been given not only on the quality of mother-infant interaction nor only on particular infant characteristics, but on the interaction between both of these aspects. This constitutes an effort of integrating the influence of the infant, the mother and the relationship between them and analyzing their potential impact of individual differences in the attachment organization.

CHAPTER 4

EMPIRICAL STUDIES

Infant's Psychophysiological Profile and Mother-Infant Interaction

Abstract

Objective: This study aims to (1) identify and profile groups of infants according to their psychophysiological characteristics, considering their neurobehavior organization, social withdrawal behavior and neuroendocrine reactivity to stress, and to (2) analyze group differences on the quality of mother-infant interaction. **Method:** Ninety seven 8 weeks-old infants were examined using the Neonatal Behavioral Assessment Scale and the Alarm Distress Baby Scale. Cortisol levels were measured both before and after routine inoculation between 8 and 12 weeks. At 12 to 16 weeks mother-infant interaction was assessed using the Global Rating Scales. **Results:** Three groups of infants were identified: (1) "Withdrawn"; (2) "Extroverted"; (3) "Underaroused". Differences between them were found regarding both infant and mother behaviors in the interaction and the overall quality of mother-infant interaction **Conclusion:** The identification of psychophysiological profiles in infants is an important step in the study of developmental pathways leading to normalcy or to psychopathology.

Keywords: cortisol, HPA axis, mother-infant interaction, neurobehavior, neuroendocrine reactivity, newborn, social withdrawal, stress.

In the first 3 months of life, mother and infant establish patterns of reciprocal interaction (Crockenberg & Smith, 2002). These interactions can be interpreted in terms of mother influencing the infant or the infant influencing the mother, but the degree of mutual influence is a relevant issue to consider (Martin, 1975). Since birth, both infant and mother act on each other mutually and reciprocally, and as such the characteristics of both contribute to the quality of interaction (Slentz & Krogh, 2001). Although full-term healthy newborns are essentially social beings, they rely on the caregiver for the organization they still lack. Infants enhance their own organization and give feedback to the caregiver, simultaneously enhancing, in turn, appropriate caregiving behavior (Brazelton & Nugent, 1995). The newborn's functioning is seen as one level on a continuum of expanding developmental organization with hierarchical tasks accomplished within the basic caregiver-infant interactive system (Als, 1978). The individuality of an infants' behavior as it entices important adults to interact with him/her suggests that it might be a powerful predictor of his/her potential for future development, since this factor is likely to shape the environment to react in an appropriate and individualized way.

Although mother-infant interaction has been the focus of numerous studies, most of the research in this field analyses the impact of maternal circumstances such as prenatal and postnatal psychopathology on mother-infant interaction (e.g. Field, Diego, Hernandez-Reif, & Ascencio, 2009; Hornstein et al., 2006), and few have considered the infants' contribution in this process. The infant is not passive in the interaction with the environment, and so his/her individual characteristics can elicit different behaviors from the caregiver. Studies on the influence of infant's characteristic on patterns of mother-infant interaction are therefore relevant and have relied mainly on infant emotionality (e.g. van den Boom & Hoeksma, 1994), neonatal behavior (e.g. Nugent et al., 1993), infant social withdrawal (e.g. Puura, Guedeney, Mantymaa & Tamminen, 2007), adrenocortical activity and reactivity (e.g. Albers, Riksen-Walraven, Sweep, & de Weerth, 2004; Azar, Paquette, Zoccolillo, Baltzer, & Tremblay, 2007; Kaplan, Evans, & Monk, 2008; Kerbel, Mertesacker, & Pauli-Pott, 2004; Spangler, Schieche, Ilg, Maier, & Ackerman, 1994).

Neonatal neurobehavior at birth has been associated with the quality of mother-infant interaction. Nugent et al. (1993) reported that the orientation and range of state clusters of the NBAS were the best predictors of the mother-child play. Murray,

Stanley, Hooper, King, and Fiori-Cowley (1996) observed that poor motor scores and high levels of infant irritability between day 10 and 15 of life predicted worse infant behavior in face-to-face interactions with the mother at two months postpartum.

The influence of infant social withdrawal has also been reported. Puura et al. (2007) observed that infant deviant ratings of two items of the Alarm Distress Baby Scale (quality of eye contact and assessment of the sense of relationship) were associated with poor interaction skills of the infant when interacting with the mother. Furthermore, mothers of withdrawn infants performed more poorly in the interaction with their infants when compared to mothers of non-withdrawn infants.

Studies on neuroendocrine functioning had provided data that indicates an association between cortisol levels and the quality of mother-infant interaction. Spangler et al. (1994) observed that intrusive, non-sensitive caregiving behavior was associated with heightened adrenocortical activity in infants during free play with the parents. Kerbel et al. (2004) noted that infants of more sensitive mothers had lower adrenocortical response to a stress–induced situation. More recently, Albers et al. (2008) reported that maternal high sensitivity and low intrusiveness were associated with better the cortisol recovery from a stressor, indicating the potential importance of social processes for physiological recovery from stressful situations in infants.

Past research has pointed out the association between specific aspects of infant's characteristics and the quality of mother-infant interaction. This study is intended to provide evidence regarding a more global and broad perspective of the infant, considering the interplay of psychological and neuroendocrine feautures and it's impact on the quality of mother-infant interaction. In the past two decades, the study of child development has become an interdisciplinary area of research including genetic, biologic, environmental and psychological factors (Alink et al., 2008). The study of the interplay between psychological and physiological processes has increased in the past years, probably due to the awareness of the relation between central and peripheral physiological systems (Cernic & Penningtin, 1987; Locke et al., 1985). Still, there is lack of research considering both psychological and physiological aspects of infant functioning and the association to the quality of mother-infant interaction.

In this study three features of the infant that have been independently related to several developmental disorders were considered: neurobehavior, social withdrawal behavior, and neuroendocrine reactivity to acute stress (Ashman et al., 2002; Granger,

Weiz, & Kauneckis, 1994; Lundqvist-Persson, 2001; Sostek & Anders, 1977). Infant neurobehavior in association with the infant's environment might enhance the prediction of later development (Horowitz & Linn, 1984). Withdrawn social behavior can be a symptom of depression, attachment disorders, pain, autistic disorders, post-traumatic syndrome or anxiety (Guedeney, 1997, 2007). It is associated with decreased frontal EEG activity (Dawson et al., 1999) and with developmental difficulties, namely cognitive, language, social and communicational impairment (Milne, Greenway, Guedeney, & Larroque, 2009), as well as with developmental disorders (Guedeney, Foucault, Bougen, Larroque, & Mentré, 2008). The study of HPA axis functioning is also important because HPA axis alterations has been associated with child depression, internalizing problems, externalizing problems and withdrawn social behavior (Ashman, Dawson, Panagiotides, Yamada, & Wilkinson, 2002; Granger et al., 1994; Lopez-Duran, Kovacs, & George, 2009).

Not only the infant characteristics but also the quality of mother-infant interaction has proven to interfere in several aspects of infant development (e.g. Cohn & Tronick, 1983; Murray & Cooper, 1997; Evans & Porter, 2009). Both infant factors and the quality and pattern of mother-infant interaction are, therefore relevant issues to consider in the study of (in)adaptative pathways of infant development. The importance of this study relies on: (1) identifying and profiling groups of infants according to their psychophysiological characteristics considering simultaneously three relevant areas of functioning – neurobehavior organization, social withdrawal behavior and neuroendocrine reactivity to acute stress –, and (2) analyzing potential group differences on the quality of mother-infant interaction. In light of past findings we hypothesized that infant's profiles characterized by low neurobehavioral performance, high social withdrawal or high neuroendocrine reactivity to stress would be associated with worse mother-infant interaction, while profiles by high neurobehavioral performance, low social withdrawal or low neuroendocrine reactivity to stress would be associated with better mother-infant interaction.

Method

Sample

The sample was composed of 97 mothers and infants. Ninety six percent of mothers are younger than 35 years old, received have more than nine years of education (97.0%), are married (81.0%) and primiparous (84.2%). Most infants were born after a normal (80.4%) and full-term gestation (92.8%). More than half are males (53.1%), born through a distocic delivery (65.8%) and generally there was no need for reanimation (94.6%). At birth infants height ranged from 45.90cm to 54.00cm (*M* = 49.44cm, *SD* = 1.84), cephalic perimeter ranged from 31cm to 37cm (*M* = 34.60cm, *SD* = 1.29), weight ranged from 2450gr to 4055gr (*M* = 3243gr, *SD* = 424), the ponderal index ranged from 2.24 to 3.29 (*M* = 2.71, *SD* = 0.23), and had an apgar score ranging from 5 to 10 (*M* = 8.63, *SD* = 0.91) in the 1st minute of life and ranging from 8 to 10 (*M* = 9.76, *S*D = 0.53) in the 5th minute of life (see Table 1A).

Table 1A

Socio-Demographic and Medical Data

Maternal and Gestational Data		(%)	Neonatal Data		(%)
Maternal Age	≥20 Λ ≤34	96.0	Time of Gestation	<37	7.2
	>35	4.0		≥37 Λ ≤40	82.1
				>40	10.7
Years of Education	<9	3.0	Gender	Female	46.9
	≥9	97.0		Male	53.1
Marital Status	Married	81.0	Reanimation at birth	No	94.6
	Cohabiting	19.0		Yes	5.4
Parity	Primiparous	84.2	Weight	<2500gr	1.7
	Multiparous	15.8		≥2500gr	98.3
Type of Gestation	Normal	80.4	Ponderal Index	<2.5	13.5
	Risk	19.6		≥2.5	86.5
Type of Delivery	Eutocic	34.2	Apgar Index: 1st m	<7	3.8
	Distocic	65.8		≥7	96.2
Type of Anesthesia	None	2.6	Type of feeding	Beast-feeding	89.4
	Epidural	86.8		Bottle-feeding	10.6
	General	10.5			

Measures

Neonatal behavior. The Neonatal Behavioral Assessment Scale (NBAS, Brazelton & Nugent, 1995) assesses the newborn's competencies across different developmental areas – autonomic, motor, states and social – and describes how these areas are integrated. The scale, composed of 28 behavioral and 18 reflex items, is suitable for examining newborns and infants up to two months old and is based on several key assumptions: (1) infants are highly capable when they are born, (2) infants "communicate" through their behavior, and (3) infants are social organisms. By the end of the assessment, the examiner has a behavioral "portrait" of the infant, describing his/her strengths, adaptive responses and possible vulnerabilities. The 28 items of the NBAS are scored on a 9-point scale. For the NBAS total score, behavioral and reflexes items were recoded so that a better performance corresponds to higher score and were then added. The alpha of Cronbach of the scales ranged from .54 (autonomic stability) to .74 (range of state) (Costa et al., submitted).

Social withdrawal. The Alarm Distress Baby Scale (ADBB, Guedeney & Fermanian, 2001) consists of eight items to assess prolonged reaction of social withdrawal in infants. The ADBB was built in order to help assess social withdrawal in children aged between 2 and 24 months, in the context of pediatrician routine physical examination or psychological assessment. The eight items, each rated from zero to four (with low scores being optimal social behavior), are the following: facial expression; eye contact; general level of activity; self-stimulation gestures; vocalizations; briskness of response to stimulation; relationship to the observer, and attractiveness to the observer. The ADBB total score derives from the sum of the eight items. The higher the ADBB score the more signs of social withdrawal are shown by the infant. The cut-off point of 5 showed the best sensitivity (0.82) and specificity (0.78) to detect infants at risk (Guedeney & Fermanian, 2001). Inter-rater reliability was calculated using intra-class coefficient (ICC = .92). The Portuguese version of the scale has a reasonable internal consistency (α of Cronbach=.60) (Figueiredo & Costa, 2008).

Neuroendocrine reactivity to inoculation. Saliva samples were collected before (5 min) and after (20 min) routine inoculation at 8 to 12 weeks of life. The

inoculation was administered in between feedings. Infants did not have any sign or symptom of illness at the time of inoculation. Mothers were instructed not to feed the infant before the end of saliva collection. Plastic tubes (Salivette) containing a cotton roll that was placed inside the infants' mouth for about 2-3 minutes. On the day of testing, all specimens were taken to the laboratory and centrifuged to remove mucus and stored in a freezer (-20ºC). The saliva was assayed for cortisol concentration using a quimioluminescence method. Cortisol units are expressed in µg/dL. Cortisol reactivity was determined by computing the difference between the post-test and pre-test cortisol levels and referred to as δ cortisol.

Mother-infant interaction. The Global Rating Scales (GRS, Murray, Fiori-Cowley, Hooper, & Cooper, 1996; Gunning, Fiori-Cowley, & Murray, 1999) are a video-based assessment of the quality of mother-infant engagement that can be applied from 2 to 6 months post-partum either at the mother's home or in a laboratory setting. Mothers are instructed simply to play with their infants in any way they choose without the use of toys in a 5–min face-to-face play session. The scales globally assess the quality of: (1) mother's behavior, (2) infant's behavior, and (3) overall interaction.

Mother's behavior was rated according to three sub-scales that describe the degree to which a mother's behavior is appropriately adjusted to her infant: (1) Good-poor – computed through the average score of 5 items (warm/positive vs. cold/hostile, accepting vs. rejecting, responsive vs. unresponsive, non-demanding vs. demanding, sensitive vs. insensitive), with a sum score near 5 rated as "good" and a sum score near 1 rated as "poor". (2) Intrusive-remote – composed of 4 items (non-intrusive behavior vs. intrusive behavior, non-intrusive speech vs. intrusive speech, non-remote vs. remote, non-silent vs. silent) using the following formula: ([intrusive behavior+intrusive speech] / 2-[non-remote + silent] / 2) / 2 that gives a sum score running from -2 (intrusive) and +2 (remote), a sum score of 0 indicating that the person is neither intrusive nor remote. (3) Depressive – computed through the average of 4 items (happy vs. sad, much energy vs. low energy, absorbed in the infant vs. self-absorbed, relaxed vs. tense), with the higher score indicating less depressive signs.

Infant behavior was rated according to two sub-scales, describing the infants' positive engagement in the interaction, and behavior: (1) Good-poor - computed through the average of 3 items (attentive vs. avoidant, active communication vs. no

active communication, positive vocalizations vs. no positive vocalizations), with a sum score near 5 rated as "good" and a sum score near 1 rated as "poor". (2) Inert-fretful - composed of 4 items (engaged with the environment vs. self–absorbed, lively vs. inert, attentive vs. avoidant, happy vs. distressed, non-fretful vs. fretful) using the formula ([engaged+lively+attentive]/3-[happy+non-fretful]/2)/2, running from -2 (withdrawn) to +2 (fretful) with a sum score near 0 being optimal.

The overall interaction was rated using one sub-scale: (1) Good-poor composed of the average score of 5 items (smooth/easy vs. difficult, fun vs. serious, satisfying vs. unsatisfying, much engagement vs. no engagement, excited engagement vs. quiet engagement), a sum score of 5 is "good interaction" and near 1 is "poor interaction".

Procedures

This research was conducted in two public primary health care centers in Portugal. Mothers were contacted when attending to the routine inoculation of their one–month–old infants. Seventy nine percent of the mothers that were contacted agreed to participate, 16.5% declined to participate alleging lack of time and 4.5% were not interested in participating. The exclusion criteria were: illiteracy and multiple gestations. The aims and the procedures of the study were explained, and an informed consent was signed. All evaluation procedures were performed and video-taped either at home or at the primary health care center.

A socio-demographic questionnaire was filled out on infant's medical data and at 8 weeks of life the Neonatal Behavioral Assessment Scale (NBAS, Brazelton & Nugent, 1995) was performed and video-taped. This examination was conducted by trained and reliable examiners midway between feedings in a quiet and semi-darkened room with a temperature of 22º-27ºC. The NBAS was scored immediately after performed and was later visualized with two purposes: (1) analyzing potential doubts on NBAS scoring and (2) scoring the infants' performance on the Alarm Distress Baby Scale (ADBB, Guedeney & Fermanian, 2001). Between 8 and 12 weeks of life a saliva sample was collected from the participants mouth before (5 min) and after (20 min) routine inoculation. Later, between 12 and 16 weeks of life the Global Rating Scales (GRS, Murray et al, 1996; Gunning et al, 1999) were performed, video-taped and rated by trained and reliable examiners.

Data Reduction and Statistical Analyses

For the classification of infants in groups according to their performance on NBAS, ADBB and δ cortisol, a two-step procedure was performed. In the first step hierarchical models were computed as an exploratory technique for indicating the K to use in the second step: non-hierarchical model. A hierarchical cluster analysis was performed using Ward's method with a Euclidean distance measure. The criterion used for the number of clusters to retain was the R-square and the solution of fewer clusters with higher total variance explained was chosen. The classification of participants in the clusters was then refined using the K-means nonhierarchical cluster analysis for three cluster solution taking the Ward's results as starting values (Hair et al., 1998). The statistical analysis of the F ANOVA of the clusters was performed in order to identify the importance of each variable in the retained clusters.

Each of the three variables – NBAS total score, ADBB total score and δ cortisol – considered in the cluster analysis were converted to standard scores (z scores). The standardization of the variables eliminates the bias introduced by the differences in the scales of the variables, thus allowing each of them to equally contribute to the formation of the clusters (Hair, Anderson, Tatham, & Black, 1998).

For purposes of validity, stepwise discriminant analysis based on Wilks' Lambda was performed with the variables used in the cluster analysis (Blashfield & Aldenderfer, 1988).

ANOVAs followed by Bonferroni post-hoc test (Field, 2005) were used to examine group differences on neurobehavior, social withdrawal and δ cortisol.

To analyze differences between the groups on maternal and infant socio-demographic and medical data, chi-square tests were performed. Independent variables were: Maternal age, education, marital status, parity, type of gestation, time of gestation, type of delivery, type of anesthesia, infant gender, reanimation at birth, weight, apgar index at the 1st minute and type of feeding.

Several multivariate analyses of variance (MANOVAs) followed by univariate F test and Bonferroni post-hoc test (Field, 2005) were used to identify potential group differences on the quality of mother-infant interaction after the validation of the assumptions. The first MANOVA includes maternal items as dependent variables; the second was performed taking infant items as dependent variables; the third taking the

overall interaction items as dependent variables and the fourth taking GRS sub-scales as dependent variables. The validation of the assumption of homogeneity of variances-covariances using the M-Box test was guaranteed for maternal items (M = 190.695; F(91,2610) = 1.247; p = .059), infant items (M = 31.879; F(28,2867) = .896; p = .623), and interaction items (M = 60.045; F(30,1131) = 1.500; p = .051). Nonetheless this assumption was not met for GRS scales (M = 98.860; F(42,1078) = 1.633; p = .007). As there is no non-parametric test alternative to this test, we will interpret the results using the Pillai's Trace, which is the most adequate under these circumstances.

