



Berzelius symposium 90

The Neurobiology of Parenting

19–21 August 2015 in Stockholm · Sweden

Programme · General information
Lectures abstracts · Poster abstracts



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The symposium is arranged by the Swedish Society of Medicine in cooperation with Acta Paediatrica Sällskapet Barnavård · John Lind Stiftelsen · Chiesi Pharma AB · Karolinska Institutet and Vetenskapsrådet, The Swedish Research Council

Berzelius symposium 90

The Neurobiology of Parenting

The aim of this Berzelius symposium is to present novel research findings with respect to the underlying physiological and psychological processes of becoming a parent, as well as to the mechanisms of how parenting emerges.

As many as 2.8 million mothers and 2.3 million fathers live in Sweden today, which amounts to approximately 51% of the entire population.

Thus, parents constitute a significant portion of the population. Parents are willing to expend enormous resources at personal costs to raise their children and 'deserve' to be noticed and understood in their own rights.

We also know that the quality of parenting has large effects on the development of children. For instance, sensitive and responsive parenting affects childrens' attachment, emotional and social regulation, their language, cognition, and executive function development and growth. It is evident that these effects are prominent from very early on: Breastfeeding, close physical contact between the mother (and father) and baby and/or talking and singing to the infant stimulates the cognitive and emotional development as early as in the postpartum period.

Lack of adequate stimulation and long term separation from care-givers can have detrimental effects on children, as was seen, for example, in the hospitalized Romanian orphans. Harsh, neglectful or abusive parenting results in higher risk for physical health problems and substance abuse, adult obesity and chronic illness or depression.

Parenting clearly matters. Parental caretaking is a fundamental and genetically transmitted biological instinct, and we are just starting to understand the underlying psycho- and neurobiological mechanisms that determine individual differences in parental behaviour in humans.

Just to illustrate some of the mechanisms involved: high levels of oxytocin, released during labour and birth stimulate the mother's readiness to take care of her newborn. High levels of cortisol stimulate the mother's alertness and capability to recognize their newborns simply by smell. The bare view of a newborn baby is capable of stimulating an adults dopaminergic reward system. The latter is true even for persons who are not parents! Increased activity has been demonstrated in the orbitofrontal cortex of adults when viewing a newborn infant regardless of parenthood.

The symposium will exhibit pre-clinical and clinical research findings and is relevant for a broad audience, including researchers and students, laymen and all personnel who are working with families and newborns.

Hugo Lagercrantz, Wibke Jonas, Ulrika Ådén, Andreas Olsson
Organizing committee

Programme

Wednesday, 19 August 2015

12.00–13.00 Registration

13.00 Welcome Addresses

Filippa Nyberg, CEO, The Swedish Society of Medicine

Hugo Lagercrantz, Chair Organizing Committee

SESSION I

Psychobiology, genetics of parental care and the brain

Chair: Kyllike Christensson and Per-Anders Rydelius

13.10 Alison Fleming: Neuropsychology of Human Mothering and the Effects of Experience

13.45 Wibke Jonas: Breastfeeding: Factors affecting its occurrence and effects.

14.00 Renée Flacking: Breastfeeding and infant-parent interaction

14.15 Discussion

14.30 Coffee

15.00 Nim Tottenham: Human Amygdala-Prefrontal Cortex Development and the Role of Caregiving.

15.35 Ruth Feldman: The Human Parental Brain; Mothers and Fathers.

16.10 Discussion

19.00 Reception at the Stockholm City Hall hosted by a member of the Presidency of the City Council and co-hosted by Stockholm's County Council.

Thursday, 20 August 2015

SESSION II

Newborn and parental behaviour in the immediate postpartum period.

Chair: Anne-Marie Widström and Stephen Matthews

09.00 Patrick McGowan: The role of early life adversity and parental care in shaping mental health trajectories.

09.35 Eva Nissen: Skin-to-skin contact after birth.

09.50 Hugo Lagercrantz: Awakening of the newborn infant.

10.05 Discussion

10.30 Coffee

- 10.50** **Mikael Norman:** Mode of delivery – epigenetic effects.
- 11.10** **Steven Lye:** Maternal Contributions to the Initiation of Term and Preterm Birth.
- 11.30** **Ulrika Ådén** and **Nelly Padilla:** The preterm brain.
- 12.00** **Discussion**
- 12.20** **Lunch**
- Chair: Karin Stjernqvist and Claes von Hofsten**
- 13.20** **William Fifer:** Fetal and infant learning.
- 13.55** **Terje Falck-Ytter:** Mirror neurons in parent infant interaction.
- 14.10** **Lianne Woodward:** Parenting a Preterm Infant in the NICU and Beyond.
- 14.45** **Andreas Olsson:** Social learning of threat and safety.
- 15.00** **Discussion**
- 15.15** **Coffee and Poster viewing.**
- 18.00** **Symposium dinner at Junibacken on Djurgården, Stockholm**
Including the "Story Train" which will take us on a journey with the fabulous stories of Astrid Lindgren.