Results

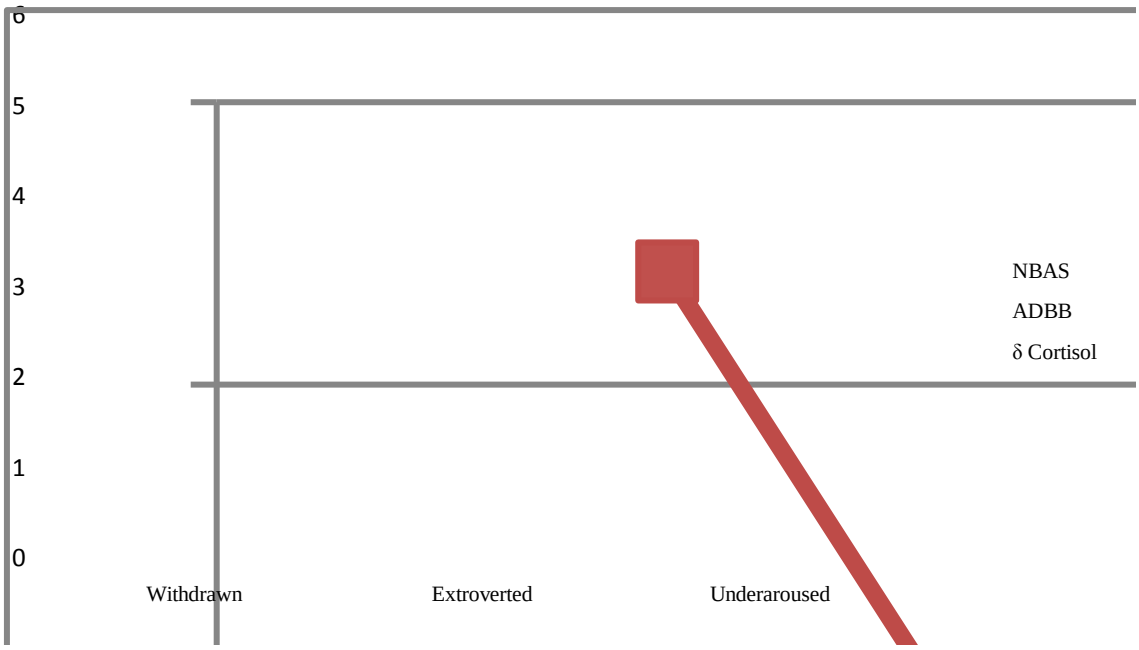
Infants' Psychophysiological Profiles

The three variables considered in the analysis were converted to standard scores: NBAS total score (M = 4.17; SD = .54), ADBB total score (M = 1.49; SD = 1.92) and δ cortisol (M = .30; SD = .37).

The hierarchical cluster analysis was performed using Ward's method with a Euclidean distance measure. Outliers were excluded using the criterion of distance from the mean greater than three times the value of the standard deviation. No Bravais-Pearson correlation coefficient was higher than .90, indicating no problems of multicollinearity. A high increase of the agglomeration schedule from a two-cluster (43.37%) to a three-cluster (54.40%) solution suggests a three-cluster solution to be suitable. According to the R-square criterion, three clusters were retained explaining 54.40% (R-sq = 0.544) of the total variance.

In order to "fine-tune" the results and verify the stability of the clusters derived from the hierarchical cluster analysis, a nonhierarchical K-means cluster analysis for the three cluster solution taking Ward's results as starting values was performed. Outliers were excluded applying the criterion of more than 1.00 units from the nearest cluster center. All variables contribute significantly to the differentiation of clusters: NBAS (F = 39.825, p < .000), ADBB (F = 62.697, p < .000) and δ cortisol (F = 19.148, p < .000). The first cluster was labeled "Withdrawn" profile and represents 17.0% of the sample. Infants in this cluster had a neurobehavioral performance below the sample mean, pathological signs of social withdrawal and neuroendocrine reactivity above the sample

mean. The second cluster was labeled "Extroverted" profile and represents 57.0% of the sample. Infants in this cluster have a neurobehavioral performance above the sample mean, and they show practically no symptoms of social withdrawal and a neuroendocrine reactivity slightly above the sample mean. The third cluster was labeled "Underaroused" profile and represents 26.0% of the sample. Infants in this cluster showed a neurobehavioral performance similar to the sample mean, some symptoms of social withdrawal and neuroendocrine reactivity below the sample mean. Figure 1 shows the cluster profiles.



Graphic 1: Infants' psychophysiological profiles

Stepwise Discriminant analysis based on Wilks' Lambda was performed with the variables entered in the clusters to identify factors that significantly discriminate between the three clusters. The normality assumption is valid as the test of equality of group means for all variables is <.05. The homogeneity of variances/covariances for each cluster was tested with the M Box test (M = 35.701, F = 2.626, p = .002) and it is not valid. Nonetheless, discriminant functions are quite resistant to the violation of this assumption as long as the dimension of the lower group is higher than the number of variables under study and the mean of the groups is not proportional to their variances

(Stevens, 1986). There are no problems of multicolinearity between variances since the *Variance Inflation Factor* for all variables are <5 and the *Tolerance* >.2 (Field, 2005).

The stepwise discriminant analysis extracted two discriminant functions and retained ADBB, NBAS and δ cortisol as significant variables. The two discriminant functions are significant. The first function is defined by ADBB and it explains 89.6% of the variability between clusters with eigenvalues of 4.69. This function significantly discriminates between the three clusters (Λ = 0.114, $X^2(6)$ = 117.422, p = .000). The second function retained is defined by NBAS and δ cortisol, and it explains 10.4% of the variability between clusters with eigenvalues of .55, and it also discriminates between the clusters (Λ = 0.647, $X^2(2)$ = 23.492, p < .000). The analysis shows that 94.8% of the cases were grouped correctly.

The ANOVA shows significant differences between groups on neurobehavior performance, social withdrawal and δ cortisol. The Bonferroni post-hoc test shows that withdrawn infants have a worse performance on NBAS compared to extroverted and underaroused infants and that underaroused infants have worse performance on NBAS compared to extroverted infants. Furthermore, withdrawn infants show more signs of social withdrawal compared to extroverted and underaroused infants, while underaroused infants show more signs of social withdrawal compared to extroverted infants. Underaroused infants have signidicantly lower neuroendocrine reactivity compared to withdrawn and extroverted infants. Table 2A shows ANOVAs results.

Table 2A

ANOVAs for analysing differences on the three groups of infants

	Withdrawn (A) (n=16) M (SD)	Extroverted (B) (n=56) M (SD)	Underaroused (C) (n=25) M (SD)	F	p	*Post-Hoc*
NBAS	3.47 (.39)	4.53 (.24)	3.73 (.43)	57.464	.000	A vs. B A vs C B vs. C
ADBB*	5.40 (1.51)	.44 (.81)	2.06 (1.12)	96.940	.000	A vs. B A vs. C B vs C
δ Cortisol	.36 (.33)	.32 (.29)	.08 (.16)	4.510	.015	A vs. C B vs C

*higher score is worse performance

Infants' Psychophysiological Profiles and Mother-Infant Interaction

In order to understand how infants with different psychophysiological profiles later interact with their mothers and vice-versa, a multivariate analysis of variance MANOVAs was performed.

First, associations were tested between the three groups of infants ("withdrawn", "extroverted" and "underaroused") regarding maternal and infant socio-demographic and medical data, using chi-square tests. Maternal variables considered were age (X=1.101, p=.577), education (X=1.559, p=.459), marital status (X=1.616, p=.656), parity (X=1.250, p=.741) and type of pregnancy (X=.672, P=.880). Infant variables were time of gestation (X=1.515, p=.469), type of delivery (X=7.657, p=.054), type of anesthesia (X=3.962, p=.682), gender (X=1.971, p=.578), reanimation at birth (X=5.909, p=.116), weight (X=1.134, p=.567) apgar index at the 1st minute (X=3.896, p=.143) and type of feeding (X=1.524, p=.677). No significant associations on maternal and infant socio-demographic and medical data were found between groups, so these variables were not controlled in further analyses.

Several multivariate analyses of variance (MANOVA) followed by univariate *f* test and Bonferroni post-hoc test were performed to analyze potential differences in groups regarding (1) Mother's behavior, (2) Infant's behavior, and (3) Overall interaction.

Mother's Behavior in the Interaction

The significance of infant psychophysiological profile on mother's behavior in the interaction (GRS maternal items) was evaluated with a MANOVA and was not significant (Pillai's Trace=.561; $F(2,96) = 1.140$; $p = .322$). Subsequent univariate analyses followed by the Bonferroni post-hoc test, indicated that mothers of withdrawn infants were less sensitive (*IC*95%]-1.25, .30[; $p = .028$), happy (*IC*95%]-1.44, -.04[; $p = .035$), and spent less energy (*IC*95%]-1.64, -.26[; $p = .025$) than mothers of underaroused infants and were less sensitive than mothers of extroverted (*IC*95%]-1.28, -.40[; $p = .042$) infants. Mothers of underaroused infants were more sensitive (*IC*95%]-

1.87, -.21[; p = .011) and spent more energy (*IC*95%]-1.57, -.23[; p = .042) in the interaction compared to mothers of extroverted infants (see Table 3A).

Table 3A

Univariate F test for mother's behavior in the interaction (GRS items)

	Withdrawn (A) (n=16) Mean (SD)	Extroverted (B) (n=56) Mean (SD)	Underaroused (C) (n=25) Mean (SD)	F	p	*Post-Hoc*
Warm/Positive	4.14 (.90)	4.37 (.56)	4.73 (.59)	2.703	.077	
Accepting	4.29 (.95)	4.73 (.52)	4.73 (.59)	1.631	.206	
Responsive	3.86 (1.07)	4.30 (.65)	4.47 (.52)	1.908	.159	
Non-demanding	4.14 (1.21)	4.00 (.98)	4.07 (.80)	.071	.933	
Sensitive	3.06 (.90)	4.03 (.57)	4.80 (.51)	3.784	.030	A vs. C A vs. B B vs. C
Non-intrusive Behavior	3.57 (1.40)	4.20 (.92)	4.07 (.88)	1.159	.322	
Non-intrusive Speech	4.43 (1.13)	3.93 (.98)	4.20 (.56)	1.049	.358	
Non-remote	4.29 (.95)	4.33 (.76)	4.53 (.64)	.422	.658	
Non-silent	4.14 (1.07)	4.50 (.78)	4.80 (.56)	1.845	.169	
Happy	3.43 (.79)	4.00 (.74)	4.47 (.64)	5.179	.009	A vs. C
Much Energy	3.89 (.76)	4.04 (.62)	4.78 (.41)	2.836	.048	A vs. C B vs. C
Absorbed in the Infant	4.14 (.90)	4.30 (.88)	4.60 (.63)	.973	.385	
Relaxed	4.00 (1.00)	4.50 (.57)	4.67 (.49)	2.794	.071	

Infant's Behavior in the Interaction

The significance of infant's psychophysiological profile on infant's behavior in the interaction (GRS infant items) was evaluated with a MANOVA and was significant (Roy's Largest Root = .406; $F(2,96) = 2.552$; p = .027). Subsequent univariate analyses

followed by the Bonferroni post-hoc test (see table 4A) indicated that compared to extroverted infants, withdrawn infants were less attentive (*IC*95%]-2.10, -.14[; *p* = .021), showed less active communication (*IC*95%]-2.30, -.12[; p = .026), less positive vocalizations (*IC*95%]-2.83, -.61[; *p* = .001), less engagement with the environment (*IC*95%]-1.76, -.19[; *p* = .011) and were less happy (*IC*95%]-1.84, -.02[; *p* = .056). Compared to underaroused infants, withdrawn infants had less positive vocalizations (*IC*95%]-2.73, -.31[; *p* = .010). Compared to extroverted infants, underaroused infants were less attentive (*IC*95%]-1.95, -.34[; *p* = .045) and less engaged with the environment (*IC*95%]-1.60, -.20[; *p* = .030).

Table 4A

Univariate F test for infant's behavior in the interaction (GRS items)

	Withdrawn (A) (n=16) Mean (SD)	Extroverted (B) (n =56) Mean (SD)	Underaroused (C) (n=25) Mean (SD)	F	p	*Post-Hoc*
Attentive	3.43	4.50	3.84			A vs. B
	(1.13)	(0.68)	(1. 10)	4.549	.015	B vs. C
Active Communication	2.86	4.07	3.93			A vs. B
	(0.90)	(1.01)	(1.10)	3.984	.025	
Positive Vocalizations	2.14	3.87	3.67			A vs. B
	(0.69)	(1.07)	(1.11)	7.778	.001	A vs. C
Engaged with	3. 86	4.83	4.00			A vs. B
Environment	(1.21)	(0.59)	(0.74)	5.000	.011	B vs. C
Lively	3.86	4.50	4.40			
	(0.38)	(0.78)	(0.74)	2.219	.120	
Happy	2.86	3.77	3.33			A vs. B
	(0.38)	(0.94)	(0.90)	3.538	.037	
Non-fretful	4.00	4.30	4.13			
	(1.00)	(0.84)	(0.92)	.412	.665	

Overall Interaction

The significance of the clusters on overall interaction (GRS items) was evaluated with a MANOVA and was significant (Roy's Largest Root = .358; *F*(2,96) = 3.250; *p* = .013). Subsequent univariate analyses followed by the Bonferroni post-hoc test, indicated a significant effect of all the items of the overall interaction (see Table 5A).

Compared to overall interaction of extroverted infants, the overall interaction of withdrawn infants is more difficult (*IC*95%]-2.10, -.17[; *p* = .017), serious (*IC*95%]-2.06, -.04[; *p* = .039), unsatisfying (*IC*95%]-2.06, -.02[; *p* = .044), shows less engagement (*IC*95%]-2.15, -.39[; p = .003) and less excited engagement (*IC*95%]-2.39, -.28[; *p* = .009). Compared to the overall interaction of underaroused infants, the overall interaction of withdrawn infants is more difficult (*IC*95%]-2.13, -.12[; *p* = .025) and with less engagement (*IC*95%]-1.98, -.01[; *p* = .046). Compared to extroverted infants, underaroused infants have less fun in the interaction (*IC*95%]-2.16, -.31[; *p* = .042).

Table 5A

Univariate F test for the overall interaction (GRS items)

	Withdrawn (A) (n=16) Mean (SD)	Extroverted (B) (n =56) Mean (SD)	Underaroused (C) (n=25) Mean (SD)	F	p	*Post-Hoc*
Smooth/Easy	3,14	4.23	4.07			A vs. B
	(1.07)	(0.73)	(1.03)	4.854	.012	A vs. C
Fun	2.71	3.77	2.97			A vs. B
	(0.95)	(0.94)	(0.99)	3.518	.037	B vs. C
Satisfying	2.86	3.90	3.53			A vs. B
	(0.90)	(0.88)	(1.13)	3.505	.038	
Much engagement	3.43	4.70	4.40			A vs. B
	(1.27)	(0.53)	(1.06)	6.715	.003	A vs. C
Excited engagement	2.43	3.77	3.33			A vs. B
	(0.79)	(0.82)	(1.35)	5.318	.008	

A multivariate analyses of variance (MANOVA) for identifying potential group differences on the GRS sub-scales was performed. The MANOVA for the GRS scales was marginally significant (Pillai's Trace = .390; *F*(2,96) = 1.817; *p* = .057). Subsequent univariate analyses followed by the Bonferroni post-hoc test, as recommended by Field (2007), indicated a significant effect of mother depressive sub-scale, infant attentiveness/communication sub-scale and overall interaction sub-scale (see Table 6A). Compared to extroverted infants, withdrawn infants are less attentive/communicative (*IC*95%]-2.22, -.45[; *p* = .002) and the overall interaction is worse (*IC*95%]-2.01, -.30[; *p* = .005). Compared to underaroused infants, withdrawn infants' mothers have more depressed behaviors in the interaction (*IC*95%]-1.25, -.09[;

p = .020), are less attentive/communicative (*IC*95%]-2.05, -.11[; *p* = .025) and the overall interaction is worse (*IC*95%]-1.82, -.05[; *p* = .066). Extroverted and underaroused infants differ in that extroverted are more attentive/communicative than underaroused infants (*IC*95%]-1.80, -.20[; *p* = .032).

Table 6A

Univariate F test for GRS sub-scales

		Withdrawn (A) (n=16) Mean (SD)	Extroverted (B) (n =56) Mean (SD)	Underaroused (C) (n=25) Mean (SD)	F	p	*Post-Hoc*
Mother	Good vs. Poor	4.06 (,75)	4.37 (,42)	4.52 (,48)	2.141	.128	
	Intrusive vs. Remote	-.11 (.64)	-.17 (.48)	-.27 (.33)	.327	.722	
	Depressive	3.96 (.57)	4.30 (.54)	4.63 (.38)	4.608	.015	A vs. C
Infant	Attentive/ Communicative	2.81 (.81)	4.14 (.78)	3.40 (.95)	7.231	.002	A vs. B A vs. C B vs. C
	Inert vs. Fretful	.14 (.53)	.29 (.39)	.31 (.46)	.400	.673	
Interaction	Overall Interaction	2.91 (.87)	4.07 (.66)	3.80 (1.02)	5.886	.005	A vs. B A vs. C

Discussion

This study was conducted with the aim of (1) identify and profile groups of infants according to their psychophysiological characteristics – neurobehavior organization, social withdrawal behavior and neuroendocrine reactivity to acute stress –, and (2) analyze potential group differences on the quality of mother-infant interaction.

In the study of neonatal psychophysiological characteristics, three profiles were identified: (1) "Withdrawn" infants showed severe signs of social withdrawal, a neurobehavioral performance below the sample mean and neuroendocrine reactivity above the sample mean; (2) "Extroverted" infants showed practically no signs of social withdrawal, had a neurobehavioral performance above the sample mean and

neuroendocrine reactivity slightly above the sample mean, and (3) "Underaroused" infants showed some signs of social withdrawal, and a neurobehavioral performance and neuroendocrine reactivity below the sample mean. Thomas, Chess, and Birch (1968) argued that as early as the age of two or three months infants display a discernible behavioral profile. The authors derived three patterns of temperament based on the constellation of the nine characteristics: "Difficult", "Easy" and "Slow to warm up". The "difficult" children withdraw from stimulus similarly to our "withdrawn" infants. Additionally they are irregular, have intense reactions, difficulties to adapt and negative mood. The "easy" children resemble our "extroverted" infants in their adaptability and approach features; additionally they are characterized by positive mood, regularity, low/moderate intensity of reaction. The "slow to warm up" are slow to adapt and show low intensity of reactions which resembles our "underaroused" infants. Furthermoere they withdraw only in the first exposure to stimuli, have some negative mood and have a low activity level.

Differences between groups in terms of the quality of mother-infant interaction were noted. In general, the quality of mother–infant interaction was extremely worse in the group of withdrawn infants compared to extroverted and underaroused infants and it was slightly worse in the group of underaroused compared to extroverted infants. This result highlights the impact of psychological individual differences early in life on the development of significant relations (van den Boom & Hoeksma, 1994).

Withdrawn infants had less sensitive mothers, were themselves less attentive, communicative, and happy, and expressed less positive vocalizations and less engagement with the environment than extroverted infants. The overall interaction was worse: less smooth, less fun, less satisfying, and showing less engagement and less excitement in the engagement than extroverted infants. Extroverted infants differ from withdrawn infants on neurobehavior and social withdrawal and that seems to reflect itself on the quality of mother infant interaction. This result is consistent with previous findings of Nugent et al. (1993) that noted that a better neonatal neurobehavior was associated with better mother-infant interaction. Similar results were obtained by Murray et al. (1996) that found poor neurobehavior to be predictive of worse infant behavior in face-to-face interactions with the mother.

Compared to underaroused infants, withdrawn infants were less attentive, less communicative, and expressed less positive vocalizations while their mothers expressed

more depressive behaviors, were less sensitive, less happy and displayed less energy in the interaction. The overall interaction was worse: more difficult and showing less engagement than underaroused interactions. Underaroused infants differ from withdrawn infants not only on neurobehavior and social withdrawal but also on neuroendocrine reactivity. In fact, withdrawn infants have higher cortisol reactivity in response to an acute stressor compared to underaroused infants. Greater reactivity of the HPA axis was also associated with lower maternal sensitivity and responsivity in previous studies (e.g. Albers et al., 2008). The possible link to this association may relie on the fact that high HPA axis reactivity is associated to infant proneness to distress, less positive emotionality and fearful temperament (e.g. Gunnar et al., 1989; Ramsay & Lewis, 2003; Talge, Donzella, & Gunnar., 2008). It is possible that these temperamental difficulties make it more difficult for the mother to understand the infant's needs and adequate her behavior to those needs. In turn, this translates in a more demanding task for the caregiver to modulate and help the infant to regulate behavioral and biological responses to stressors (Gunnar & Quevedo, 2008).

Other explanation is that, since these mothers express significantly more depressive behaviors in the interaction, it is possible that they might be experiencing psychological difficulties that influence both their behaviors in the interaction and the quality of the overall interaction (e.g. Boyd, Zayas, & McKee, 2006; Tronick & Weinberg, 1997)).

With regard to the comparision of withdrawn infants with the other two groups of infants, the results of this study are consistend with the results of Puura et al. (2007). These authors found that withdrawn infants had a poor performance during the interaction with their mothers compared to non-withdrawn infants. Additionally, mothers of social withdrawn infants demonstrated less optimal behaviors in the interaction with their infants when compared to mothers of non-withdrawn infants. Withdrawn infants were significantly less engaged and more inert than non-withdrawn infants, and their mothers were less engaged and more intrusive. Whatever might be the explanation for the mechanisms beneath this pattern of behaviors, this group of infants may be considered a risk group for developmental difficulties, because the impairment of the quality of interaction has been related to later infant difficulties (Evans & Porter, 2009)

When we consider the groups of extroverted and underaroused infants, some differences were found between them in terms of infant behavior, maternal behavior and overall interaction. Mothers of underaroused infants spend significantly more effort in the interaction, nonetheless infants do not respond as well as extroverted infants and the quality of the interaction is poorer. Although mothers of underaroused infants are more sensitive and spend more energy on the interaction; infants are less attentive and less engaged with the environment and the interaction is less fun. Underaroused infants are unresponsive in the interaction despite of their mothers' best effort to engage. This group of infants resemble the hyposensitive/under-responsive infant described in the diagnostic classification of mental health and developmental disorders of infancy and early childhood (Zero to three, 2005). According to this, hyposensitive infants are quiet, watchful and seem unresponsive to the environment and unreceptive to overtures from others. This hypo-reactivity is due to "their failure to reach the threshold of arousal that would motivate them to act and interact" (Zero to three, 2005) and not to sadness or lack of interest in their surroundings. Usually, they require high-intensity sensory input before they are able to respond. We might postulate that underaroused mothers' "extra-sensitivity" competences might have been elicited by their infants' hyposensitive behaviors and developed as an adaptative response to engage with them. This process was denominated "reactive genotype-environment correlation" by Plomin, deFries and Loehlin (1977), and if that is so, then we can infer that individual differences early in life interfere with parental behavior in the interaction.

It seems that underaroused infants were less competent on giving feedback to the caregiver and this might be a powerful predictor of his/her potential for future development, since it is likely to shape the environment to react in a particular way. Nonetheless, their mothers were extremely sensitive and responsive to their infants' cues and were eager to interact with their infants and very energetic and persistent in the effort of responding to their demands. The underaroused mothers' investment and involved behavior in the relationship may be a protective factor for the resolution of future difficulties. The question is whether this pattern of persistence and energy will or will not remain over time as the infant grows older.

The identification of infants with different psychophysiological profiles may contribute to the understanding of developmental trajectories that could lead to

(in)adaptative development. The lack of connectedness that characterizes both mother and withdrawn infant behavior in the interaction is often the reflection of the low care offered by the mother. Mothers miss or misinterpret their infants' cues and so they are unresponsive/insensitive to those cues, thus ignoring, rejecting or failing to comfort the infant. This study alerts us to the fact that withdrawn infants may be at risk for developmental difficulties due to both infant and mother difficulties in the interaction. The quality of infant interaction with the primary caregiver is a relevant issue because within this relationship the infant develops a sense of what is expected of him/her and of what is possible in the relationship with others. The infant will also develop competencies for social initiation, reciprocity, synchrony, and cooperation. The capacity for increased emotional regulation and self-control develops throughout repeated positive social experiences (Zero to three, 2005).

Previous studies pointed out the importance of specific psychological aspects of infants on the quality of mother-infant interaction The major contribution of this study relies on considering the interplay of both psychological and physiological features and its impact on the mothers' behavior and on the quality of mother-infant interaction. Further research is needed to study the developmental pathways of different groups of infants, namely the mediator effect of the quality of mother-infant interaction on the association between infant psychophysiological profile and child development. Future research should also address the different psychophysiological profiles as potential precursors of psychological problems such as depression, anxiety, attention deficit hyperactivity disorder or autism, in order to understand the developmental pathways of these disorders.

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Infant's Psychophysiological Profile and Temperament at 3 and 12 Months

Abstract

Objective: This study is intended to analyze (1) differences in infant temperament at 3 and 12 months according to infants' psychophysiological profiles: "withdrawn", "extroverted", and "underaroused", (2) changes in infant temperament from 3 to 12 month, and (3) changes in infant temperament from 3 to 12 months according to the infant psychophysiological profile and the quality of mother-infant interaction. **Method:** Ninety four 8 week-old infants were assessed using the Neonatal Behavioral Assessment Scale (NBAS, Brazelton & Nugent, 1995) and the Alarm Distress Baby Scale (ADBB, Guedeney & Fermanian, 2001). Saliva samples were collected at 8 to 12 weeks old, both before and after a routine inoculation for cortisol reactivity measurement. Mother infant interaction was evaluated at 12 to 16 weeks, using the Global Rating Scales (GRS, Murray, Fiori-Cowley, Hooper, & Cooper, 1996) and mothers' reports on infant temperament at 3 and 12 months were collected using the Infant Behavior Questionnaire (IBQ, Rothbart, 1981). **Results:** Significant differences in mothers' perception of infant temperament were found at both 3 and 12 months in infants with distinct psychophysiological profiles. Stability was observed in most of the temperament's dimensions from 3 to 12 months old; still, there were changes in mothers' perception of infant temperament in terms of level of distress, cuddliness, sadness and approach. Infant psychophysiological profile and mother-infant interaction both interfere with the pattern of those changes. **Conclusion:** The results corroborate that both infant's early life characteristics and the environmental factors interfere with mothers' perception of infant temperament and their changes across the 1st year of life.

Keywords: infant temperament, mother-infant interaction, neurobehavior, neuroendocrine reactivity, newborn, social withdrawal.

There is no clear consensus about the nature of the temperament construct, although it is almost completely accepted that temperament has early development and biologic roots (Goldsmith, et al. 1987), even if its characteristics may change over time. Several approaches to the construct have been advanced; Thomas, Chess, and Birch (1968) argued that infants begin to express themselves as individuals from the time of birth and show distinct individuality in temperament in the first weeks of life. Furthermore, they claimed that at as early as the age of two or three months there is a discernible behavioral profile or temperament which is defined essentially by nine features: activity level, rythmicity (regularity), approach or withdrawal, adaptability, threshold of responsiveness, intensity of reaction, quality of mood, distractibility, attention span and persistence. Three general types of temperaments are derived from the constellation of the nine characteristics: "Easy", "Difficult", and "Slow to warm up". The "easy" children are characterized by a positive mood, regularity, low/moderate intensity of reaction, adaptability and approach. The "difficult" children are irregular, have intense reactions, withdraw from stimuli, have troubles adapting and a negative mood. The "slow to warm up" show a low activity level, only withdraw at the first exposure to stimuli, are slow to adapt, have a mildly negative mood and low intensity reactions. These authors hypothesized that personality is shaped by the constant interplay of temperament and environment. If there is harmony between the infant's characteristics and the environment, the child is expected to show a healthy development. Behavioral disorders appear when there is a conflict between the child's temperament and the environmental demands.

Rothbart's (1981) psychobiological oriented approach to temperament emphasizes primarily biological based individual differences in reactivity and self-regulation. Reactivity refers to the characteristics of individual's reactions to stimulus change that include behavioral, endocrine, and nervous system responses. Self-regulation refers to the processes that modulate reactivity (e.g. approach, avoidance, attentional orientation and selection (Rothbart & Posner, 1985; Rothbart, Derryberry, & Posner, 1994). Behaviorally, temperament is relatively stable and can be observed as a set of individual differences in the emotionality, activity, and attention patterns (Goldsmith et al., 1987). These authors have been studying different variables of the temperament including approach, high and low intensity pleasure, smile and laughter,

activity level, perceptual sensitivity, sadness, distress to limitation, fear, falling reactivity, cuddliness, duration of orientation, soothability and fear (Derryberry & Rothbart, 1988).

Buss and Plomin (1984), for instance, define temperament as a set of inherent personality traits of genetic origin that appear during the first year of life. On the other hand, Goldsmith and Campos (1986) conceived temperament as emotional in nature, referring to individual differences in the probability of experiencing and expressing the primary emotions and arousal.

Parental and Infant Factors Associated with Infant Temperament

Temperament is an important dimension of the infant's and it has been associated with antenatal and postnatal maternal mood as well as with parental and infant socio-demographic and medical factors. Ventura and Stevenson (1986) found that both parental socio-demographic factors and psychopathology (depression/somatic complaints) were related to infant temperament: infants from higher socio-economic status backgrounds showed a tendency to present lower levels of soothability and higher levels of distress to limitations. Recently, Jansen et al. (2009) reported that difficult temperament, characterized by higher scores on activity level, duration of orientation, and fear, was found in infants whose mothers had a low education level. Temperament has also been related to maternal physical symptoms, feelings of incompetence, negative reinforcement from the infant, and negatively associated with spousal emotional support (Clark, Hyde, Essex, & Klein, 1997). Van den Bergh (1990) found that women's state and trait anxiety elevations in the 3rd trimester were related to difficult temperament at 10 weeks and 7 months. Antenatal stress was related to problems in adaptation to novelty at the age of 3 months (Buitelaar, Huizink, Mulder, de Medina, & Visser, 2003). In another study it was associated with reduced infant crying at 4 months of age (Mohler, Parzer, Brunner, Wiebel, & Resch, 2006). The odds of the child being classified as having high cry reactivity increased if the mother was depressed and/or had an anxiety disorder during pregnancy. Having a psychiatric diagnosis during pregnancy was associated with greater cry reactivity to novelty at 4 months old (Werner et al., 2007).

Studies on infant characteristics relied mainly on prematurity, gender differences and physiological functioning. Prematurity has been associated with less rhythmic, more distractability, less approaching (Hughes, Shults, McGrath, & Medoff-Cooper, 2002). Boys exhibit higher activity and approach levels (Campbell & Eaton, 1999; Maziade, Boudreault, Thivierge, Caperaa, & Cote, 1984), whereas girls show higher hesitation when approaching novel objects (Martin, Wisenbaker, Baker, & Huttunen, 1997; Rothbart, 1988). Studies on infant physiological functioning and temperament have provided evidence regarding the association of both basal adrenocortical activity (Gunnar, Mangelsdorf, & Hertsgaad, 1989; Gunnar, Larson, Hertsgaad, Harris, & Brodersen, 1992; Kagan, Reznick, & Snidman, 1987) and cortisol responses (Gunnar et al., 1989; Ramsay & Lewis, 2003; Talge, Donzella, & Gunnar, 2008) with temperament. For example, Gunnar et al. (1992) found that maternal reports of infant distress to limitation predict the infant adrenocortical responses to separation. Talge et al. (2008) showed that greater cortisol reactivity was associated with fearful temperament.

Still the literature on the subject evidences a gap in the knowledge of the early life infant neurobehavioral characteristics that affect the maternal perception of infant temperament.

Stability and Change in Individual Differences

Another major empirical issue in infant temperament research concerns the stability of individual differences (Bates, 1987). Some authors argue that the original characteristics of temperament tend to remain constant in quality over the years, although environmental circumstances may influence the infants' reactions and behavior throughout the development (Thomas et al., 1968). As a child develops, there are manifestations of temperamental change over time, with rapid development during infancy (Rothbart, 1989). Some dimensions of temperament such as positive emotionality, level of activity, approach, distress to limitations, and fear tend to increase throughout the first year of life (Carranza, Perez-Lopez, Gonzalez, & Martinez-Fuentes, 2000; Rothbart, 1986, 1988, 1989), while others, like attention and orientation develop in a U-shape curve (Ruff & Rothbart, 1996). Greater stability was found in aggregated

scores, particularly in those reflecting difficultness (Lee & Bates, 1985) or emotionality (Matheny, Riese, & Wilson, 1985; Riese, 1987). The continuation of a child being classified as temperamentally difficult was found to be of about 50% at ages from 6 to 24 months (Lee & Bates, 1985; McNeil & Persson-Blennow, 1988).

(Dis)Continuity in infant temperament, and the comprehension of the variables that influence it, is an extremely relevant challenge within developmental theory and research. Some researchers attempted to answer the question of what are the conditions for continuity and discontinuity in infant temperament. Matheny (1986) found that infants' who had become less negative, more attentive, and more socially oriented at an age from 12 to 24 months, came from more emotionally cohesive families and their mothers were more expressive and involved with them. Similarly, Washington, Minde, and Goldberg (1986) found that preterm babies who became less difficult over time (compared with premature infants that became more difficult) had more sensitive mothers. Engfer (1986) found that mothers who perceived their infants as becoming more difficult between 4 and 18 months were less sensitive and experienced more marital problems, while mothers perceiving their infants as becoming less difficult were more relaxed, optimistic and less irritable.

Because temperament is thought to be related to child developmental problems such as attachment security (Seifer, Schiller, Sameroff, Resnick, & Riordan, 1996), internalization/externalization behavior problems (Belsky, Hsieh, & Crnic, 1998), hyperactivity (Wolke, Rizzo, & Woods, 2002), depression (Gartstein & Bateman, 2008) and anxiety disorders (Lindhout, Markus, Hoogendijk, & Boer, 2009), the study of infant characteristics as well as early mother-infant interaction associated with infant temperament is of great interest. In this study we intend to analyze (1) differences in infant temperament at 3 and 12 months according to infants' psychophysiological profiles: "withdrawn", "extroverted", and "underaroused", (2) changes in infant temperament from 3 to 12 month, (3) changes in infant temperament from 3 to 12 months according to the infant psychophysiological profile and the quality of mother-infant interaction.

Method

Sample

The sample was composed of 94 infants. Most infants were born after a normal and full-term gestation. More than half were born through a distocic delivery and generally had no need for reanimation. At birth, the infants' height ranged from 45.90cm to 54.00cm (*M* = 49.44cm, *SD* = 1.84), the cephalic perimeter ranged from 31cm to 37cm (*M* = 34.60cm, *SD* = 1.29), weight ranged from 2450gr to 4055gr (*M* = 3243gr, *SD* = 424) and the ponderal index ranged from 2.24 to 3.29 (*M* = 2.71, *SD* = 0.23). The apgar scores ranged from 5 to 10 (*M* = 8.63, *SD* = 0.91) in the 1st minute of life and from 8 to 10 (*M* = 9.76, *S*D = 0.53) in the 5th minute of life (see Table 1B).

Table 1B

Socio-Demographic and Medical Data

Maternal and Gestational Data		(%)	Neonatal Data		(%)
Maternal Age	≥20 Λ ≤34	95.8	Time of Gestation	<37	7.3
	>35	4.2		≥37 Λ ≤40	82.4
				>40	10.3
Year of Education	<9	22.7	Gender	Female	46.5
	≥9	77.3		Male	54.5
Marital Status	Married	81.3	Reanimation at birth	No	94.8
	Cohabiting	18.7		Yes	5.2
Parity	Primiparous	83.6	Weight	<2500gr	1.4
	Multiparous	16.4		≥2500gr	98.6
Type of Gestation	Normal	81.2	Ponderal Index	<2.5	13.3
	Risk	18.8		≥2.5	86.7
Type of Delivery	Eutocic	34.4	Apgar Index: 1st m	<7	3.6
	Distocic	65.5		≥7	96.4
Type of Anaesthesia	None	2.8	Type of feeding	Beastfeed	89.5
	Epidural	86.5		Bottle-Feed	10.5
	General	10.6			

Procedures

This research was conducted in Primary Health Care Centers in Espinho (*N* = 50) and Santa Maria da Feira (*N* = 44) (Portugal). The mothers were contacted when attending the routine inoculation of their one month-old infants. 96% of the contacted mothers agreed to participate, 3% declined participation alleging lack of time and 1% alleged lack of interest. The exclusion criteria were: incapability to read or write Portuguese and multiple gestations. The study's aims and procedures were explained, and the mothers signed an informed consent. All evaluation procedures were performed and videotaped either at the mothers' homes or at the Primary Health Care Center.

A socio-demographic questionnaire on the infants' medical data was filled out and at their 8 weeks of life the assessment using the Neonatal Behavioral Assessment Scale (NBAS, Brazelton & Nugent, 1995) was performed and video-taped. This examination was conducted in a particular sequence by trained and reliable examiners halfway between feedings in a quiet and semi-darkened room with a temperature of 22º-27ºC. The NBAS scores were taken immediately after performing the assessment and were later visualized with two purposes: (1) - to analyze potential doubts on NBAS scoring and (2) - to score the infant's performance on the Alarm Distress Baby Scale (ADBB, Guedeney & Fermanian, 2001). At between 8 and 12 weeks of life, a saliva sample was collected from the infants' mouth before (5 min) and after (20 min) a routine inoculation. Mother infant interaction was evaluated at 12 to 16 weeks, using the Global Rating Scales (GRS, Murray, Fiori-Cowley, Hooper, & Cooper, 1996). At 3 and 12 months the Infant Behavior Questionnaire (IBQ, Rothbart, 1981) was filled out by the mothers.

Measures

Neonatal behavior. The Neonatal Behavioral Assessment Scale (NBAS, Brazelton & Nugent, 1995) assesses the newborn's competencies across different developmental areas – autonomic, motor, states and social – and describes how these areas are integrated. The scale, composed of 28 behavioral and 18 reflex items, is suitable for examining newborns and infants up to two months old and is based on several key assumptions: (1) infants are highly capable when they are born, (2) infants

"communicate" through their behavior, and (3) infants are social organisms. By the end of the assessment, the examiner has a behavioral "portrait" of the infant, describing his/her strengths, adaptive responses and possible vulnerabilities. The 28 items of the NBAS are scored on a 9-point scale. For the NBAS total score, behavioral and reflexes items were recoded so that a better performance corresponds to higher score and were then added. The alpha of Cronbach of the scales ranged from .54 (autonomic stability) to .74 (range of state) (Costa et al., submitted).

Social withdrawal. The Alarm Distress Baby Scale (ADBB, Guedeney & Fermanian, 2001) consists of eight items and aims to assess prolonged reactions of social withdrawal in infants. The ADBB was created to help assessing social withdrawal in children aged between 2 and 24 months, in the context of a pediatrician routine physical examination or a psychological assessment. To enable the observation of a child's behavioral response, the clinician must engage the infant in social behavior by talking, touching and smiling to him). The eight items, each one rated from zero to four (the lowest scores representing optimal social behavior), are: facial expression; eye contact; general level of activity; self-stimulation gestures; vocalizations; briskness of response to stimulation; relationship with the observer, and attractiveness to the observer. The ADBB total score is given by the sum of the eight items. The higher the ADBB results the greater the signs of social withdrawal shown by the infant. The cut-off point of 5 resulted in the best sensitivity (0.82) and specificity (0.78) to detect infants at-risk (Guedeney & Fermanian, 2001). Inter-rater reliability was calculated using an intra-class coefficient (ICC = .92). The Portuguese version of the scale has a reasonable internal consistency (α of Cronbach = .60) (Figueiredo & Costa, 2008).

Neuroendocrine reactivity to inoculation. Saliva samples were collected before (5 min) and after (20 min) routine inoculation between 8 to 12 weeks old. A cotton roll was placed in the infant's mouth for about 2-3 minutes and then put into a plastic tube (Salivette). On the day of the testing, all specimens were taken to the laboratory where they were centrifuged to remove mucus and then stored in a freezer (-20ºC). All saliva samples were assayed for cortisol concentration using a quimioluminescence method. Cortisol units are expressed in µg/dL. The difference between the post-test and pre-test cortisol was calculated and referred to as "δ cortisol".