Friday, 21 August 2015

THE JOHN LIND FOUNDATION LECTURES:

- 09.00** **Chair: Lena Hellström-Westas and Björn Westrup**
- 09.05** **Martin Ritzén:** John Lind – a pioneer pediatrician understanding the importance of parental-infant bonding.
- 09.15** **Marc Bornstein:** Two Kinds of Mother-Infant Interactions across Cultures and their Neurobiological Underpinnings.
- 09.50** **Anna Sarkadi:** The Swedish father.
- 10.10** **Discussion**
- 10.20** **Coffee**
- Chair: Hugo Lagercrantz and Kerstin Uvnäs Moberg**
- 10.40** **Larry Young:** The biology of parenting.
- 11.15** **Morten Kringelbach:** Parallels between the neural control of parental care and pair bonding and the influences of parental nurturing on infant social development.
- 11.50** **General discussion**
Concluding remarks: Kerstin Uvnäs Moberg

General information



The Society's building in Stockholm



The conference Hall



When & Where?

19–21 August 2015 at the Swedish Society of Medicine (SSM), Klara Östra Kyrkogata 10 in Stockholm, Sweden.

Lunches and coffee are included in the participation cost and will be served in the on-site restaurant at the SSM.

Organizing Committee

Hugo Lagercrantz, Wibke Jonas, Ulrika Ådén and Andreas Olsson.

Symposium Coordinator

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Social programme

Wednesday, 19 Augusti 2015 at 7 p.m (sharp!):

Reception at the Stockholm City Hall. Address: Hantverkargatan 1. The city of Stockholm and the Stockholm County Council invite you to a buffet dinner. The Reception is free of-charge.

Thursday, 20 August 2015 at 6.p.m:

Conference dinner at Junibacken on Djurgården. Price: 500 SEK. The conference dinner is open to participants who have registered within the stipulated time.

Symposium website

www.sls.se/Utbildning/Berzeliussymposier/parenting/

Speakers and chairpersons

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Harvard Medical School, Boston, USA

Larry Young

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Emory University School of Medicine
Atlanta, Georgia, USA

Ulrika Ådén

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Neuropsychology of Human Mothering and the Effects of Experience

Alison S. Fleming, Department of Psychology, University of Toronto

What makes a mother want to mother? In most mammalian species, the female is not normally maternal until she herself gives birth. In rodents, inexperienced non-mothers withdraw from pups or in some cases even cannibalize them. However, at the end of pregnancy and at birth the hormonal changes that occur result in a shift in the mother's approach-withdrawal tendencies and the new mother will approach young and develop an attraction to them; she then shows the full repertoire of species-characteristic maternal behaviors. Among humans as well, mothering motivation tends to increase after birth and is affected by a shift in her appraisal of babies, an enhanced emotional sensitivity and lability and a change in a number of executive (cognitive) functions. The present talk will discuss the role of these psychological systems in the regulation of mothering and how hypothalamic, limbic, and cortical systems within the brain are involved. It will show, in addition, that there are variations in mothering behavior and that the mothering exhibited by the daughters when they have young often reflects the mothering they themselves received as infants. These developmental patterns are also associated with experience-based changes in the 'maternal brain'.

Breastfeeding: Factors affecting its occurrence and effects

Wibke Jonas, Department of Women's and Children's Health, Karolinska Institutet and Fraser Mustard Institute of Human Development Fellow, University of Toronto, Canada

Breastfeeding, together with motherese, singing and carrying as a way of infant transport is one of a handful of maternal behaviors that occurs in all cultures worldwide. Breastfeeding is also known to have positive effects on both maternal and infant health. In spite of its universality and the well -documented effects of breastfeeding, there is considerable cultural variation in the prevalence of breastfeeding.

In my talk I will present findings from a large longitudinal Canadian study entitled “Maternal Adversity, Vulnerability and Neurodevelopment (MAVAN)”, a project designed to understand the pre- and postnatal influences on maternal health and child social-emotional and cognitive development, including the role of genetics and environmental influences. Mothers and babies are tracked from mothers’ early pregnancy up to the infant age of 10. The purpose of my work in this sample was to better understand factors that regulate breastfeeding by the mothers and the “effects” of breastfeeding on the infant.

The approach I have adopted in these studies is to explore the effects of predictors that occur during an earlier period in mother’s life on outcomes that occur considerably later during the postpartum period and to consider the factors that both moderate and mediate the basic relationship of interest. To give some examples, we found that maternal early life adversity was associated with reduced breastfeeding and elevated levels of depression in the postpartum mother. A moderated mediation analysis showed that the inverse relation between mothers’ earlier experiences of adversity and the duration of her breastfeeding postpartum was mediated by mothers’ depression level, but only in women carrying one variant of the oxytocin *rs2740210* gene marker (*CC* genotype). When extending the above work to explore the ‘effects’ of breastfeeding on the mother-infant relationship and infant temperament, we found in a moderated mediation analysis that mothers who breastfeed at 3 months act more sensitively towards their infants when they are 6 months old and they have infants who at 18 months show reduced negative affectivity. However, this relationship occurred only in women with higher anxiety. Finally, we studied the role of cortisol and breastfeeding and we found that mothers and infant dyads who breastfeed, have higher and more attuned (more highly correlated) cortisol levels, suggesting that breastfeeding also functions to coordinate the physiology of mothers and their children.

Breastfeeding and infant-parent interaction

Renée Flacking, School of Education, Health and Social Studies, Dalarna University

Although breastfeeding is triggered through biological mechanisms which have not changed with time, the perception of breastfeeding as a phenomenon is variable, as it not only reflects cultural values of motherhood but is also negotiable from the perspective of the individual. Sweden is known to be a country with high breastfeeding rates, even among preterm infants. However, recent data suggests that the breastfeeding rate is declining, especially among extremely preterm infants. In neonatal units, the notion of breast milk and breastfeeding as a product is evident and it permeates the care given. The nutritional aspect of breastfeeding is vital as preterm babies are particularly vulnerable, the transition from tube feeding to breastfeeding is a (long) stepwise process often due to the baby's immature sucking behaviour, and the institutionalised environment enables staff to supervise each mother-infant dyad in order to assess, judge and evaluate the performance. Furthermore, the transitional process from tube feeding to breastfeeding has been, and still is, regulated by a diversity of non-evidence-based guidelines and care routines, which have consequences for the infant-parent interaction. There is a continuing challenge to assist parents and their preterm infants in the transition to breastfeeding as far as the aspects of relationality are concerned. Steps should hence be taken to increase the means of experiencing breastfeeding as a mutual pleasure in which fulfilment of the infant's behavioural and emotional needs, as well as the mother's physiological and emotional needs, are regarded. Thus, we must strive for a balance which considers the nutritional benefits yet does not disregard the relational aspect of motherhood and feeding.

Human Amygdala-Prefrontal Cortex Development and the Role of Caregiving

Nim Tottenham, University of Minnesota, Developmental Psychology & Neuroscience

Strong evidence indicates that reciprocal connections between the amygdala and medial prefrontal cortex (mPFC) support fundamental aspects of emotional behavior in adulthood. However, this circuitry is slow to develop in humans, exhibiting immaturity in childhood. In this talk, I will present developmental functional magnetic resonance imaging data describing age-related changes in amygdala-mPFC circuitry throughout childhood and adolescence and how it relates to emergent emotional behaviors. The argument will be made that the development of this circuitry in humans is intimately associated with caregiving, such that parents exert a significant buffering effect during childhood. I will focus on both typical development as well as development following caregiver deprivation (e.g., orphanage care), showing that early life stress may accelerate development of this circuitry. The findings presented are highly consistent with the animal literature showing both large changes in amygdala-mPFC circuitry throughout childhood/adolescence, as well as the large influence of parental care in shaping this neural circuitry. These age-related changes will be discussed in terms of potential developmental sensitive periods for environmental influence.

The Human Parental Brain; Mothers and Fathers

Ruth Feldman, Bar-Ilan University, Ramat-Gan, Israel

Parenting is the most critical phenomenon for evolutionary adaptation, observed across species and taxa, expressed by highly conserved neuroendocrine and brain functions, and carrying important implications for brain development of the young.