Infant temperament. The Infant Behavior Questionnaire - Revised (IBQ-R, Gartstein, & Rothbart, 2003) is a revised version of the IBQ (Rothbart, 1981) which was designed to assess temperament in infants aged between 3 and 12 months. The Portuguese version used in this study was obtained after translation and back-translation of the aforementioned one. It is composed of 191 items scored on a 7 points Lickert scale. It assesses the following 14 dimensions of temperament: (1) activity level: movement of arms and legs, squirming and locomotor activity. (2) Distress to limitations: baby's fussing, crying or showing distress while a) in a confining place or position; b) involved in caretaking activities; c) unable to perform a desired action. (3) Approach: rapid approach, excitement, and positive anticipation of pleasing activities. (4) Fear: the baby's startle or distress to sudden changes in stimulation, novel physical objects or social stimuli; inhibited approach to novelty. (5) Duration of orienting: the baby's attention to and/or interaction with a single object for extended periods of time. (6) Smiling and laughter: the child's smile or laughter in general caretaking and playing situations. (7) Vocal reactivity: amount of vocalization exhibited by the baby in daily activities. (8) Sadness: general low mood; lowered mood and activity specifically related to personal suffering, physical state, object loss, or inability to perform a desired action. (9) Perceptual sensitivity: amount of detection of slight, low intensity stimuli from the external environment. (10) High intensity pleasure: amount of pleasure or enjoyment related to high stimulus intensity, rate, complexity, novelty, and incongruity. (11) Low intensity pleasure: amount of pleasure or enjoyment related to situations involving low stimulus intensity, rate, complexity, novelty, and incongruity. (12) Cuddliness: the baby's expression of enjoyment and shaping of the body to express desire of being held by a caregiver. (13) Soothability: baby's reduction of fussing, crying, or distress when the caretaker uses soothing techniques. (14) Falling reactivity/rate of recovery from distress: rate of recovery from peak distress, excitement, or general arousal; ease to fall asleep. Three dimensions of temperament were computed: (1) surgency/extraversion – computed from the mean scores of approach, vocal reactivity, high intensity pleasure, smiling and laughter, activity level and perceptual sensitivity; (2) negative affectivity – computed from the mean scores of distress to limitation, fear and falling reactivity; (3) orienting/regulation – computed

from the mean scores of low intensity pleasure, cuddliness, duration of orienting and soothability.

The IBQ reliability is good (Rothbart, 1986). Cronbach's alpha for surgency/extraversion was 0.92, with estimates for the negative affectivity and orienting/regulation factors both equaling 0.91 (Gartstein & Rothbart, 2003). The Portuguese version of this instrument shows good internal consistency in all the sub-scale with alpha of Cronbach ranging from 0.70 to 0.93 (Costa & Figueiredo, submitted).

Mother-infant interaction. The Global Rating Scales (GRS, Murray et al., 1996; Gunning, Fiori-Cowley, & Murray, 1999) were developed to assess differences in mother-infant interaction between women who were or who were not depressed. This is a video-based assessment of the quality of the mother-infant engagement that can be applied from 2 to 6 months post-partum and can be carried out either at the mother's home or in a laboratory setting. Mothers are instructed simply to play with their infants in any way they choose without the use of toys. The mother was asked to sit in front of the infant and play with him/her for a 5 minute face-to-face playing session. A video camera was set up to film the event in order to obtain a full image of the infants' body, and the mother's full-face image was also filmed using a mirror placed adjacently to the infant. During a 5 min video-recorded assessment of free play between mother and infant, the scales globally assess the quality of: (1) maternal behavior, (2) infant behavior, and (3) overall interaction.

In this study we only used the sub-scale of quality of the overall interaction: (1) good-poor composed of the average score of 5 items (smooth/easy vs. difficult, fun vs. serious, satisfying vs. unsatisfying, much engagement vs. no engagement, and excited engagement vs. quiet engagement), a sum score of 5 is "*good interaction*" and near 1 "*poor interaction*". This scale rates the nature of the engagement between mother and infant.

Data Reduction and Statistical Analyses

Several multivariate analyses of variance (MANOVAs) were performed to identify potential differences in maternal perception of infant temperament at ages of 3

and 12 months in three groups of infants with three different psychophysiological profiles "Withdrawn", "Extroverted" and "Underaroused". The identification of these psychophysiological profiles was performed through cluster analysis - according to the infants' neurobehavioral performance, social withdrawal and neuroendocrine reactivity to inoculation - and is described elsewhere (Costa & Figueiredo, submitted).

Repeated measures ANOVAs with between-subjects factors were performed to identify changes in the maternal perception of infant temperament at ages from 3 to 12 months old and the potential effect of the infants' psychophysiological profile on those changes. The model consideres temperament dimensions as measures and time moments as within-subjects factors. The infant's psychophysiological profile was considered as between-subjects factor. Sphericity assumption is not an issue in this analysis, seen that there are only two levels of within-subjects factors (Field, 2005).

Repeated measures ANOVA with between subject factors were performed to identify changes on maternal perception of infant temperament from 3 to 12 months old and the potential effect of the quality of mother-infant interaction on those changes. The model included the quality of mother-infant interaction as measures and time moments as within-subjects effects factor. Mother-infant interaction was considered as between-subjects factors. Sphericity assumption is not an issue in this analysis since there are only two levels of the within-subjects factor (Field, 2005).

Results

Infant's Psychophysiological Profile and Temperament at 3 Months

Several multivariate analyses of variance (MANOVAs) were performed to identify potential differences in the maternal perception of infant temperament at the age of 3 months in three groups of infants with different psychophysiological profiles "Withdrawn", "Extroverted" and "Underaroused". The MANOVA is not significant (Λ=1.414; $F(2,96) = 1.414$; $p = .263$). Subsequent univariate analyses followed by the Bonferroni post-hoc test, indicated a significant effect for infant distress, cuddliness, approach and vocal reactivity (see Table 2B). Compared to extroverted infants,

withdrawn infants have a higher score on distress to limitation (IC95%]-.40, 1.38[; p = .038) and lower scores on approach (IC95%]-2.68, .26[; p = .010). Compared to underaroused infants, withdrawn infants have lower scores on cuddliness (IC95%]-1.41, -.29[; p = .040) and vocal reactivity (IC95%]-2.28, .55[; p = .041).

Table 2B

Univariate F test: Differences between groups on mothers' perception of infant temperament at 3 months old

	Withdrawn (A) (n = 16) M (SD)	Extroverted (B) (n = 56) M (SD)	Underaroused (C) (n = 25) M (SD)	F	p	*Post-Hoc*
Distress	4.38 (.39)	3.89 (.83)	4.31 (.62)	3.482	.030	A vs. B
Cuddliness	5.81 (.83)	6.14 (.58)	6.37 (.57)	3.224	.034	A vs. C
Approach	4.81 (1.22)	5.85 (1.39)	6.64 (1.35)	5.210	.011	B vs. C
Vocal Reactivity	4.42 (.99)	4.83 (1.24)	5.28 (.79)	3.284	.044	A vs. C

Infant's Psychophysiological Profile at 3 Months and Temperament at 12 Months

A Multivariate analysis of variance (MANOVA) was performed to identify potential group differences on mothers' perceptions of infant temperament at 12 months. The MANOVA is marginally significant (Λ = .044; F(2,96) = 2.142; p = .056). Subsequent univariate analysis followed by the Bonferroni post-hoc test, indicated a significant effect for infant activity level and perceptual sensitivity (see Table 3B). Compared to extroverted infants, withdrawn infants have lower scores on activity level (IC95%]-3.23, .31[; p = .020) and on smiling/laughter (IC95%]-1.71,.05[; p = .60). Compared to underaroused infants, withdrawn infants have higher scores on perceptual sensitivity (IC95%]-.74, 3.50[; p = .034).

Table 3B

Univariate F test: Differences between groups on mothers' perception of infant temperament at 12 months old

	Withdrawn (A) (n = 16) M (SD)	Extroverted (B) (n = 56) M (SD)	Underaroused (C) (n = 25) M (SD)	F	p	*Post-Hoc*
Activity level	3.09 (1.11)	4.54 (.95)	4.08 (.86)	4.864	.022	A vs. B
Smiling/Laughter	4.90 (.44)	5.73 (.62)	5.60 (.66)	3.278	.058	A vs. B
Perceptual sensitivity	5.46 (.98)	4.47 (.67)	4.08 (1.47)	3.946	.030	A vs. C

Changes on Infant´s Temperament from 3 to 12 Months

Repeated measures ANOVA were performed in order to analyze differences on maternal perception of infant temperament from 3 to 12 month old. The homogeneity of variances/covariances was tested with the M Box test (M = 63.270; F = 1.421; p = 0.101) and is valid. The within-subjects analyses reveal that marginally significant differences in the maternal perception of infant temperament occur between 3 and 12 month regarding the maternal perception of infant's distress to limitation (F = 4.200, p = .057) and approach (F = 4.336, p = .054), and significant differences regarding the infant's cuddliness (F = 5.691, p = .030) and sadness (F = 12.735, p = .003). Older infants have lower scores on distress to limitation, cuddliness and sadness and higher scores on approach (see Table 4B).

Table 4B

Repeated measures ANOVA: Changes on mothers' perception of infant temperament from 3 to 12 month old.

	3 month M (SD)	12 month M (SD)	F	p
Activity level	4,48 (1,70)	4,20 (0,99)	.051	.824
Distress	4,52 (0,93)	3,85 (0,77)	4.200	.057
Fear	4,14 (2,05)	3,17 (1,40)	.519	.482
Duration/Orientation	5,30 (1,98)	4,19 (1,17)	.800	.384
Smilling/Laughter	5,24 (1,69)	5,64 (0,64)	3.583	.077
High pleasure	5,68 (1,45)	5,80 (0,66)	1.536	.233
Low pleasure	5,40 (1,50)	5,44 (0,89)	.584	.456
Soothability	5,89 (1,09)	5,22 (0,73)	1.668	.215
Falling reactivity	5,14 (1,10)	5,11 (1,01)	.689	.419
Cuddliness	6,25 (0,92)	5,43 (0,70)	5.691	.030
Perceptual sensitivity	5,37 (1,66)	4,72 (1,30)	1.098	.310
Sadness	4,88 (1,40)	3,44 (0,84)	12.735	.003
Approach	5,15 (1,28)	5,70 (0,71)	4.336	.054
Vocal reactivity	5,50 1,37)	5,35 0,77	.019	.892

Infant's Psychophysiological Profile and Changes on Temperament from 3 to 12 Months

To analyze the potential effect of the infant's psychophysiological profile on changes of mothers' perception of infant temperament, the infants' psychophysiological profile was considered as between-subjects factors in the repeated measures ANOVA. The results show that the infant's psychophysiological profile has a significant effect on the pattern of change of mothers' perception of some dimensions of infant temperament,

including fear (Λ = .846, F = 3.648, p = .045), smiling (Λ = .792, F = 4.448, p = .029) and approach (Λ = .923, F = 3.856, p = .042). Mothers of withdrawn infants perceived their infants' expressions of fear decreasing over time, while mothers of extroverted (IC95%]-1.38, 2.55[; p = .032) and underaroused (IC95%]-2.04, 1.20[; p = .044) infants perceived their infants' expressions of fear to increase over time. Mothers of withdrawn infants perceived their infants' to smile less over time, while mothers of extroverted (IC95%]-2.48, -.13[; p = .028) and underaroused (IC95%]-1.89, 2.30[; p = .046) infants perceived their infants' to smile more over time. Mothers of withdrawn infants perceived their infants' approach to decrease over time, while mothers of extroverted (IC95%]-1.23, .64[; p = .037) and underaroused (IC95%]-1.04, .51[; p = .048) infants perceived their infants' approach to increase over time (see table 5B).

Table 5B

Descriptive statistics on mothers' perception of infant temperament from 3 to 12 month old according to infant psychophysiological profile

	Withdrawn		Extroverted		Underaroused			
	3 m M (SD)	12 m M (SD)	3 m M (SD)	12 m M (SD)	3 m M (SD)	12 m M (SD)	F	p
Fear	4.38 (1.31)	4.00 (1.00)	3.21 (1.81)	3.75 (1.18)	3.88 (1.39)	2.85 (.96)	3.648	.045
Smilling/Laughter	5.05 (1.39)	4.90 (.44)	5.22 (1.21)	5.73 (.62)	5.16 (1.46)	5.60 (.66)	4.448	.029
Approach	4.81 (.22)	4.78 (1.11)	5.85 (1.39)	5.92 (1.26)	6.64 (1.35)	6.71 (1.18)	3.856	.042

Mother-Infant Interaction and Changes on Infant Temperament from 3 to 12 Months

To analyze the potential effect of the quality of mother-infant interaction (good vs. poor) on changes on mothers' perception of infant temperament, the quality of mother-infant interaction (good vs. poor) was considered as between-subjects factors in the repeated measures ANOVA. The results show that the quality of mother infant interaction has a significant effect on the pattern of changes on mothers' perception of some dimensions of infant temperament, including high pleasure (Λ = .745, F = 3.928, p

= .043), smiling (Λ = .692, F = 4.638, p = .024) and activity level (Λ = .843, F = 3.466, p = .047). A poor mother-infant interaction is associated with decreases in mothers' perception of infant high pleasure (IC95%]-1.54, 2.05[; p = .042), in mothers' perception of infants' smile (IC95%]-2.04, -.56[; p = .038) and increases in mothers' perceptions of infant level of activity (IC95%]-1.56, .54[; p = .043) (see table 6B).

Table 6B

Repeated measures ANOVA: Changes on mothers' perception of infant temperament from 3 to 12 month old according to quality of mother-infant interaction.

	Poor interaction		Good interaction			
	3 m M (SD)	12 m M (SD)	3 m M (SD)	12 m M (SD)	F	p
Activity level	4.30 (1.50)	4.40 (.86)	4.06 (1.45)	4.10 (.80)	3.466	.047
Smilling/Laughter	5.34 (1.44)	5.09 (0.70)	5.41 (1.38)	5.97 (0.74)	4.638	.024
High Pleasure	5.64 (1.37)	5.45 (0.57)	5.65 (1.31)	5.98 (0.64)	3.928	.043

Discussion

This study shows that mothers' perception of infants' temperament depends on the infant psychophysiological profile. This means that infants' social and emotional behaviors displayed early in life, before the development of diverse social interactions, may interfere with infant temperament. This result gives empirical evidence to the concept of temperament as biologically determinated and present at birth (Goldsmith et al., 1987). Mothers' perception of extroverted infants differs from maternal perception of withdrawn infants in that the first ones show more approach, excitement and positive anticipation of pleasurable activities. Mothers' of withdrawn infants perceived them as having less cuddliness behaviors and vocal reactivity than mothers of underaroused infants. Withdrawn infants' temperament seems to fit Thomas et al. (1968) "difficult" type of temperament. "Difficult" children have irregular behavior, intense reactions, are withdrawn from stimulus, have difficulty to adapt and negative mood. Accordingly, withdrawn infants have difficulties in engaging in new activities, approaching and

giving vocal feedback compared to other infants. At 12 months, withdrawn infants are perceived by their mothers as having lower levels of activity and smiling/laughter compared to extroverted infants as well as higher perceptual sensitivity compared to underaroused infants. At both 3 and 12 months withdrawn infants seem to be perceived by their mothers as more difficult, which might place them in a more vulnerable position for later personality and social development difficulties (Kagan, 1998; Rothbart & Bates, 1998). According to Thomas et al. (1968), behavioral disorder appears when there is a conflict between a child's temperament and his environmental characteristics, and given the difficulty of withdrawn infants' temperament, there is a higher probability that this conflict might occur.

Additional evidence was gathered regarding stability on mothers' perception of infant temperament from 3 to 12 months on most temperament dimensions: activity level, fear, duration/orientation, smiling/laughter, high pleasure, low pleasure, soothability, falling reactivity, perceptual sensitivity and vocal reactivity. Worobey and Blajda (1989) also found that the activity level, responsivity, and irritability remained stable from 2 to 12 months. Other studies found stability in temperament dimensions reflecting difficultness (Belsky, Rovine, & Fish, 1989; Lee & Bates, 1985) or emotionality (Matheny et al., 1985; Riese, 1987).

Nonetheless changes were noticed in distress to limitation, approach, cuddliness and sadness. Older infants have lower scores in distress to limitation, cuddliness and sadness and higher scores in approach. As occurred in our study, other authors also pointed out that there was an increment of approach in the first year of life (Rothbart, 1981) and increases in activity level, distress to limitation and fear (Carranza et al., 2000; Rothbart, 1986, 1988, 1989). Some authors argue that the original characteristics of temperament tend to remain constant in quality over the years, although in the course of development, the environmental circumstances may influence the infants' reactions and behavior (Thomas et al., 1968). Our results give empirical support to this premise of some stability in the expression of infant temperament (Rothbart & Derryberry, 1981).

This study also provides evidence of the influence of infants' psychophysiological profile on changes on mothers' perception of infant temperament over the 1st year of life, including fear, smiling and approach. This brings out the fact

that the complex social emotional behaviors, displayed early in life, have an influence on later changes in the mother's perceptions of infant temperament. This result adds importance to the role of infant factors, which have been downplayed in previous studies that have only emphasized the influence of maternal and family factors, such as emotional cohesiveness of the family, maternal expressiveness (Matheny, 1986) and sensitivity (Washington et al., 1986) and marital problems (Engfer, 1986) on infant temperament,.

Additionally, the quality of mother-infant interaction also interferes with changes in mothers' perception of infant temperament. Good patterns of mother-infant interaction are related to increases in the infants' positive emotionality and activity level. These results corroborate those of Belsky et al. (1991) who also found that the quality of mother infant interaction is an important factor accounting for changes in infant temperament from 3 to 9 months. It seems that poor interactive experiences, with insensitive and unresponsive mothers may originate distress in the quality of care, leading the infant to express less positive emotionality. Additionally, the infant may present more trouble developing competences to deal more effectively with negative emotionality. It is noteworthy that under conditions of lower quality of maternal interaction, troubles in the infants' capacity to regulate his/her negative emotionality may arise. Conversely, a higher quality of maternal interaction seems to improve the infant's capacity of self-regulation and lead to positive changes in negative emotionality. These results corroborate the theories that sustain that the environment interferes with changes in infant temperament over time (Rothbart & Derryberry, 1981).

This study's major contribution relies on providing evidence regarding individual differences early in life, considering the infant's psychological and physiological characteristics, and it's impact on their mother's perception of infant temperament. Additionally, this study contributes to the knowledge of the environmental factors that interfere with the development of those individual differences. Further research should comprise a larger sample and study the developmental pathways of these different groups of infants, namely in terms of their personality and child development.

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Infant's Psychophysiological Profile and Attachment: Mediating and Moderating Effect of Mother-Infant Interaction

Abstract

Objective: to assess the effect of infant's psychophysiological functionning early in life on the quality of mother-infant interaction and on later attachment. Adittionally it was aimed to explore the mediation and moderation effects of the quality of mother-infant interaction on the association between the infant's psychophysiological functioning and attachment security. **Method:** a longitudinal prospective design over the first year of life was conducted with 94 infants and their mothers. Eight week-old infants were assessed with the Neonatal Behavioral Assessment Scale (NBAS, Brazelton & Nugent, 1995) and the Alarm Distress Baby Scale (ADBB, Guedeney & Fermanian, 2001). Saliva samples were collected at 8- to 12 weeks old, both before and after routine inoculation for measuring cortisol levels. Mother infant interaction was evaluated at 12-16 weeks, using the Global Rating Scales (GRS, Murray, Fiori-Cowley, Hooper, & Cooper, 1996). The strange situation procedure (Ainsworth, Blehar, Waters, & Wall, 1978) was performed to assess infant attachment style at 12 months. **Results:** infants with different psychophysiological profiles differ in terms of their performance when interacting with the mother as well as in the quality of the overall dyadic interaction. Infants' psychophysiological profile also has a significant effect on the probability of having a secure attachment. The quality of mother-infant interaction differs in a secure vs. insecure attached infants. Furthermore, the overall quality of mother-infant interaction mediates the relation between infant's psychophysiological profile and infant attachment, whereas mother behaviors in the interaction moderate this association. **Conclusion:** the co-construction of the mother-infant relationship has bidirectional origins on the infant characteristics and on patterns of interaction.