Based on neuroimaging research of parents' brain response to infant cues, this talk will chart a global "human parental caregiving" network, which consists of several interconnected cortical networks superimposed upon an ancient limbic network that has shown in animal studies to underpin the expression of maternal care in female rodents. I will describe two pathways to the parental brain, the "maternal pathway", triggered by hormones of pregnancy and childbirth and relying to a great extent on the subcortical mammalian network, and the "paternal pathway", a more evolutionary-recent pathway built upon cortical mirror and mentalizing structures and activated by caregiving experiences. The convergence of these two pathways in primary-caregiving fathers is addressed. Next, I will present studies on the associations between parenting-related hormones, particularly oxytocin, vasopressin, and testosterone, and parenting behavior with structures of the parental brain and discuss longitudinal effects of the parental brain on children's long-term social-emotional growth are presented. Finally, implications of research on the parental brain for the early detection of psychopathology will be discussed.

The role of early life adversity and parental care in shaping mental health trajectories

Patrick McGowan, Centre for Environmental Epigenetics and Development
Department of Biological Sciences, University of Toronto Scarborough

Parental experiences exert a profound influence on offspring neurodevelopment, especially during periods of heightened neuroplasticity in prenatal and early post-natal life. Epigenetic mechanisms offer a potential biological link between environmental and genetic factors that direct stable changes in developmental trajectories. To date, a few examples appear to clearly link early parental experiences to epigenetic changes in pathways relevant for mental health in adulthood. We will discuss our studies in humans, animal models, and wild populations that address the impacts of early life adversity and parental care on candidate gene pathways such as those involved in glucocorticoid signaling. Glucocorticoid signaling pathways act as sensors for environmental factors that affect a range of physiological functions, including the response to stress within sensitive brain regions. A key question concerns the extent to which these and other pathways are epigenetically labile, and under what conditions. We will discuss parallels we have identified between regions of the genome that are epigenetically responsive to psychosocial factors (e.g. maternal care) in rodent models, and regions of the human genome that are epigenetically labile in conditions of early adversity (e.g. childhood abuse). Our work points to wide-spread changes in gene pathways in addition to epigenetic alterations in candidate genes involved in the response to psychosocial stress and neuroplasticity.

Skin-to-skin contact after childbirth

Eva Nissen, Department of Women's and Children's Health, Karolinska Institutet

Skin-to-skin contact after birth leads to early initiation and longer duration of breastfeeding. It is known to benefit postnatal adaptations in infants by reducing the stress of the extra-uterine life, as shown by increased foot temperature and decreased crying. It may also exert positive effects on the mother and father.

During skin-to-skin contact the first hour after birth, the infant goes through nine different stages; *The birth cry, the relaxation stage, the awakening stage, the active stage, the crawling stage, the resting stage, the familiarization phase, the suckling stage and the sleeping stage.*

In touch with the mother's body the infant becomes calm and relaxed which facilitates the use of all its senses to reach the nipple and start sucking the breast. In this process the baby becomes aware of its body and co-ordinates its body movements with sense of sight, hearing, smell and taste. In other words skin-to-skin contact helps the baby to reach self-regulation. Indeed, skin-to-skin contact soon after birth has also been shown to optimize self-regulation of the infant and dyadic mutuality one year after birth.

Opiates during labor hamper the development of the feeding behavior by reducing both the development of sucking and rooting behavior and also the ability to locate the nipple. In studies after Caesarean section, infants perform similar behaviors if they are in skin-to-skin with either mother or father. Skin-to-skin contact seems to increase vocal interaction with the infant, but skin-to-skin contact with the father, instead of the mother, during the first 5–30 minutes after Caesarean birth delays the first breastfeeding. Mothers respond to the infant's soliciting disregarding skin-to-skin contact, while fathers only respond to the infant's soliciting when in skin-to-skin contact.

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Awakening of the Newborn Infant

Hugo Lagercrantz, Karolinska Institute and Astrid Lindgren Children's Hospital, Stockholm, Sweden

The newborn infant is awakened at birth. The eyes become wide open with usually large pupils and it may cry. This arousal is probably triggered by the stress of being born and the transition from the warm environment in the womb to the cooler extra uterine environment. The evaporation of amniotic fluid has this cooling effect even in a tropical milieu. This also triggers the first breaths of air. The first breaths of air have since the antique time been regarded as the ignition of life as indicated by the latin word spiritus.

The stress of being born is probably mainly due to the squeezing and squashing of the fetal head during vaginal delivery. This triggers an enormous catecholamine surge resulting in about a 20-fold higher levels in umbilical arterial blood. There is a parallel surge of the noradrenergic activity in the brain originating from the locus coeruleus, as indicated by studies of newborn rats. Locus coeruleus is responsible for the arousal.

After elective cesarean section less catecholamines are released, which also has been showed to delay the transition at birth. However, the cooling and also the clamping of the umbilical cord and the removal of the above mentioned placental suppressors seem to be sufficient to awake the newborn also after caesarean section.

The awakening of the newborn probably also causes the emergence of consciousness. Before birth the fetus is mainly asleep and in an inhibited state. Although it can open the eyes briefly and react to maternal speech it is probably not aware of itself and the environment. Furthermore it does not express primordial emotions like hunger and thirst.

The awakening of the newborn probably evokes parental instincts, when it is s/he looks at the parents with wide pupils.

Mode of delivery – epigenetic effects

Mikael Norman, Department of Clinical Science, Intervention and Technology, Karolinska Institutet & Department of Neonatal Medicine, Karolinska University Hospital, Stockholm, Sweden

The worldwide rate of cesarean section (CS) has quadrupled in <2 decades, making CS the most common surgical procedure performed in women of childbearing age today. This rapid change in mode of delivery probably reflects the widespread notion that CS is life saving and prevents injury to both the mother and her baby. The rise in parental requests for CS is also boosted by a worrying increase in fear for childbirth and at the same time, both professionals and parents tend to choose CS for reasons of convenience and better control over the timing of delivery. Finally, financial incentives may promote hospitals and physicians to favor CS at the expense of vaginal delivery.

Currently, the emphasis of discussion and counseling around mode of delivery is on the benefits and potential harms for the pregnant woman herself. As for her infant, the risks with vaginal delivery are often underlined, whereas only 2 of 3 women are reported to have discussed neonatal problems after elective CS. To date, implications of delivery mode for the future health of the offspring is seldom discussed, mainly due to a lack of existing information. With the increasing number of children and young adults who have been delivered by CS, this gap in knowledge is now addressed.

Given the established evidence that environmental influences during early life shape the developmental trajectory of the offspring and alter the risk of disease in adulthood, it is no longer unintelligible to see how changes from fetal to neonatal life may play a role in future health. Existing data suggest that prelabor CS is associated with aberrant short-term immune responses, such as reduced expression of inflammatory markers in the newborn infant. Children born by prelabor CS also face a greater risk of developing immune diseases such as asthma, allergies, type 1 diabetes, and celiac disease. However, it is still unknown whether CS causes a long-term effect on the immune system of the offspring that contributes to compromised immune health. The potential mechanisms by which CS can impact the development of the immune system may work at the level of intestine by altering bacterial colonization, or may be related to an adverse birth stress response and epigenetic modification of gene expression in the immune system.

As for the clinical significance of these findings, we should not discontinue an everyday procedure that in an emergency can be truly lifesaving, and in many circumstances, constitutes a preventive measure with clear and sound cost-benefit ratio. However, it is time to leave the sometimes 1-sided perspective that seems to drive and justify the current epidemic of CS. A higher awareness among both professionals and childbearing women about the associations between elective CS and adverse health of their offspring is warranted. CS should not be recommended without a clear medical indication, or without a solid evaluation of harms and benefits, both for the mother and her baby. In such evaluation, both short- and long-term consequences for the infant and the child should carry a greater weight than what is considered today.

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Maternal Contributions to the Initiation of Term and Preterm Birth

Steven Lye, Department of Obstetrics and Gynaecology, University of Toronto, Canada

The timely onset of labour is critical to newborn survival. However, the mechanisms that maintain pregnancy and initiate labour are poorly understood and this likely accounts for our limited ability to prevent preterm birth. Our research has demonstrated that there is an intricate interaction between maternal endocrine and immune systems that supports healthy fetal development during pregnancy and at term, results in the onset of labour. During pregnancy interactions between the maternal immune system and fetal/uterine tissues support placentation and the increase in placental blood flow required for fetal growth and development. Prior to the onset of labour signals from the uterine tissues activate uterine endothelial cells as well as maternal peripheral immune cells. This leads to an influx of maternal monocytes into the uterine tissues where they differentiate into macrophage and induce a physiologic inflammation that contributes to the onset of labour. The maternal endocrine environment balances the pregnancy maintenance and labour inducing properties of the maternal immune system through the effects of the pregnancy hormone, progesterone. During pregnancy, progesterone supports myometrial quiescence and suppression of immune cell activation. During labour dramatic changes in the properties of progesterone receptors induce a functional withdrawal of progesterone and lead to the activation of the maternal immune systems and the preparation of uterine tissues for labour and delivery. This new understanding is aiding the development of new diagnostic and therapeutic approaches that will enhance our ability to prevent preterm birth and its consequent newborn mortality and morbidity.