Keywords: infant attachment, neurobehavior, neuroendocrine reactivity, social withdrawal, mother-infant interaction

Attachment is "a tie that binds individuals together over time and space" (Bowlby, 1969). John Bowlby's (1958, 1960, 1969) ethological/control systems theory of attachment offered a paradigm that included both affective and behavioral facets of attachment. The child's tie to his mother is a product of the activity of a number of behavioral systems that lead to proximity to mother. The infant is competent, curious, and fully engaged with the environment and, as such, the behavioral systems develop within the infant as a result of (1) evolutionary adaptedness, (2) interaction with the environment, and especially (3) interaction with the principal caregiver.

Attachment behavior aims to increase proximity of the child to the attachment figure (Cassidy, 1999) in order to protect the child from danger (Marvin & Britner, 1999). When the distance from the attachment figure becomes too great, the attachment system is activated and when considerable proximity is achieved the attachment system deactivates. This process is called of behavioral homeostasis/control system (Cassidy, 1999). Some infants were better at this kind of relationship: more confident in the mother's availability (that she would always be there if needed) and consequently more confident to explore. These infants were called securely attached. The other infants who lacked this confidence in their mother were called insecurely attached. These variations reflect individual differences in the quality of attachment relationships that arise after a history of infant-caregiver interactions (Weinfield, Sroufe, Egeland, & Carlson, 1999).

Both secure and insecure organizations of attachment constitute adaptative strategies to deal with stressful situations. Secure infants' strategy to organize their attachment system is to use their parents as secure base from which to explore (Ainsworth, 1984; Main & Solomon, 1986). These infants assess the environment and the mother's availability; if the environment or the mothers' availability becomes threatened they seek proximity (Main, 1990). The knowledge that the caregiver will be available in case of need provides confidence for independent exploration of the environment. Insecure infants are anxious about the caregivers' availability. They fear that they will be unresponsive or ineffective when needed. In response to a parent minimally or inconsistently responsive, the infant develop a resistant strategy of emphasizing the attachment behavior and increasing bids of attention. On the other hand in response to a rejecting parental behavior, the infant develops an avoidant strategy of ignoring cues that might activate the attachment system (Bowlby, 1980; Main, 1981).

Although insecure attachment organization is an adaptative strategy to deal with the caregiver behavior, it compromises exploration. These infants are not free to explore without worry, and consequently they do not have the same self-confidence nor mastery of their environments (Weinfeld et al., 1999)

Individual Differences and Infant Attachment

Several investigators have proposed that infant characteristics might influence the quality of attachment or, at least, the behavior displayed in the strange situation. In 1980, Waters, Vaughn, and Egeland examined the relationship between neonatal neurobehavior in 100 seven to ten days old neonates and their attachment security at 12 months. The results of this study indicated that infants showing signs of unresponsiveness, motor immaturity and problems with physiological regulation on day 7 were later classified as anxious attached/resistant, whereas those with better scores were later classified as secure infants. Crockenberg (1981), in a study conducted with 48 mother-infant dyads, reported that infant high irritability between day 5 and 10 was associated with anxious attachment style at 12 months in a group of mothers with low social support. Five years later the studies of Myiake, Chen, and Campos (1985) with 31 mother-infant pairs confirmed that infant high irritability in the neonatal period was related to infant anxious attachment/resistant classification at 12 months. Grossmann, Grossmann, Spangler, Suess, and Unzner (1985) reported that the orienting ability in the newborn period was related to attachment classification at 12 months, differentiating secure infants from avoidant infants.

Calkins and Fox (1992) performed a longitudinal study with 52 infants and their mothers from birth to 24 months old. The authors found that higher distress reactivity in the 2nd day of life was associated with insecure attachment at 14 months. Seifer, Schiller, Sameroff, Resnick, and Riordan (1996) conducted a longitudinal study that included the observation of families at 6, 9, and 12 months. The results of this study showed that infant mood and lower difficulty at 6 and 9 months was related to later higher security. Both distress to limitation at 6 and 9 months as well as emotionality at 9 months were related to attachment security at 12 months. Insecure resistant infants had the highest fussy-difficult ratings.

All these mention studies provide evidence for the role of the infant individual differences very early in life for the development of attachment. These suggests that early neurobehavior difficulties may reflect problems in integrative and adaptive mechanisms, which interact with difficult environments to produce insecure attachments (Waters et al., 1980)

Mother-Infant Interaction and Infant Attachment

One of the most pressing issues in contemporary attachment theory is to describe complete causal pathways to explain well replicated correlations between early care and subsequent patterns of secure base behavior. Several maternal variables measured during mother-child interaction seem to be associated with the security of attachment. More sensitive mothers to their infants' cues for proximity and contact early in the first year of life (Ainsworth, Bell, & Stayton, 1971, 1974; Ainsworth, 1979, 1982; de Wolff & van IJzendoorn, 1997; Finger, Hans, Bernstein, & Cox, 2009; Grossmann et al., 1985; Moran, Forbes, Evans, Tarabulsy, & Madigan, 2008), more responsive and encouraging in face-to-face interaction at 6 to 15 weeks (Blehar, Lieberman, & Ainsworth, 1977; Isabella, Belsky, & von Eye, 1989), emotionally open mothers (Pauli-Pott & Mertesacker, 2009; Ziv, Aviezer, Gini, Sagi, & Koren-Karie, 2000) and more sensitive to their infants in free play activities at 9 month (Fuentes, Lopes dos Santos, Beeghly, & Tronick, 2006) are more likely to have securely attached infants. Additionally, interactions characterized by synchrony, cooperation and symmetrical co-regulation are related to secure infant-mother attachments (Evans & Porter, 2009; Isabella et al., 1989; Veríssimo & Salvaterra, 2006).

Isabella et al. (1989) noted that secure attachments are fostered by interactions with mothers consistent in their perceptions, using accurate interpretation, and contingent and appropriate responsiveness to their infants' cues. Several aspects of the interaction, including maternal responsiveness to distress and vocal signals differentiated mothers of secure and insecure babies. Moreover, mothers of avoidant infants were overstimulating and intrusive while mothers of resistant infants were underinvolved and unavailable. Additionally synchronous interaction at 1 and 3 months was related to secure attachment.

Recently, Evans and Porter (2009) found that higher levels of symmetrical co-regulation with mothers at 6 months old were associated to secure attachment at 12 months while unilateral patterns of interactions were associated to insecure attachment.

Pauli-Pott and Mertesacker (2009) reported that insecurity was associated with a pattern consisting of positive maternal affect expression accompanied by neutral or negative expression in the infant. Low maternal openness, low amount of negative affect expression and the coincidence of mother and infants' positive affect expression at 12 months were linked to insecurity. Mothers of insecurely attached infants show, in the first months, a high amount of positive emotion which is not shared with the infant. At the end of the infants' first year these mothers have a less open emotional communication that includes hiding negative affect and heightening positive mood.

In a meta-analytic study of 66 researches on parental antecedents of attachment security, De Wolff and van IJzendoorn (1997) reported that maternal sensitivity was an important condition (although not exclusive) of attachment security. Further studies provided evidence of the role of maternal sensitivity as a mediating factor between maternal characteristics and infant attachment. Atkinson et al. (2005) for example, studied the impact of maternal state of mind and sensitivity on infant attachment in 2 samples. In the first sample both maternal sensitivity and infant attachment were assessed between 12 and 16 months of infant age. In the second sample, maternal sensitivity was assessed at 6 month and infant attachment at 12 months. The authors reported that both mental representations and sensitivity influence infant attachment security directly, with sensitivity moderating the impact of mental representations. Laranjo, Barnier, and Meins (2008) performed a longitudinal study with 50 dyads and found that maternal sensitivity at 12 month of infant age mediates the association between maternal mind-mindedness at 12 months and infant attachment security at 15 months.

Individual Differences, Mother-Infant Interaction and Infant Attachment

Several studies have analyzed the interplay of biologically and environmentally founded child characteristics in order to understand the multifactorial aspects involved in the development of attachment relationships.

Bates, Maslin, and Frankel (1985) performed a longitudinal study with a sample of 160 dyads from 6 months to 3 years old infants. The authors reported that infant characteristics did predict ratings of contact maintenance during the reunion episodes of the strange situation. At 13 months, babies rated by their mothers as low in social responsiveness at 6 months (unexcitable and not liking to play with others), tended to have less secure attachments and were more likely to resist contact in the second reunion. Sociability and unresponsiveness to mother, as well as examiner's impression of fear were related to contact maintenance in the strange situation. Infants perceived as outgoing and fearless and infants perceived by their mothers as lacking interest in them all made less effort to maintain contact. The authors concluded that these correlations may be due to a biological basis in infant emotional reactivity and stress reactions to strangers, but the cause of the correlation might also lie in subtle parent-child interaction processes.

Goldsmith and Alansky (1987) analyzed the potential predictive power of infant proneness to distress and of maternal interactional variables on infant-mother attachment. A meta-analysis demonstrated that sensitive, responsive maternal interaction predicted the security of attachment measured in the strange situation procedure. Proneness to distress predicted resistance in the strange situation that is thought to indicate one variety of insecure attachment.

In 1989, van den Boom examined the links between irritability between day 10 and 15 of life, the quality of mother-infant interaction observed at month 6 and attachment assessed at 12 months. The author found that infant's irritability predicted later attachment classification, especially the avoidant category. Furthermore, mothers of irritable infants, tended to develop a pattern of interaction characterized by gradual non-involvement and unresponsiveness with age. Looking at this data, the author developed and implemented an intervention program to enhance maternal sensitive responsiveness with irritable infants. A natural to quasi-experimental study was conducted with 100 dyads with irritable infants. In the experimental group, mothers were given a training program (beginning when the infants were 6 months old) in which they were taught how to soothe and play with their children. The very interesting results of this study showed that, compared with the control groups, infants in the experimental group were more sociable, showed more self-centered behavior, explored more and with more cognitively sophisticated ways and cried less from 6 to 9 months compared to

control infants. These infants were less likely to be categorized as insecurely attached at 12 months (strange situation - 68% secure classification for the experimental infants; 28% for control infants) and exhibited more sophisticated levels of exploratory play with objects, even in the absence of their mothers. van den Boom's studies are indicative of both the strength of biologically founded characteristics in predicting later attachment and the importance of the influence of maternal skills when training is added. They illustrate that the interaction between the infant predisposition and mother behavior may develop into a trajectory of experience for the child, with important developmental outcomes (Rothbart & Ahabi, 1994).

The contribution of individual differences at birth to the development of particular patterns of mother-infant interaction and to later infant attachment has been dowlooked in the literature compared to the caregiver contribution. The attachment theory states that the caregiving sensitivity is of extreme importance for the development of a secure attachment style. Further research studies confirmed the association between not only of mother behaviors in the interaction but also of the quality of interaction and infant attachment. The issue we are trying to address in this study is the effect of infant's psychophysiological functionning early in life on the quality of mother-infant interaction and on later attachment. Exploring the mediation and moderation effects of the mother-infant interaction on the association between infant's psychophysiological functioning and attachment security.

In a previous study (Costa & Figueiredo, submitted) three groups of infants with three different psychophysiological profiles "Withdrawn", "Extroverted" and "Underaroused" at 2 months were identified. The identification of these psychophysiological profiles was determined according to the infants' neurobehavioral performance, social withdrawal and neuroendocrine reactivity to inoculation. (1) "Withdrawn" infants showed severe signs of social withdrawal, poor neurobehavioral performance as well as high neuroendocrine reactivity; (2) "Extroverted" infants showed practically no signs of social withdrawal, had a good neurobehavioral performance and average neuroendocrine reactivity, and the (3) "Underaroused" infants showed some signs of social withdrawal, average neurobehavioral performance and low neuroendocrine reactivity.

Bearing in mind that "it takes two to become attached" (van den Boom, 1997), the study of both infant psychophysiological functioning and early mother-infant interaction associated with infant attachment is of great interest. Our purpose is to consider bidirectional effects on the dyadic system and the way in which they contribute to the co-construction of the infant-mother relationship.

Method

Sample

The sample was composed of 94 infants. Most infants were born after a normal and full-term gestation. More than half were born through a distocic delivery and generally had no need for reanimation. At birth infants height ranged from 45.90cm to 54.00cm (*M* = 49.44cm, *SD* = 1.84), cephalic perimeter ranged from 31cm to 37cm (*M* = 34.60cm, *SD* = 1.29), weight ranged from 2450gr to 4055gr (*M* = 3243gr, *SD* = 424), ponderal index ranged from 2.24 to 3.29 (*M* = 2.71, *SD* = 0.23), and apgar scores ranging from 5 to 10 (*M* = 8.63, *SD* = 0.91) in the 1st minute and ranging from 8 to 10 (*M* = 9.76, *S*D = 0.53) in the 5th minute of life (see Table 1C).

Table 1C

Socio-Demographic and Medical Data

Maternal and Gestational Data		(%)	Neonatal Data		(%)
Maternal Age	≥20 Λ ≤34	95.8	Time of Gestation	<37	7.3
	>35	4.2		≥37 Λ ≤40	82.4
				>40	10.3
Year of Education	<9	22.7	Gender	Female	46.5
	≥9	77.3		Male	54.5
Marital Status	Married	81.3	Reanimation at birth	No	94.8
	Cohabiting	18.7		Yes	5.2
Parity	Primiparous	83.6	Weight	<2500gr	1.4
	Multiparous	16.4		≥2500gr	98.6
Type of Gestation	Normal	81.2	Ponderal Index	<2.5	13.3
	Risk	18.8		≥2.5	86.7
Type of Delivery	Eutocic	34.4	Apgar Index: 1st m	<7	3.6
	Distocic	65.5		≥7	96.4

Procedures

This research was conducted in the Primary Care Centers of Espinho (N=54) and Santa Maria da Feira (N=50) (Portugal). Mothers were contacted when attending routine inoculation of their one month-old infant. 96% of the contacted mothers agreed to participate, 3% declined participation alleging lack of time and 1% were uninterested in participating. The exclusion criteria were: not reading or writing Portuguese and multiple gestations. The aims and the procedures of the study were explained, and an informed consent was signed. All evaluation procedures were performed and videotaped either at home or at the Primary Care Center.

A socio-demographic questionnaire was completed on infants' medical data and at 8 weeks of life the Neonatal Behavioral Assessment Scale (NBAS, Brazelton & Nugent, 1995) was performed and video-taped. This examination was conducted in a particular sequence by trained and reliable examiners midway between feedings in a quiet and semi-darkened room with a temperature of 22º-27ºC. The NBAS was scored immediately after being performed and was later visualized with two purposes: (1) Analyze potential doubts on NBAS scoring and (2) scoring the infant performance on the Alarm Distress Baby Scale (ADBB, Guedeney & Fermanian, 2001). Between 8 and 12 weeks of life a saliva sample was collected from the participants mouth before (5 min) and after (20 min) routine inoculation. Mother infant interaction was evaluated at 12-16 weeks, using the Global Rating Scales (GRS, Murray, Fiori-Cowley, Hooper, & Cooper, 1996). The strange situation procedure was performed to assess infant attachment style between 12 and 14 months (Ainsworth et al., 1978).

Measures

Neonatal behavior. The Neonatal Behavioral Assessment Scale (NBAS, Brazelton & Nugent, 1995) assesses the newborn's competencies across different developmental areas – autonomic, motor, states and social – and describes how these areas are integrated. The scale, composed of 28 behavioral and 18 reflex items, is suitable for examining newborns and infants up to two months old and is based on several key assumptions: (1) infants are highly capable when they are born, (2) infants "communicate" through their behavior, and (3) infants are social organisms. By the end

of the assessment, the examiner has a behavioral "portrait" of the infant, describing his/her strengths, adaptive responses and possible vulnerabilities. The 28 items of the NBAS are scored on a 9-point scale. For the NBAS total score, behavioral and reflexes items were recoded so that a better performance corresponds to higher score and were then added. The alpha of Cronbach of the scales ranged from .54 (autonomic stability) to .74 (range of state) (Costa et al., submitted).

Social withdrawal. The Alarm Distress Baby Scale (ADBB, Guedeney & Fermanian, 2001) consists of eight items to assess prolonged reaction of social withdrawal in infants. The items are rated from zero to four (with low scores being optimal social behavior): facial expression; eye contact; general level of activity; self-stimulation gestures; vocalizations; briskness of response to stimulation; relationship to the observer, and attractiveness to the observer. The ADBB total score derives from the sum of the eight items and higher results represent more signs of social withdrawal. The cut-off point of 5 showed the best sensitivity (0.82) and specificity (0.78) to detect infants at-risk (Guedeney & Fermanian, 2001). Inter-rater reliability was calculated using intra-class coefficient (ICC = .92). The Portuguese version of the scale has a reasonable internal consistency (α of Cronbach = .60) (Figueiredo & Costa, 2008).

Neuroendocrine reactivity to inoculation. Saliva samples were collected before (5 min) and after (20 min) routine inoculation between 8- and 12 weeks old. Plastic tubes (Salivette) containing a cotton roll that were placed in the infants' mouth for about 2-3 minutes. On the day of testing, all specimens were taken to the laboratory and were centrifuged to remove mucus and were then stored in a freezer (-20ºC). All saliva was assayed for cortisol concentration using a quimioluminescence method. Cortisol units are expressed in µg/dL. The difference between the post-test and pre-test cortisol was calculated and referred to as δ cortisol.

Mother-infant interaction. The Global Rating Scales (GRS, Murray et al., 1996) is a video-based assessment of the quality of mother-infant engagement that can be applied from 2 months to 6 months post-partum. The mother sat in front of the infant and was asked to play with him/her in any way they choose without the use of toys in a 5-min face-to-face play session. The scales globally assess the quality of: (1) maternal

behavior, (2) infant behavior, and (3) overall interaction. Maternal behavior describes the degree to which a mother's behavior is appropriately adjusted to her infant. Mother's behavior was computed using the sum score of maternal the items. Infant behavior describes the infants' positive engagement in the interaction and behavior. Infant behavior was computed through the sum score of infant items The final dimension assesses the quality of the overall interaction between mother and infant; it rates the nature of the engagement between mother and infant and was computed through the sum score of the overall interaction items. A higher the punctuation corresponds to a better performance.

Infant attachment style. The Ainsworth strange situation was performed (Ainsworth et al., 1978) and videotaped between 12 and 14 months old. Two expert coders classified infants as secure, insecure-avoidant, or insecure-resistant, as described in Ainsworth et al. (1978). Raters agreed on major classifications in 97.6% of the cases. Disagreements were resolved by conference. The distribution of attachment classifications was (61.9%) secure, (21.6%) insecure-resistant and (16.5%) insecure-avoidant. In this study we considered the classification insecure (0) vs. secure (1).

Data Reduction and Statistical Analyses

A multivariate analysis of variance (MANOVA) followed by univariate F test and Bonferroni post-hoc test (Field, 2005) was performed to identify potential differences on the quality of mother infant interaction according to infant's psychophysiological profile after the validation of the assumptions. The validation of the assumption of homogeneity of variances-covariances using the M-Box test was guaranteed (M = 93.635; F(37,3349) = .957; p = .137).

In order to explore if the infant's psychophysiological profile is associated with secure vs. insecure attachment classification the Chi-Square test was used. Infant's psychophysiological profile "withdrawn", "extroverted" and "underaroused" was performed through cluster analysis - according to the infants neurobehavior performance, social withdrawal and neuroendocrine reactivity to inoculation - and is described elsewhere (Costa & Figueiredo, submitted).

A multivariate analysis of variance (MANOVA) followed by univariate F test and Bonferroni post-hoc test (Field, 2005) was performed to identify potential differences in the quality of mother-infant interaction in infants with secure vs. insecure attachment after the validation of the assumptions. The validation of the assumption of homogeneity of variances-covariances using the M-Box test was guaranteed (M = 88.563; $F(35,2769) = .995$; $p = .097$).

To determine if the quality of mother-infant interaction mediated the effect of the infant's psychophysiological profile on attachment security, several regression analyses were performed (Tabachnick & Fidell, 1996). In the first equation the infant's psychophysiological profile was entered as an independent variable and the infant attachment as the criterion (dichotomous variable: 0-insecure, 1-secure). In the second equation the infant's psychophysiological profile was entered as an independent variable and the quality of mother-infant interaction as the criterion. In the third equation the quality of mother-infant interaction was entered as independent variable and the infant attachment as the criterion (dichotomous variable: 0-insecure, 1-secure). The fourth equation to test mediation was conducted with the infant's psychophysiological profile and the quality of mother-infant interaction as independent variables and the infant attachment as the criterion (dichotomous variable: 0-insecure, 1-secure).

To determine if the quality of mother-infant interaction moderated the relationship between infant psychophysiological profile and infant attachment security, hierarchical logistic regressions (Tabachnick & Fidell, 1996) were performed with infant attachment as the criterion (dichotomous variable: 0-insecure, 1-secure). In the first equation infant psychophysiological profile was entered as an independent variable, in the second equation the quality of mother-infant interaction was entered as independent variable and in the third equation the cross-product of the infant psychophysiological profile and mother-infant interaction was entered to test the moderating effect of mother-infant interaction on the link between infant psychophysiological profile and attachment security (Tabachnick & Fidell, 1996).

Results

The MANOVA performed to identify potential differences on the quality of mother infant interaction according to infant's psychophysiological profile was significant (Λ=.724; F(2,94) = 2.634; p = .021). Subsequent univariate analyses followed by the Bonferroni post-hoc test, indicated a significant effect for infant behavior and overall interaction but not for mother behavior (see Table 2C). Withdrawn infants had lower scores on infant behavior compared to extroverted (IC95%]-.40, 1.38[; p = .038) and underaroused infants (IC95%]-2.68, .26[; p = .010). Withdrawn infants had lower scores on overall interaction compared to extroverted infants (IC95%]-1.41, -.29[; p = .040).

Table 2C

Differences in the quality of mother-infant interaction in three groups of infants with different psychophysiological profiles

	Withdrawn (A) (N=16) M (SD)	Extroverted (B) (N=56) M (SD)	Underaroused (C) (N=25) M (SD)	F	p	*Post-Hoc*
Mother-Infant Interaction						
Mother behavior	4.03 (.73)	4.25 (.38)	4.41 (.52)	1.881	.164	
Infant behavior	2.97 (.93)	4.33 (.65)	3.61 (.88)	6.709	.003	A vs. B A vs. C
Overall interaction	2.76 (.68)	4.28 (.57)	3.41 (.44)	4.965	.011	A vs. B

Significant associations were found between the infant's psychophysiological profile and attachment security (X^2 = 5.442, p = .046). More than half of withdrawn infants, a third of underaroused infants and only a forth of extroverted infants are insecurely attached at 12 months (see table 3C).

Regarding the quality of mother-infant interaction and infant attachment the MANOVA was significant (Λ=.724; F(2,94) = 2.634; p = .021). Subsequent univariate analyses, revealed that mean scores for mother behavior (F(1,94) = 4.982, p = .037), infant behavior (F(1,94) = 3.947, p = .049) and overall interaction (F(1,94) = 4.987, p =

.041) were significantly higher in the securely attached infants compared to insecure attached infants (see table 3C).

Table 3C

Association between infant's psychophysiological profile and attachment classification and differences on the quality of mother-infant interaction according to attachment classification.

	Insecure N = 36 (%)	Secure N = 58 (%)	X^2	p
Infant Profile				
Withdrawn	66.7	33.3	5.442	.046
Extroverted	25.0	75.0		
Underaroused	38.9	61.1		
	M (SD)	M (SD)	F	p
Mother-Infant Interaction				
Mother behavior	51,67 (5,12)	58,78 (3,73)	4.982	.037
Infant behavior	24,94 (3,75)	30,16 (4,34)	3.947	.049
Overall interaction	15,56 (4,23)	20,94 (3,12)	4.987	.041

Test of Mediation Model.

To test if mother-infant interaction accounts for the relation between infant psychophysiological profile and attachment, we will analyse four conditions considered to be essential to show mediation (Baron & Kenny, 1986).

(1) variations on infant's psychophysiological profile account for variations in infant attachment (Path c, Figure 1),

(2) variations on infant's psychophysiological profile account for variations in the quality of mother-infant interaction (Path a1, a2, a3, Figure 1),

(3) variations in the mother-infant interaction account for variations in the infant attachment (Path b1, b2, b3, Figure 1) and

(4) a previously significant relation between infant's psychophysiological profile and infant attachment is significantly reduced or no longer significant when the

quality of mother-infant interaction is added to the model (Path c, Figure 1). If path c is reduced to zero, then mother-infant interaction can be considered a single mediator, whereas if path c is not zero multiple mediating factors may exist (Baron & Kenny, 1986).

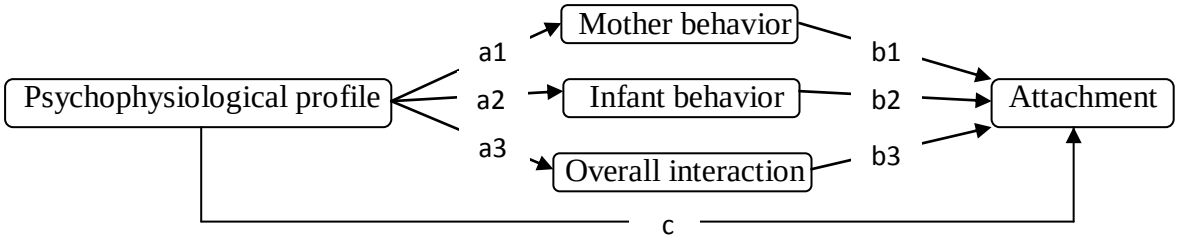

Figure 1: Mediation Model

The first logistic regression (Path c, Figure 1) revealed that infant's psychophysiological profile ($X^2_{Wald}(2) = 4.926$, $p = .049$) has a significant effect on the probability of having a secure attachment (see table 4C). According to the model ($G^2(6) = 5.319$, $p = .070$, $X^2 = 35.015$, $R^2_{CS} = .086$, $R^2_{N} = .118$, $R^2_{MF} = .069$) being withdrawn decreases the probability of been securely attached to the mother by 83.3% and being underaroused decreases the probability of being securely attached to the mother by 47.6%, compared to extroverted infants.

Table 4C

Predicting infant attachment from infant's psychophysiological profile and quality of mother-infant interaction.

Variable	B	S.E.	X^2_{Wald}	d.f.	p-value	Exp(B)	I.C. 95%
Infant Psychophysiological Profile							
Extroverted			4.926	2	.085	1.810	
Withdrawn	-1.792	.816	4.816	1	.028	.167	].034; .826[
Underaroused	-.647	.633	1.044	1	.307	.524	].152; 1.811[
Mother-Infant Interaction							
Mother behavior	.334	.114	8.518	1	.004	1.396	]1.116; 1.747[
Infant behavior	.144	.281	.263	1	.608	.866	].499; 1.502[
Overall interaction	.737	.381	3.981	1	.058	1.190	].974; 4.484[
Mediating Effect							
Extroverted*Overall interaction							
Withdrawn*Overall interaction	.709	.582	1.483	1	.223	2.032	]6.49; 6.358[
Underaroused*Overall interaction	.038	.498	.006	1	.939	1.039	].391; 2.758[

Three linear regression analyses was performed to test Path a1, a2 and a3, thus exploring if the infant's psychophysiological profile accounts for variations on mother behavior, infant behavior and overall quality of interaction. The variation on infant's psychophysiological profile does not account for variations on mother behavior ($F(2,94) = 1.591$, p=.209) but it accounts for variations on infant behavior ($F(2,94) = 23.247$, p = .005) and overall interaction ($F(2,94) = 16.488$, p = .011) (see table 5C).

This result excludes mother behavior in the interaction as a potential mediator variable of the relation between infant's psychophysiological profile and infant attachment because Path a1 was not confirmed (see figure 1, table 5C).

Table 5C

Predicting the quality of mother-infant interaction from infant's psychophysiological profile.

	R^2	F	p	β	t	p
Mother Behavior						
Withdrawn	.033	1.591	.209	-.192	-1.763	.081
Underaroused				-.036	-.328	.744
Infant Behavior						
Withdrawn	.336	23.247	.002	-.610	-6.771	.005
Underaroused				-.135	-1.497	.138
Overall Interaction						
Withdrawn	.264	16.488	.003	-.540	-5.693	.008
Underaroused				-.112	-1.184	.239

To test Path b1, b2 and b3, logistic regressions were perfomed for mother behavior, infant behavior and overall interaction. Mother behavior ($b_{MotherBehavior}(1)$ =,.334, p =.004, OR = 1.396) has a significant effect on the probability of having a secure attachment (Path b1), while the overall quality of interaction ($b_{OveralInteraction}(1)$ = .737, p =.058, OR =2.090) has a marginally significant effect on the probability of having a secure attachment (Path b3, Figure 1). According to the model ($G^2(3)$ = 35.015, p = .000, X^2 = 29.088, R^2_{CS} = .504, R^2_{N} = .697, R^2_{MF} = .537), the probability of been securely attached increases 39.6% with good mother behavior and 19.0% with good overall interaction. On the contrary, infant behavior does not have a statistically significant effect ($b_{InfantBehav}(1)$ =.144, p =.608) on the probability of having a secure attachment (Path b2, Figure 1, see table 4C).

This result excludes infant behavior in the interaction as a potential mediator variable of the relation between infant's psychophysiological profile and infant attachment because Path b2 was not confirmed (see figure 1, table 4C).

We will now analyse if the previously significant relation between infant's psychophysiological profile and infant attachment decreases or disappears after adding the overall interaction to the model to test the mediation model.

The logistic regression revealed that the association between infant's psychophysiological profile and infant attachment is reduced when the overall interaction is added in the equation ($G^2(2) = 1.603$, $p = .449$, $R^2_{CS} = .017$, $R^2_{N} = .023$, $R^2_{MF} = .013$) (see table 4C). The data thus meet the requirements for mediation.

Test of Moderation Model

Previous analyses showed that the (1) overall interaction mediates the association between infant's psychophysiological and infant attachment and (2) variations in infant behavior do not account for variations in infant attachment. These results exclude both the overall interaction and infant behavior as moderating the effect of infant's psychophysiological profile on infant attachment. Thus, we will test if mother behavior influences the effect of infant psychophysiological profile on infant attachment (moderator effect). For that we will examine three conditions considered to be essential to show moderation (Baron & Kenny, 1986).

(1) the effect of infant psychophysiological profile on infant attachment must be tested (Path a, Figure 2). This effect was previously tested and confirmed (Path c, Figure1, table 4C)
(2) the effect of mother behavior on infant attachment must be tested (Path b, Figure 2). This effect was previously tested and confirmed (Path b1, Figure 1, table 4C)
(3) the effect of the interaction between infant psychophysiological profile and mother behavior on infant attachment must be tested (Path c, Figure 2).

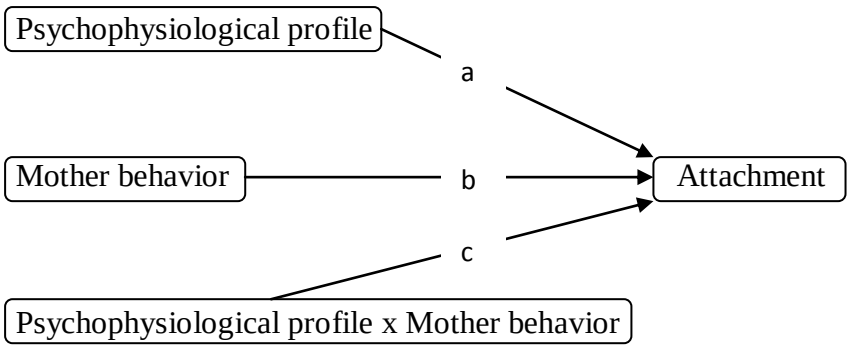

Figure 2: Moderation Model

Steps 1 and 2 were already confirmed in previous analyses (see table 4C). We are now going to test the third step. The logistic regression revealed that the association between infant psychophysiological profile and infant attachment depends on mother behaviors in the interaction ($G^2(5) = 22.547$, $p = .000$, $X^2 = 41.557$, $R^2_{CS} = .363$, $R^2_{N} = .502$, $R^2_{MF} = .631$) (see table 6C). According to the model, good mother behaviors increase the probability of withdrawn infants to have a secure attachment by 69.9%.

Table 6C

Moderating effect of the mother behavior in the association between the infant's psychophysiological profile and the infant's attachment.

Variable	B	S.E.	X^2_{Wald}	d.f.	p-value	Exp(B)	I.C. 95%
Moderation Effect							
Extroverted * Mother behavior			1.098	2	.152		
Withdrawn * Mother behavior	.234	.465	5.508	1	.041	1.696	].156; .756[
Underaroused * Mother behavior	.487	.514	4.789	1	.123	.789	]1.006; 1.934[

Discussion

The results of this study show that psychophysiological functioning early in life has a significant effect on the probability of having a secure attachment. More than half of withdrawn infants at 3 months are insecurely attached at 12 months, while almost half of underaroused infants are insecurely attached and only a fourth of extroverted infants are insecurely attached. Withdrawn infants are characterized by their high social withdrawal, low neurobehavior performance and high neuroendocrine reactivity, while

underaroused infants are mainly characterized by their low neuroendocrine reactivity. Compared to extroverted infants the probability of being securely attached decreases in withdrawn infants and in underaroused infants. This result is concordant with the results of previous studies. Waters et al. (1980) noted that neurobehavior difficulties early in life are related to insecure attachments at 12 months. Bates et al. (1985) also found that babies low in social responsiveness, unexcitable and not liking to play with others, tended to have less secure attachments. Additionally, Grossmann et al. (1985) reported a significant association between low orienting ability and insecure attachment classification. In 1992, Calkins and Fox described that higher distress reactivity early in life was associated with insecure attachments. Furthermore, Seifer et al. (1996), noted that higher infant difficulty was related to later insecurity. It is possible that early neonatal difficulties are the reflection of problems in integrative and adaptative mechanisms that still influence the infant's behavior later in life, namely the social interaction behavior (Waters et al., 1980).

Regarding the quality of mother-infant interaction the results show that mean scores for mother behavior, infant behavior and overall interaction are higher in the securely attached infants.

Good mother behavior in the interaction characterized by warmth, acceptance, responsiveness and sensitiveness had a significant effect on the probability of having a secure attachment. Other studies have also reported that mothers of securely attached infants were more sensitive to their infants' cues (Ainsworth, 1979, 1982; De Wolff & van IJzendoorn, 1997; Grossmann et al., 1985), more responsive and encouraging in face-to-face interaction (Blehar et al., 1977) and more sensitive to their infants in free play activities (Fuentes et al., 2006) compared to mothers of insecurely attached infants.

The overall quality of interaction characterized by smooth, fun, satisfying and excited engagement had a marginally significant effect on the probability of having a secure attachment. Previous research has noted that interactions characterized by synchrony, and symmetrical co-regulation are related to secure infant-mother attachments (Evans & Porter, 2009; Isabella et al., 1989). This association between mother behavior and the overall pattern of interaction and later infant attachment corroborates the attachment theory that holds that attachment relationships develop within the context of infant-mother interactions (Ainsworth et al., 1978; Bowlby, 1969).

The infant's psychophysiological profile predicts the infant behavior in the interaction as well as the quality of overall interaction but not the mother behavior in the interaction. Extroverted infants are characterized by their good psychological performance, while withdrawn infants are characterized by their poor psychological performance and that seems to reflect itself on the quality of mother infant interaction. Nugent et al. (1993) also reported a significant association between neonatal behavior and the quality of mother-infant interaction. Similar results were obtained by Murray, Stanley, Hooper, King, and Fiori-Cowley (1996) that noted that poor motor performance and high levels of infant irritability in the neonatal period predicted worse infant behavior in face-to-face interactions with the mother at two months postpartum. New evidence is provided with this study: individual differences on psychophysiological functioning early in life are determinant for the development of particular patterns of interaction. This is confirmative of the infant effect on the dyadic system.

Additionally, the relationship between infant psychophysiological profile and infant attachment is mediated by the quality of overall interaction and moderated by the mother behavior in the interaction. As such, the overall interaction seems to be the primary pathway by which the infant's psychophysiological profile interferes on later attachment. Nonetheless the mother behavior also plays a role on infant attachment by moderating the influence of infant profile on the development of secure attachments. Apparently, maternal optimal behavior in the interaction may function as a buffer against the influence of the infant's psychophysiological profile. This implies that both aspects of the interaction have important implications for the infant's attachment.

Bates et al. (1985) reported that the correlation between infant characteristics and later attachment may be due to a biological basis in infant emotional reactivity and stress reactions, but the cause of the correlation might also lie in subtle parent-child interaction processes. Goldsmith and Alansky (1987) demonstrated that sensitive, responsive maternal interaction predicted the security of attachment while the infant proneness to distress predicted resistance in the strange situation that is thought to indicate one variety of insecure attachment. In 1989, van den Boom found that infant's irritability predicted later attachment classification, especially the avoidant category. Additionally the mothers of irritable infants, tended to develop a pattern of interaction

characterized by gradual non-involvement and unresponsiveness with age. The author proved that intervention programs aimed at enhancing maternal sensitive responsiveness with irritable infants had positive effects on infant attachment to the mother.

In withdrawn infants the mother behavior seems to be particularly relevant for the development of secure/insecure attachments. We may than conclude that the mother behavior might have a differencial impact on infant development according to his/her previous unique characteristics. Considering that infant behavior early in life interferes with the caretaking environment, than difficulties at this time limit the quality of the mother-infant interaction (Waters et al., 1980). The caregiver behavior is also a function of the infant behavior and as such early difficulties can be expected to limit the quality of the caregiving environment. Nonetheless, when mothers are able to overcome the difficulties to coordinate their behavior with the withdrawn infant's functioning; this seems to have a protective effect to the infant development. A probable explanation to this fact is that these mothers can provide to their infants more positive interaction experiences in the day-to-day activities. This is an important cue for clinical practice once early intervention programs could be developed for mothers of withdrawn infants in order to help them overcome the difficulties inherent their infants' behavior. The interaction between the infant predisposition and mother behavior may develop into a trajectory of experience for the child, with important developmental outcomes (van den Boom, 1989).

This study presents some limitations including the lack of data regarding mothers' psychossocial status that could interfere with their behavior in the interaction. Nonetheless, the results of this study suggest that the infant contributions to the development of particular patterns of mother-infant interaction and later attachment begin soon after birth. Additionally, it alerts to the fact that neither the infant functioning nor the caregiver behavior can be overlooked, since both contribute to the development of the dyadic system and of the relationship. Future research should address this issue in a bigger sample in order to analyze the differential impact of both infant characteristics and mother-infant interaction on insecure-avoidant, insecure-resistant and disorganized infants. Additional evidence would also be usefull regarding

the timing of both infant difficulties and interaction problems on the developmental outcomes.

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CHAPTER 5

CONCLUSION

The notion that infants show organized behavior very early in life, that they play a role in the pathway of their own development through the influence they exert on the quality of earliest and closest relationship, lead us on a quest for looking at infant's developmental trajectories in the first year of life.