The preterm brain

Ulrika Ådén and Nelly Padilla, Department of Women's and Children's Health, Karolinska Institutet

The development of the brain is a long lasting process characterized by a protracted and orchestrated chain of specific ontogenetic events. The second half of gestation and the neonatal period are the most important developmental periods for the formation of cerebral pathways through axonal growth, neuronal differentiation and synaptogenesis. During this period the brain continues to grow and specialize according to a precise genetic program, with modifications driven by environmental influences. In this context, premature birth, the most common pregnancy complication, interrupts crucial brain development processes leading to an atypical developmental outcome and an increased risk of psychiatric disorders. In addition, infants who are born preterm face a significant risk of brain injury and perinatal complications, which affect an already vulnerable brain.

Although Sweden has the best survival rates of extremely preterm infants in the world with an overall survival rate about 70%, international data show that about 7–10% of infants born extremely preterm have obvious motor impairments (cerebral palsy) and at age 8 years as many as 50% have cognitive, behavioral or motor impairments. Using advanced Magnetic Resonance Imaging (MRI) acquisitions, we have recently demonstrated structural brain alterations in extremely preterm infants at term age related with prematurity, neonatal outcome, cognition, motor outcome and gender. The microstructure of the white matter is also affected in extremely preterm infants. In addition, results from functional MRI studies in the extremely preterm population have identified functional subdivisions of the infant brain primarily involving brain areas that are known to be active for visual, auditory and sensorimotor processing.

Of particular concern is the risk for atypical social-behavioural functioning in this population suggesting the diagnosis of autism spectrum disorders. Children born extremely preterm face a dramatically elevated risk of autism spectrum disorder. These infants are highly exposed to stressors during a critical period of brain development and this exposure may play a key role in the development of autism. In extremely preterm children diagnosed with autism at 6.5 years we have found evidence of global and regional brain structural alterations detectable on neonatal MRI, particularly affecting the brain areas involved in social skills, behavior and salience integration.

Fetal and Infant Learning

William P. Fifer, Professor in Psychiatry and Pediatrics, Columbia University
Associate Director Sackler Institute for Developmental Psychobiology

The human infant is ready and willing to engage in interpersonal encounters shortly after birth. The newborn is equipped with several perceptual and sensory preferences, tuned in part by experiences in the womb, which guide the earliest social interactions and allow them to become active participants in forming the first relationships. The newborn baby is a “data sponge” prepared to interact with the environment and adapt to life outside the womb. They pay attention, respond to events and different kinds of stimulation, and can remember and learn, even while asleep. I will discuss the science behind our efforts to find out what the newborn knows about the world, how babies effectively learn about their new environment, how adverse exposures can alter early behavioral capacities and whether these early capabilities can shape their future development.

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Mirror neurons in parent infant interaction

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Mirror neurons fire both when an individual performs an action and when he or she observes someone else perform a similar action [1, 2]. According to the 'mirror neuron theory', the firing of these neurons provides a direct link between people that can explain phenomena such as spontaneous action understanding, empathy and even aspects of human language. The discovery of mirror neurons in the monkey brain, and putatively similar mirroring mechanisms in humans, have inspired many researchers and philosophers. At the same time, several aspects of the mirror neuron theory are highly controversial [3, 4].

Mirroring mechanisms are implicated in early emerging social behaviors and socio-cognitive processes. In this talk I will provide some examples of how such processes may operate in the interaction between parent and their children, and how they may promote parenting and the development of the child.