Several questions were in need to be answered, among them: 1) can we profile infants according to their psychological and physiological functioning? And if so, 2) are there differences in the quality of mother-infant interaction according to the infant psychophysiological profile? 3) can the psychophysiological profile predict security of attachment? Infant attachment is an important factor to consider since it is the result of a history of interactional experiences between the infant and the caregiver (Ainsworth, 1982; Ainsworth et al., 1978) and is also an important predictor of infant developmental outcomes (e.g. Renken et al., 1989; Burgess et al., 2003)

Some authors argue that the infant plays a role on the quality of mother-infant interaction (Field, 1985, 1989; Tronick, 1989), nonetheless few research studies have analyzed exactly which characteristics are associated with difficulties in establishing dyadic interactions. Which are the behavioral profiles associated with good interactions and those associated with difficult interactions? Can we very early in life detect dyads in need of clinical attention just by examining the infant?

In order to answer these questions infant's psychophysiological characteristics were analysed and groups of infants with distinct profiles were identified as well as differences on the quality of mother-infant interaction between them.

Three distinct patterns of functioning were found and named of (1) withdrawn, (2) extroverted and (3) underaroused. Withdrawn infants showed difficulties on both neurobehavior and social behavior, while on a physiological level they had the higher neuroendocrine response to stressful situations. Extroverted infants have optimal psychological functioning and a neuroendocrine reactivity on the average. Finally, the underaroused infants had some slightly signs of difficulties on neurobehavior and social behavior, and low endocrine response to stressful situations.

These results are in accordance to Thomas et al. (1968) arguments of a discernible behavioral profile at 2/3 months-old. These authors have identified three patterns of temperament that resemble the classification of this study. The "difficult" children show withdrawn from stimulus similarly to our "withdrawn" infants,

additionally they are irregular, have intense reactions, difficulties to adapt and negative mood. The "easy" children resemble our "extroverted" infants in their adaptability and approach features; additionally they are characterized by positive mood, regularity, low/moderate intensity of reaction. The "slow to warm up" are slow to adapt and show low intensity of reactions which resembles our "underaroused" infants furthermore they withdrawn only in the first exposure to stimuli, have some negative mood and have low activity level.

Additional information was gathered regarding the quality of mother-infant interaction in these three groups of infants that highlight the impact of individual differences soon after birth on the development of significant relationships (van den Boom & Hoeksma, 1994).

In general the quality of mother–infant interaction was extremely worse in the group of withdrawn infants compared to extroverted and underaroused infants and slightly worse in the group of underaroused compared to extroverted infants. Extroverted infants are characterized by a good psychological performance, while withdrawn infants are characterized by a poor psychological performance and that seems to reflect on the quality of mother-infant interaction. In fact, the results provide evidence of relational difficulties in withdrawn infants and their mothers. These difficulties can be observed on infant behaviors, but also on maternal behaviors and overall interaction. Attending to the fact that the impairment of the quality of interaction has been related to later infant difficulties, this group of infants may be considered a risk group for experiencing difficulties in their trajectories during the first year of life (Evans & Porter, 2009).

Evidence concerning underaroused infants was also reported. This group of infants resemble the hyposensitive/under-responsive infant described in the diagnostic classification of mental health and developmental disorders of infancy and early childhood (Zero to three, 2005). Interestingly, these infants' hyposensitive/under-responsive characteristics were reflected on difficulties regarding infant behavior in the interaction and the overall interaction, but not on maternal behavior in the interaction. In fact mothers in this group of infants are extremely sensitive and adequate in the interaction which may be indicative of an important process of "reactive genotype-environment correlation" (Plomin, deFries and Loehlin, 1977), going on in this group of

infants. Probably the underaroused mothers' "extra-sensitivity" competences might have been elicited by their infants' hyposensitive behaviors and developed as an adaptative response to engage with them. If that is so, this may constitute a protective factor to the development of infant disorders.

We can now answer the initial set of questions: is it possible to identify individual psychophysiological differences early in life associated with later difficulties on mother-infant relationships?

More than in a general sense arguing that infant characteristics influence the ability of the dyad to establish equilibrium, we can now add that this equilibrium is more easily reached in dyads of extroverted infants. These dyads seem to easily reach the mutual regulation goal (Tronick, 1989), since both demonstrate to adequately employ their interactive competencies in an effort to achieve coordination in the interaction. The mismatches are easily repaired in a mutually regulated reparatory process. The result is a high quality of mother-infant interaction.

Dyads of withdrawn and underaroused infants experience more difficulties in the interaction. If we consider that despite the infants' impressive capacities at birth, they clearly have limits and that the infant is a sub-system within a larger dyadic regulatory system that also comprises the caregiver as the other sub-system (Tronick, 1989), one may conclude that the caregiver sub-system is having troubles to use its capacities to overcome the withdrawn infants' difficulties. The goal of mutual regulation, or reciprocity, is therefore difficult to achieve and so a lack of coordination between the infant and the adult is observed without re-achieving a matching state. However, the caregiver sub-system on underaroused infants seems to be extremely competent on this task. In such a way that in spite of infant difficulties, they are able to overcome them in order to reach to scaffold the infants' limited regulatory capacities. For these mothers the difficulties inherent to the interactive process motivate them to modify it by employing their interactive skills in order to better regulate the interaction in a bidirectional, synchronous and coordinated manner. The result is a better overall interaction compared to withdrawn dyads, although not as good as in the extroverted infants. This group of dyads provides us the evidence of the importance of the infant contribution to the interaction, because no matter how good the caregiving system is, a good interaction pattern can only be achieved with the effort of both parts of the system.

But also, how mothers can adequate their behavior to infant's psychological difficulties, resulting in an improved interaction with the infant.

In the next step it was examined how mothers of withdrawn, extroverted and underaroused infants perceive their infants's temperament. Do these groups of infants show distinct temperament individuality in the first weeks of life and a discernible behavioral profile later in the first year of life? And what is the role of mother-infant interaction on the stability of infant temperament?

The results of this study give some empirical support to the notion of temperament as biologically determinate and present at birth (Goldsmith et al., 1987) since mothers' perception of infant temperament differ according to the infant psychophysiological profile. This means that infant' social and emotional behaviors displayed early in life, before the development of diverse social interactions, can be differentiated. In fact, maternal perception of extroverted infants differs from maternal perception of withdrawn infants in that the first ones show more approach, excitement and positive anticipation of pleasurable activities. Mothers of withdrawn infants perceived them as having less cuddliness behaviors and vocal reactivity than mothers of underaroused infants. At 12 months, withdrawn infants are perceived by their mothers as having lower levels of activity and smiling/laughter compared to extroverted infants as well as higher perceptual sensitivity compared to underaroused infants.

At both 3 and 12 months withdrawn infants seem to be perceived by their mothers as more difficult. This might increase the probability for these infants to experience a conflict between their temperament and the environment which in turn may lead to behavioral disorders (Thomas et al., 1968) and might place them in a more vulnerable position for later personality and social development difficulties (Kagan, 1998; Rothbart & Bates, 1998).

Most temperament theories argue that the original characteristics of temperament tend to remain constant in quality over the years, although in the course of development, environmental circumstances may influence the infants' reactions and behavior (Thomas et al., 1968). The results of this study give empirical support to this premise of some stability in the expression of infant temperament (Rothbart & Derryberry, 1981). Temperament characteristics are relatively stable over time and it

can happen that while some characteristics change, others remain stable. In fact, stability on mothers' perception of infant temperament from 3 to 12 months on most temperament dimensions: activity level, fear, duration/orientation, smiling/laughter, high pleasure, low pleasure, soothability, falling reactivity, perceptual sensitivity and vocal reactivity. Nonetheless older infants have lower scores on distress to limitation, cuddliness and sadness and higher scores on approach. This means that mothers are able to recognize subtil individual differences over the first year of life, although that might not correspond to adaptation of their own behaviors to their infant's characteristics.

Other interesting finding was that the complex social emotional behaviors, displayed early in life, influence later changes on maternal perceptions of infant temperament over the first year of life. This influence seems particularly important regarding fear, smiling and approach dimensions. Additionally, the quality of mother-infant interaction also interferes with changes on mothers' perception of infant temperament. Good patterns of mother-infant interaction are related to increases on the perception of infants' positive emotionality and activity level. This suggests that poor interactive experiences may be in the origin of more distress in the quality of care, leading the infant to express less positive emotionality. Additionally, the infant may have more difficulty to develop competencies to deal effectively with negative emotionality. Conversely, when maternal interaction is better, the self-regulatory capacity of the infant is facilitated and leads to positive change in negative emotionality. These results corroborate the theories that claim that the environment interferes with changes on temperament over time. The expression of temperament is influence by the extent of stimuli and regulation provided by the environment and vice versa in an interactional model (e.g. Rothbart & Derryberry, 1981).

To answer the second set of questions one may add to previous knowledge that the infant' social and emotional behaviors displayed early in life, before the development of diverse social interactions, can be differentiated by their mothers. Furthermore, mothers of withdrawn infants perceive them as more difficult. Considering the fact that our first study indicated relational difficulties in dyads of withdrawn infants, we might speculate that those difficulties may also be due to the infant temperament particularities. The fact that this group of infants are seen by their mothers as more difficult and that there are difficulties in the relational level may be

indicative of an increased probability of developmental problems. Nonetheless, data also suggests that the quality of interaction may influence the development of these temperamental difficulties; in fact it seems that when a good interaction is established an increased positive emotionality is possible to develop. In turn this may have a potential positive impact on the mother-infant interaction and act as a protective factor to the infant development.

Finally the third set of questions concerned the impact of individual differences displayed early in life on the development of attachment. Additionally the role of mother-infant interaction on this association was also questioned. What is exactly the role of on the one hand the infant characteristics and, on the other hand the quality of mother-infant interaction for the development of secure attachments?

The importance of individual differences early in life on the development of attachment was observed in this study as in previous ones (Bates et al., 1985; Grossmann et al., 1985; Waters et al., 1980). Psychophysiological profiles were associated with secure attachments: withdrawn and underaroused infants have a higher probability of being insecurely attached compared to extroverted infants.

New evidence was provided by this study regarding the role of infant's characteristics on the dyadic system. The infant's psychophysiological profile predicts the infant behavior in the interaction as well as the quality of overall interaction. This means that individual differences on psychophysiological functioning early in life are determinant for the development of particular patterns of interaction.

Attending to previous evidence of difficulties on temperament and interaction of withdrawn and underaroused infants, the mediating or moderating role of the mother-infant interaction in the association between profiles and later attachment was further investigated. Evidence was provided that the association between infant psychophysiological profile and infant attachment was mediated by the overall interaction and moderated by the mother behavior. The overall interaction seems to be the main pathway by which the infant's characteristics influence later attachment. Nonetheless the mother's behavior also influences infant attachment by moderating the impact of infant's characteristics on the development of secure attachments. This may be indicative that the correlation between infant characteristics and later attachment

relies at least partially in subtle parent-child interaction processes (e.g. Bates, Maslin, & Frankel, 1985).

To answer the last set of questions one might say that infant characteristics displayed soon after birth as well as the quality of early interactions contribute to the development of (in)secure attachments. As such neonatal difficulties may be the reflection of integrative and adaptative mechanisms that influence the infant's later behavior (Waters et al., 1980). Furthermore, the correlation between infant's characteristics and later attachment may rely in patterns of dyadic interaction (Bates et al., 1985). This indicates the importance of considering both the infant's characteristics and the dyadic interaction in the study of infant attachment; and corroborates the attachment theory that holds that attachment relationships develop within the context of infant-mother interactions (Ainsworth, 1982; Ainsworth et al., 1978; Bowlby, 1969).

We conclude that the identification of infants with different psychophysiological profiles may contribute to the understanding of infant developmental trajectories in the first year of life that could lead to (in)adaptative development. The lack of connectedness that characterizes both mother and withdrawn infant behavior in the interaction is often the reflection of miss or misinterpreting the infants' cues resulting in unresponsiveness or insensitiveness and in difficulties in achieving the mutual regulation. As such the infant collects experiences of maternal unavailability to provide confort and protection when needed that will teach him/her not to trust that the mother will be there to relieve stress or to responde to his needs (e.g. Ainsworth, 1978). We alert for the fact that withdrawn infants may be at risk for developmental difficulties due to these negative experiences.

The quality of the infant interaction with the primary caregiver is a relevant issue for the infant development because within this relationship the infant develops the sense of what is expected from him and what is possible in the relationship with others. Within this relationship the infant develops (or not) competencies for social initiation, reciprocity, synchrony, and cooperation. The fact that mother's of underaroused infants express such competent behaviors in the interaction may a protective factor for infant development. Their sensitivity, responsivity, investment, involvement and persistence

may contribute to achieve a good overall mother-infant interaction. These mothers are constantly passing a message to their infants of availability to confort and protect and so the infant learns to trust that the mother will respond to his needs. Under these conditions of confidence, the infant has the opportunity to grow in an autonomous way (e.g. Ainsworth et al., 1978).

This study presents some limitations including the the fact that the sample consisted of primarily White, adult mothers with a simple gestation, the generalization of results is limited to this population. Aditionally no data was collected regarding mothers' socioeconomical adversity and psychological problems that can adversely affect mother-infant interactions. Furthermore, the observation of mother-infant interactions was not evaluated in multiple contexts and as such the conclusions may be confined to structured contexts in which they took place.

Despite the limitations, this study has contributed to the comprehension of a global and broad perspective of the infant, considering the interplay of psychological and physiological features and its impact on mothers' behaviors, on the quality of mother-infant interaction, on mother's perceptions and on later attachment security. This study also alerts to the influence of both individual differences and quality of early interactions and bears important clinical implication to the development of early intervention focused on mother-infant interaction. Withdrawn infant are at risk of developmental difficulties, once they have worse mother-infant interaction and increased probability of becoming insecurely attached. This means that clinicians can, in the context of routine medical care procedures, detect and signalize infants at risk. In this condition, early intervention on emerging developmental difficulties would be possible and desirable. We are not talking about helping families after years of asynchronous and uncoordinated relationships. We are talking about a preventive effort that implies helping caregivers to understand the infant behavior and to act with the intention of constantly and consistently repair mismatches of affective states and relational intentions, enhancing their sensitivity and responsivity to the infant's needs in order to achieve positive effects on infant development (Tronick, 2007). This would give the dyad the opportunity to live positive experiences in their relational context that are essential for the infant healthy development.

Future research should consider the different psychophysiological profiles as potential precursors of psychological problems such as depression, anxiety, attention deficit hyperactivity disorder or autism, in order to understand the developmental pathways of these disorders. Future research should also address this issue in a larger sample in order to analyze the differential impact of both infant characteristics and mother-infant interaction on insecure-avoidant, insecure-resistant and disorganized infants. Important factors to consider would be the timing of both infant difficulties and interaction problems on the developmental outcomes.

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ANNEXES

ANNEX 1 – NBAS quotation sheet

NBAS	Cotação
Response dec. to light	
Response dec. to rattle	
Response dec. to bell	
Response dec. to foot	
Animate visual	
Animate visual & auditory	
Inanimate visual	
Inanimate visual & auditory	
Animate auditory	
Inanimate auditory	
General tone	
Motor maturity	
Pull-to-sit	
Defensive	
Activity Level	
Peak of excitement	
Rapidity of build-up	
Irritability	
Lability of states	
Cuddliness	
Consolability	
Self-quieting	
Hand-to-mouth	
Tremulousness	
Startle	
Lability of skin color	

NBAS	Cotação
Smiles	
Quality of alertness	
Cost of attention	
Examiner facilitation	
General irritability	
Robustness/Endurance	
State regulation	
E's emotional response	
Plantar grasp	
Babinski	
Ankle clonus	
Rooting	
Sucking	
Glabella	
Passive resistence - Legs	
Passive resistence - Arms	
Palmar grasp	
Placing	
Standing	
Walking	
Crawling	
Incurvation	
Tonic Dev. Head/Eyes	
Nystagmus	
TNR	
Moro	

ANNEX 2 – ADBB quotation sheet

Sub-Escalas	Cotação
1. Expressões faciais	
2. Contacto visual	
3. Actividade corporal	
4. Actividades de auto-estimulação	
5. Vocalizações	
6. Vivacidade na reacção à estimulação	
7. Relação	
8. Atractividade	
Total	

ANNEX 3 - GRS quotation sheet

GRS	**Cotação**
Warm/Positive	
Accepting - Rejecting	
Responsive - Unresponsive	
Non-demanding - Demanding	
Sensitive - Insensitive	
Non-Intrusive Behaviour - Intrusive Behaviour	
Non-Intrusive Speech - Intrusive Speech	
Non-Remote - Remote	
Non-Silent - Silent	
Happy - Sad	
Much enegy - Low energy	
Absorved in Infant - Self-absorbed	
Relaxed - Tense	
Attentive to Mother - Avoidant	
Active Communication - No communication	
Positive Vocalisations - No Vocalisations	
Engaged with Environment - Self Absorbed	
Lively - Inert	
Happy - Distressed	
Non-Fretful - Fretful	
Smooth/Easy - Difficult	
Fun - Serious	
Mutualy Satisfying - Unsatisfying	
Much Engagement - No Engagement	
Excited Engagement - Quiet Engagement	

ANNEX 4 – IBQ

Infant Behavior Questionnaire – Revisto

Traduzido por Costa & Figueiredo, 2005

Participante Nº._____ Data de Nascimento da Criança _____
Data de Hoje:_____ Idade da Criança :_____
Sexo da Criança:_____

INSTRUCÇÕES

POR FAVOR, LEIA COM ATENÇÃO ANTES DE INICIAR:

À medida que vai lendo cada descrição do comportamento da criança, indique com que frequência esse comportamento ocorreu na ÚLTIMA SEMANA (últimos 7 dias) colocando um circulo num dos números da coluna da esquerda.
Os números indicam com que frequência observou o comportamento descrito na última semana.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(X)
Nunca	Muito raramente	Menos de metade das vezes	Cerca de metade das vezes	Mais de metade das vezes	Quase sempre	Sempre	Não se aplica

A **coluna "Não se aplica" (X)** é usada quando a situação descrita não ocorreu na última semana com o bebé. Por exemplo, se a situação se refere ao bebé ter que esperar por comida ou bebida e não houve nenhuma situação dessas na última semana coloque um circulo na coluna (X).

"Não se aplica" (X) é diferente de "Nunca" (1). "Nunca" é usado quando a situação ocorre, mas o bebé não tem esse comportamento durante a última semana. Por exemplo, se o bebé teve que esperar por comida ou bebida na última semana pelo menos uma vez mas nunca chorou enquanto esperava, coloque um circulo na coluna (1).

Por favor, certifique-se que coloca UM E SÓ UM CÍRCULO POR ITEM em todos os itens.

ALIMENTAÇÃO

Durante a alimentação, com que frequência o bebé:
1 2 3 4 5 6 7 X . . . . (1) ficou ou sentou-se calmamente?
1 2 3 4 5 6 7 X . . . . (2) afastou-se ou pontapeou?
1 2 3 4 5 6 7 X . . . . (3) abanou os braços?
1 2 3 4 5 6 7 X . . . . (4) notou uma textura grumosa na comida (ex.: na farinha)?

Na última semana, enquanto estava a ser alimentado no seu colo, com que frequência o bebé:
1 2 3 4 5 6 7 X . . . . (5) pareceu gostar da vossa proximidade?
1 2 3 4 5 6 7 X . . . . (6) aninhou mesmo depois de ter terminado?
1 2 3 4 5 6 7 X . . . . (7) pareceu ansioso por sair do colo assim que acaba de comer/beber?

Com que frequência o bebé fez sons de fala:
1 2 3 4 5 6 7 X . . . . (8) enquanto esperou numa cadeira alta pela comida?
1 2 3 4 5 6 7 X . . . . (9) quando estava pronto para comer mais?
1 2 3 4 5 6 7 X . . . . (10) quando já comeu o suficiente?

SONO

Na última semana, antes de adormecer à noite com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (11) não mostrou protesto ou choro?

Durante o sono, com que frequência o bebé:
1 2 3 4 5 6 7 X . . . . (12) virou-se no berço?
1 2 3 4 5 6 7 X . . . . (13) se moveu do meio para o fim do berço?
1 2 3 4 5 6 7 X . . . . (14) dormiu apenas numa posição?