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Parenting a Preterm Infant in the NICU and Beyond

Professor Lianne Woodward, Director of Research, Department of Pediatric Newborn Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, USA

Very preterm infants spend several months in the NICU during a critically important period of brain development. This time also poses considerable challenges for parents. Not only is their infant's hospitalization a major source of stress and anxiety about survival and the risk of disability, postnatal depression and feelings of parental loss are also common. In addition, staff practices and the NICU environment can create further barriers to normal parental care and the establishment of an emotional connection between parents and their preterm infant. There is now a growing body of evidence to show that the quality of early parent-infant interaction can help a preterm infant to organize and regulate their emotional and behavioral states in the NICU. Parental care that is high in warmth/sensitivity and low in negative/intrusive behavior has also been shown to have a positive impact on infant clinical as well as longer term neurodevelopmental outcomes. These include self regulation, school achievement, and emotional and behavioral wellbeing. This presentation will provide an overview of this evidence base and discuss recent shifts in the model of neonatal care from an emphasis on infant health to a more family centered approach. Potential mechanisms of parenting influence will also be considered. It is argued that the neonatal period offers a valuable therapeutic opportunity to assist parents' with their adjustment to an often unexpected preterm birth, establish a mutually satisfying relationship with their infant, and better prepare them for parenting an infant who may need additional behavioral and developmental support.

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Social learning or threat and safety

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Learning to avoid and approach objects and situations by observing conspecifics' emotional responses is common across species. Observational learning might be especially important in the transfer of emotionally relevant information from caregivers to pre-linguistic infants and children. This claim is supported by research on imitation, social referencing, shared attention, and observational fear learning. Here, I will present behavioral and imaging experiments examining how adult humans learn that a stimulus is threatening ('fear learning') or no longer threatening ('safety learning') through social observation. We show that observational fear and safety learning depend partially on the same behavioral and neural processes as direct (Pavlovian) fear conditioning and extinction learning, respectively. Importantly, the strength of observational fear and safety learning is determined by social information, such as familiarity with, and empathic appraisals of, the observed individual. These experimental paradigms might serve to inspire new studies investigating the social transmission of value information between caregivers and infants/children, and how this learning is shaped by social cognition.

Two Kinds of Mother-Infant Interactions across Cultures and their Neurobiological Underpinnings

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Development

Human caregiving has evolutionary bases and is constituted of many highly conserved actions. Consider the power of the infant cry to capture our attention and our inability to resist responding in its presence. Consider the unconscious, automatic, and thoroughgoing changes in our speech – in prosody, lexicon, syntax, pragmatics, and content – when we engage infants. We spontaneously and blissfully talk to babies knowing full well they cannot understand what we say.

Behavioral and cultural study reveal some universal forms of parenting that guide formulating testable hypotheses about central nervous system substrates of such caregiving. My talk follows that path. First, I briefly discuss parenting and a general orientation toward this evolutionarily significant and individually important activity in terms of its nature, structure, and goals. Next, I turn to operationalizing parenting behavior and place that discussion in the broad context of culture. Here, I review behavioral and cross-cultural research designed to uncover two commonly expressed – perhaps universal – approaches to parenting infants. They are turn-taking in mother-infant vocalizations and maternal responsiveness to infant cry. Last, I recount fMRI studies of central nervous system function that may subserve each kind of parenting.

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The Swedish Father

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Department of Women's and Children's Health

Sweden was the first country in the world to create an egalitarian parental leave policy which allowed both parents to take time off of work to care for their children. Sweden also created the child health centres, a societal institution that is highly regarded and helpful in providing parenting advice and support for managing infants' health care. In spite of these direct and indirect family policies, fathers still do not participate in their child's health and care to the same extent as mothers. Mothers continue to utilize the majority of the parental leave and visit the CHCs much more often than fathers do.

In our systematic review¹ we found that engaged fathers have a key role to play in reducing behaviour problems in boys and psychological problems in young women. We also described that regular positive contact with fathers reduces criminal behaviour among children in low-income families and enhances cognitive skills like intelligence, reasoning and language development.

If taken seriously, the importance of engaged fathers means that we have to rethink the way we provide services to families to better suit the needs of fathers and actively promote their involvement for the best interest of the child.

In a number of studies we and others have shown that the current organisation of pre-, peri- and postnatal services in Sweden passively dissuades fathers from getting actively involved in the healthcare of their infants. Fathers also participate to a much lower extent than mothers in parenting support groups and programs.

In sum, there is a mismatch between a general image of Sweden as the "mecca" of gender equity and involved fatherhood and fathers' use of parental leave and their experiences of the services and options available to them when they become parents.

The science tells us that fathers have unique contributions to make to their children's lives. But are services ready to involve fathers in matters concerning their infants' health and wellbeing? And are official policies powerful enough to create gender equity in parenting?