Depois de dormir, com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (15) protestou ou chorou imediatamente?
1 2 3 4 5 6 7 X . . . . (16) brincou calmamente no berço?
1 2 3 4 5 6 7 X . . . . (17) chorou se ninguém apareceu em poucos minutos?

Com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (18) pareceu zangado (chorou e protestou) quando o deixa no berço?
1 2 3 4 5 6 7 X . . . . (19) pareceu ficar contente quando deixado no berço?
1 2 3 4 5 6 7 X . . . . (20) chorou ou protestou antes de ir dormir a sesta?

Quando foi dormir à noite, com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (21) adormeceu em 10 minutos?
1 2 3 4 5 6 7 X . . . . (22) teve dificuldade em se acalmar para dormir?
1 2 3 4 5 6 7 X . . . . (23) acalmou para dormir facilmente?

Quando o seu bebé acordou à noite, com que frequência:
1 2 3 4 5 6 7 X . . . . (24) teve dificuldade em voltar a adormecer?
1 2 3 4 5 6 7 X . . . . (25) voltou a adormecer imediatamente?

Quando deitado para dormir a sesta, com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (26) permaneceu acordado por muito tempo?
1 2 3 4 5 6 7 X . . . . (27) adormeceu imediatamente?
1 2 3 4 5 6 7 X . . . . (28) acalmou rapidamente?
1 2 3 4 5 6 7 X . . . . (29) teve dificuldade em se acalmar?

Quando foi altura de ir para cama dormir ou fazer uma sesta e o seu bebé não quis ir, com que frequência ele:
1 2 3 4 5 6 7 X . . . . (30) choramingou ou soluçou?
1 2 3 4 5 6 7 X . . . . (31) ficou choroso?

BANHO E VESTIR

Na última semana ao ser vestido ou despido, com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (32) abanou os braços e pontapeou?
1 2 3 4 5 6 7 X . . . . (33) afastou-se e/ou tentou rolar para longe?
1 2 3 4 5 6 7 X . . . . (34) sorriu ou riu?
1 2 3 4 5 6 7 X . . . . (35) palrou ou vocalizou?

Quando colocado na água do banho, com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (36) sorriu?
1 2 3 4 5 6 7 X . . . . (37) riu?
1 2 3 4 5 6 7 X . . . . (38) chapinou ou pontapeou?
1 2 3 4 5 6 7 X . . . . (39) virou o corpo ou afastou-se?

Quando lhe lavou a cara, com que frequência o bebé:
1 2 3 4 5 6 7 X . . . . (40) sorriu ou riu?
1 2 3 4 5 6 7 X . . . . (41) protestou ou chorou?
1 2 3 4 5 6 7 X . . . . (42) palrou?

Quando lhe lavou o cabelo, com que frequência o bebé:
1 2 3 4 5 6 7 X . . . . (43) sorriu?
1 2 3 4 5 6 7 X . . . . (44) protestou ou chorou?
1 2 3 4 5 6 7 X . . . . (45) vocalizou?

BRINCADEIRAS

Durante a última semana com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (46) olhou para figuras nos livros e/ou revistas por 2 a 5 minutos seguidos de cada vez?
1 2 3 4 5 6 7 X . . . . (47) olhou para figuras nos livros e/ou revistas por 5 ou mais minutos seguidos de cada vez?
1 2 3 4 5 6 7 X . . . . (48) olhou para um mobile, berço ou figura por 5 minutos ou mais?
1 2 3 4 5 6 7 X . . . . (49) brincou com um brinquedo ou objecto por 5 a 10 minutos?
1 2 3 4 5 6 7 X . . . . (50) brincou com um brinquedo ou objecto por 10 minutos ou mais?
1 2 3 4 5 6 7 X . . . . (51) passou tempo a olhar para os brinquedos?
1 2 3 4 5 6 7 X . . . . (52) repetiu os mesmos sons várias vezes?

1 2 3 4 5 6 7 X . . . . (53) riu alto durante as brincadeiras?
1 2 3 4 5 6 7 X . . . . (54) repetiu o mesmo movimento com um objecto por 2 ou mais minutos (ex.: colocar um bloco numa chávena, pontapear ou bater num mobile?
1 2 3 4 5 6 7 X . . . . (55) prestou atenção à sua leitura na maior parte da história enquanto olhava para as figuras do livro?
1 2 3 4 5 6 7 X . . . . (56) sorriu ou riu após ter conseguido algo (e.g., empilhar blocos, etc.)?
1 2 3 4 5 6 7 X . . . . (57) sorriu ou riu quando lhe deram um brinquedo?
1 2 3 4 5 6 7 X . . . . (58) sorriu ou riu quando lhe fizeram cócegas?

Com que frequência durante a última semana o seu bebé apreciou:
1 2 3 4 5 6 7 X . . . . (59) que cantassem para ele?
1 2 3 4 5 6 7 X . . . . (60) que lessem para ele?
1 2 3 4 5 6 7 X . . . . (61) ouvir o som das palavras, como nas rimas dos berçários?
1 2 3 4 5 6 7 X . . . . (62) olhar para figuras de livros?
1 2 3 4 5 6 7 X . . . . (63) actividades rítmicas delicadas, tais como oscilar ou balançar?
1 2 3 4 5 6 7 X . . . . (64) ficar quieto a examinar os dedos ou pés?
1 2 3 4 5 6 7 X . . . . (65) que você ou alguém da família lhe fizesse cócegas?
1 2 3 4 5 6 7 X . . . . (66) envolver-se numa brincadeira turbulenta?
1 2 3 4 5 6 7 X . . . . (67) observá-lo, ou a outro adulto, a fazer "caretas"?
1 2 3 4 5 6 7 X . . . . (68) tocar ou ficar perto de animais de peluche?
1 2 3 4 5 6 7 X . . . . (69) sentir os cobertores suaves?
1 2 3 4 5 6 7 X . . . . (70) ser enrolado num cobertor quente?
1 2 3 4 5 6 7 X . . . . (71) ouvir um brinquedo musical num berço?

Enquanto brincava tranquilamente com um dos seus brinquedos favoritos, com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (72) mostrou prazer?
1 2 3 4 5 6 7 X . . . . (73) apreciou ficar no berço por mais de 5 minutos?
1 2 3 4 5 6 7 X . . . . (74) apreciou ficar no berço por mais de 10 minutos?

Quando algo com que o bebé brincava teve que ser removido, com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (75) chorou ou mostrou distress por um tempo?
1 2 3 4 5 6 7 X . . . . (76) não pareceu ficar incomodado?

Quando o lançou em volta na brincadeira, com que frequência o bebé:
1 2 3 4 5 6 7 X . . . . (77) sorriu?
1 2 3 4 5 6 7 X . . . . (78) riu?

Durante um jogo, com que frequência o bebé:
1 2 3 4 5 6 7 X . . . . (79) sorriu?
1 2 3 4 5 6 7 X . . . . (80) riu?

Com que frequência o seu bebé apreciou ser balanceado:
1 2 3 4 5 6 7 X . . . . (81) no seu colo?
1 2 3 4 5 6 7 X . . . . (82) num objecto, como uma cama, cadeira de balouço ou brinquedo?

Com que frequência o bebé desviou o olhar da brincadeira:
1 2 3 4 5 6 7 X . . . . (83) quando o telefone tocou?
1 2 3 4 5 6 7 X . . . . (84) quando ouviu vozes noutros quartos?

Quando o seu bebé viu um brinquedo que desejou, com que frequência:
1 2 3 4 5 6 7 X . . . . (85) ficou muito excitado para consegui-lo?
1 2 3 4 5 6 7 X . . . . (86) tentou agarrá-lo imediatamente?

Quando lhe deram um brinquedo novo, com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (87) ficou muito excitado para consegui-lo?
1 2 3 4 5 6 7 X . . . . (88) tentou agarrá-lo imediatamente?
1 2 3 4 5 6 7 X . . . . (89) pareceu não ficar muito excitado?

ACTIVIDADES DIÁRIAS

Com que frequência na última semana o bebé:
1 2 3 4 5 6 7 X . . . . (90) chorou ou mostrou distress aquando da mudança de aparência de um dos pais, (tirar os óculos, pôr uma touca, etc.)?
1 2 3 4 5 6 7 X . . . . (91) quando em posição para ver televisão, olhou para ela durante 2 a 5 minutos de cada vez?

Com que frequência durante a última semana o seu bebé:
1 2 3 4 5 6 7 X . . . . (92) quando em posição de ver televisão, olhou para ela por 5 minutos ou mais?
1 2 3 4 5 6 7 X . . . . (93) protestou quando colocado num local restrito (acento de criança, parque, acento de carro, etc.)?
1 2 3 4 5 6 7 X . . . . (94) estremeceu durante uma mudança súbita na posição corporal (ex.: quando movido de repente)?
1 2 3 4 5 6 7 X . . . . (95) pareceu ouvir até sons mesmo muito baixos?
1 2 3 4 5 6 7 X . . . . (96) deu atenção a sinais e sons quando estava ao ar livre (por exemplo, vento ou gotas de água)?
1 2 3 4 5 6 7 X . . . . (97) moveu-se rapidamente em direcção a objectos novos para ele/a?
1 2 3 4 5 6 7 X . . . . (98) mostrou um forte desejo por algo que quis?
1 2 3 4 5 6 7 X . . . . (99) estremeceu com um som alto ou repentino?
1 2 3 4 5 6 7 X . . . . (100) olhou para crianças a brincar no parque ou no playground por 5 minutos ou mais?
1 2 3 4 5 6 7 X . . . . (101) observou adultos a fazer tarefas domésticas (ex.: cozinhar, etc.) por 5 minutos ou mais?
1 2 3 4 5 6 7 X . . . . (102) gritou quando excitado?
1 2 3 4 5 6 7 X . . . . (103) imitou os sons que você fez?
1 2 3 4 5 6 7 X . . . . (104) pareceu excitado/a quando você ou outro adulto agiu de uma forma excitada perto dele?

Enquanto estava ao colo, com que frequência o bebé:
1 2 3 4 5 6 7 X . . . . (105) se afastou ou pontapeou?
1 2 3 4 5 6 7 X . . . . (106) pareceu estar divertido?
1 2 3 4 5 6 7 X . . . . (107) se moldou ao seu corpo?
1 2 3 4 5 6 7 X . . . . (108) afastou-se?

Quando deitado de costas, com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (109) protestou?
1 2 3 4 5 6 7 X . . . . (110) sorriu ou riu?
1 2 3 4 5 6 7 X . . . . (111) abanou os braços e pontapeou?
1 2 3 4 5 6 7 X . . . . (112) afastou-se e/ou virou o corpo?

Quando o bebé quis algo, com que frequência:
1 2 3 4 5 6 7 X . . . . (113) ficou perturbado quando não conseguiu o que quis?
1 2 3 4 5 6 7 X . . . . (114) ficou furioso (chorar, gritar, face vermelha, etc.) quando não conseguiu o que quis?

Quando colocado num banco de crianças ou numa cadeira de automóvel, com que frequência o bebé:
1 2 3 4 5 6 7 X . . . . (115) abanou os braços e pontapeou?
1 2 3 4 5 6 7 X . . . . (116) afastou-se e virou o corpo?
1 2 3 4 5 6 7 X . . . . (117) ficou ou sentou-se calmamente?
1 2 3 4 5 6 7 X . . . . (118) mostrou um pouco de distress de início mas depois acalmou?

Quando frustrado com algo, com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (119) se acalmou em 5 minutos?

Quando o seu bebé ficou perturbado por algum motivo, com que frequência:
1 2 3 4 5 6 7 X . . . . (120) permaneceu perturbado por 10 minutos ou mais?
1 2 3 4 5 6 7 X . . . . (121) permaneceu perturbado por 20 minutos ou mais?
1 2 3 4 5 6 7 X . . . . (122) acalmou-se a ele próprio com outras coisas (tais como peluche ou cobertor)?

Quando balanceado ou abraçado, na última semana, com que frequência:
1 2 3 4 5 6 7 X . . . . (123) pareceu apreciar?
1 2 3 4 5 6 7 X . . . . (124) pareceu desejoso por sair?
1 2 3 4 5 6 7 X . . . . (125) fez barulhos de protesto?

Durante a última semana, quando se reuniram depois de uma separação, com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (126) pareceu gostar que lhe peguem ao colo?
1 2 3 4 5 6 7 X . . . . (127) mostrou interesse em estar próximo, mas resistiu a ser pegado ao colo?
1 2 3 4 5 6 7 X . . . . (128) mostrou distress quando pegaram nele ao colo?

Na última semana, quando transportado ao colo, com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (129) pareceu apreciar?
1 2 3 4 5 6 7 X . . . . (130) fez força contra si até ser largado?

Enquanto sentado no seu colo com que frequência o bebé:
1 2 3 4 5 6 7 X . . . . (131) pareceu estar a gostar?
1 2 3 4 5 6 7 X . . . . (132) não ficou contente sem que se mexesse de um lado para o outro?

Com que frequência o seu bebé deu conta de:
1 2 3 4 5 6 7 X . . . . (133) barulhos de baixa frequência, ar condicionado, sistemas de aquecimento, ou frigoríficos a funcionar ou a arrancar?
1 2 3 4 5 6 7 X . . . . (134) sirenes de carros de bombeiros ou ambulâncias à distância?
1 2 3 4 5 6 7 X . . . . (135) mudanças na temperatura do quarto?
1 2 3 4 5 6 7 X . . . . (136) uma mudança na intensidade da luz quando uma nuvem passa sob o sol?
1 2 3 4 5 6 7 X . . . . (137) o som de um avião a passar por cima?
1 2 3 4 5 6 7 X . . . . (138) um pássaro ou esquilo numa árvore?
1 2 3 4 5 6 7 X . . . . (139) tecidos que picam (ex.: lã)?

Quando está cansado, com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (140) provavelmente chorou?
1 2 3 4 5 6 7 X . . . . (141) mostrou distress?

No fim de um dia entusiasmante, com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (142) ficou choroso?
1 2 3 4 5 6 7 X . . . . (143) mostrou distress?

Sem nenhuma razão aparente, com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (144) pareceu triste?
1 2 3 4 5 6 7 X . . . . (145) pareceu não responder?

Com que frequência o seu bebé emitiu sons de fala quando:
1 2 3 4 5 6 7 X . . . . (146) andou de carro?
1 2 3 4 5 6 7 X . . . . (147) andou num carrinho de supermercado?
1 2 3 4 5 6 7 X . . . . (148) você fala com ele?

NAS 2 ÚLTIMAS SEMANAS

Quando regressou após ter estado ausente e o bebé estava acordado, com que frequência ele::
1 2 3 4 5 6 7 X . . . . (149) sorriu ou riu?

Quando apresentado a um adulto que não lhe é familiar, com que frequência o bebé:
1 2 3 4 5 6 7 X . . . . (150) se inclinou para um dos pais?
1 2 3 4 5 6 7 X . . . . (151) recusou ir à pessoa que não lhe é familiar?
1 2 3 4 5 6 7 X . . . . (152) se afastou do adulto?
1 2 3 4 5 6 7 X . . . . (153) nunca se acostumou ao adulto que não lhe é familiar?
Quando está na presença de vários adultos desconhecidos, com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (154) se inclinou para um dos pais?
1 2 3 4 5 6 7 X . . . . (155) chorou?
1 2 3 4 5 6 7 X . . . . (156) permaneceu perturbado por 10 minutos ou mais?

Quando visitou um lugar novo, com que frequência o bebé:
1 2 3 4 5 6 7 X . . . . (157) mostrou distress nos primeiros minutos?
1 2 3 4 5 6 7 X . . . . (158) continuou perturbado por 10 minutos ou mais?
1 2 3 4 5 6 7 X . . . . (159) ficou excitado por explorar um novo ambiente?

1 2 3 4 5 6 7 X . . . . (160) moveu-se activamente quando explorou um novo ambiente?

Quando uma pessoa desconhecida se aproximou do seu bebé quando estão fora (ex. Centro Comercial), com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (161) mostrou distress?
1 2 3 4 5 6 7 X . . . . (162) chorou?

Quando uma pessoa desconhecida foi a sua casa, com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (163) permitiu que pegassem nele sem protestar?
1 2 3 4 5 6 7 X . . . . (164) chorou quando a visita tentou pegar nele?

No meio de uma multidão de gente, com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (165) pareceu divertir-se?

O seu bebé pareceu triste quando:
1 2 3 4 5 6 7 X . . . . (166) o cuidador se ausentou por um período de tempo invulgarmente longo?
1 2 3 4 5 6 7 X . . . . (167) foi deixado sozinho num berço ou parque por um período prolongado de tempo?

Quando está ocupado com outra actividade e o seu bebé não conseguiu chamar a sua atenção, com que frequência ele:
1 2 3 4 5 6 7 X . . . . (168) ficou triste?
1 2 3 4 5 6 7 X . . . . (169) chorou?

Quando o seu bebé viu outro bebé a chorar, com que frequência:
1 2 3 4 5 6 7 X . . . . (170) ficou choroso?
1 2 3 4 5 6 7 X . . . . (171) mostrou distress?

Quando familiares ou amigos foram visitá-lo, com que frequência o seu bebé:
1 2 3 4 5 6 7 X . . . . (172) ficou excitado?
1 2 3 4 5 6 7 X . . . . (173) pareceu indiferente?

TÉCNICAS DE APAZIGUAMENTO

Tentou alguma das técnicas de apaziguamento que se seguem nas 2 últimas semanas? Em caso de ter tentado, com que rapidez o seu bebé acalmou usando cada uma das seguintes técnicas?
Coloque um círculo no (X), se não tentou essa técnica durante as **2 ÚLTIMAS SEMANAS.**

Quando balanceou o seu bebé, com que frequência ele:
1 2 3 4 5 6 7 X . . . . (174) acalmou de imediato?
1 2 3 4 5 6 7 X . . . . (175) não acalmou imediatamente, mas nos primeiros 2 minutos?
1 2 3 4 5 6 7 X . . . . (176) demorou mais de 10 minutos a acalmar?

Quando cantou ou falou com o bebé, com que frequência ele:
1 2 3 4 5 6 7 X . . . . (177) acalmou de imediato?
1 2 3 4 5 6 7 X . . . . (178) não acalmou imediatamente, mas nos primeiros 2 minutos?
1 2 3 4 5 6 7 X . . . . (179) demorou mais de 10 minutos a acalmar?

Quando andou de um lado para o outro com o seu bebé, com que frequência ele:
1 2 3 4 5 6 7 X . . . . (180) acalmou de imediato?
1 2 3 4 5 6 7 X . . . . (181) não acalmou imediatamente, mas nos primeiros 2 minutos?
1 2 3 4 5 6 7 X . . . . (182) demorou mais de 10 minutos a acalmar?

Quando lhe deu um brinquedo, com que frequência o bebé:
1 2 3 4 5 6 7 X . . . . (183) acalmou de imediato?
1 2 3 4 5 6 7 X . . . . (184) não acalmou imediatamente, mas nos primeiros 2 minutos?
1 2 3 4 5 6 7 X . . . . (185) demorou mais de 10 minutos a acalmar?

Quando mostrou ao bebé algo para ele olhar, com que frequência ele:
1 2 3 4 5 6 7 X . . . . (186) acalmou de imediato?
1 2 3 4 5 6 7 X . . . . (187) não acalmou imediatamente, mas nos primeiros 2 minutos?
1 2 3 4 5 6 7 X . . . . (188) demorou mais de 10 minutos a acalmar?

Quando acariciou ou massajou gentilmente alguma parte do corpo do bebé, com que frequência ele:
1 2 3 4 5 6 7 X . . . . (189) acalmou de imediato?
1 2 3 4 5 6 7 X . . . . (190) não acalmou imediatamente, mas nos primeiros 2 minutos?
1 2 3 4 5 6 7 X . . . . (191) demorou mais de 10 minutos a acalmar?