¹ **Sarkadi A.**, Kristiansson R., Oberklaid F., and Bremberg, S. Fathers' involvement and children's developmental outcomes. A systematic review of longitudinal studies. *Acta Paediatrica* 2008; **97**(2):153–8.

Parallels between the neural control of parental care and pair bonding and the influences of parental nurturing on infant social development

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The neural mechanisms underlying the onset of maternal behavior share many common features with pair bonding in monogamous species¹. As maternal care is ubiquitous among mammals, while pair bonding is rare, it is likely that monogamy evolved through modification of the neural circuitry regulating maternal bonding. I will provide an overview of the neural mechanisms of pair bonding, which leads to parental partnerships, in monogamous prairie voles and highlight parallels with the neural control of maternal bonding. Oxytocin (OT) enhances the salience and reinforcing value of social stimuli both in the establishment of the pair bond and during maternal bonding through interactions with dopamine in the mesolimbic reward system. OT release in the brain during parturition and nursing facilitates maternal motivation and mother-infant bonding². In prairie voles, mating likewise facilitates OT and dopamine release to facilitate the formation of the pair bond. Specifically, OT and dopamine D2 receptor signaling in the nucleus accumbens (NAcc) are critical for the establishment of partner preferences³. Species differences in oxytocin receptor (OTR) density in the NAcc contribute to species differences in the ability to form pair bonds and to display alloparental care. Prairie voles have high densities of OTR in the NAcc, while the promiscuous and minimally maternal meadow vole does not. OTR signaling in the NAcc is also critical for spontaneous alloparental behavior both in juveniles and virgin adult females. There is remarkable individual variation in OTR density in the NAcc among prairie voles, and those with high densities of OTR in the NAcc are more likely to display alloparental behavior toward pups. Parental nurturing plays an important role in the development of neural systems of infants involved in the capacity to form social attachments in adulthood. Prairie voles are biparental and both parents contribute to parental nurturing. To explore the influence of family dynamics on adult behavior, we created prairie vole families consisting of both parents (biparental) or only the mother (single mother) and examined the social behaviors of the pups as they became adults. Pups raised by a single mother received less licking and grooming and as adults displayed less spontaneous alloparental care and were less likely to form pair bonds. More recently, to model parental neglect, we subjected pups to daily 3hr social isolations during the first two weeks of life.

Compared to unmanipulated controls, as adults many but not all voles experiencing the neonatal social isolation were incapable to form pair bonds. Those that were resilient to the early life isolations and formed pair bonds had high densities of OTR in the NAcc, while those that failed to form adult bonds had low densities of OTR in the NAcc⁴. We have identified genetic polymorphisms in the OTR gene that robustly predict OTR expression in the NAcc, providing an opportunity in this animal model to explore the neural mechanisms by which genetic polymorphisms in the OTR gene moderate how early life nurturing influences adult social behaviors.

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The parental instinct

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The parent-infant relationship is fundamental to infant survival and development, and the bond appears to form effortlessly and intuitively (Konner, 2010). Yet the underlying brain mechanisms have not been explored in much detail. Still, emerging evidence suggests the carefully orchestrated involvement of wide-spread brain networks driven by several key brain regions (Barrett & Fleming, 2011; Parsons et al 2010). I will examine new evidence that the orbitofrontal cortex is engaged in several phases of parent–infant interactions, from rapid, privileged orienting to infant cues, to ongoing monitoring of interactions and subsequent learning (Kringelbach et al 2008; Parsons et al 2013a). The role of the orbitofrontal cortex is linked to the activity in brain-wide networks and such caregiving brain signatures are found even in non-parents (Parsons et al 2013b). I will describe ongoing research addressing the key challenge of characterizing the longitudinal evolution of these signatures in adults during normal or disrupted parenting (Parsons et al 2014). In time such studies may help shape new behavioural interventions which could make a huge difference, especially in low and middle income countries where the burden of e.g. post-natal depression is very significant (Parsons et al 2012). Ultimately, an increased understanding of the brain basis of caregiving will provide insight into our greatest challenge: parenting our young.

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Breastfeeding patterns in preterm infants born at 28–33 gestational weeks

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Background: Studies of breastfeeding patterns during preterm infants' first year of life are scarce, but are important for providing breastfeeding mothers of preterm infants with optimal support.

Objective: To describe breastfeeding patterns in preterm infants up to one year of corrected age.

Methods: As part of a larger study on Kangaroo Mother Care, a 24-hour breastfeeding diary was sent home after discharge from hospital, and at two, six, and twelve months of the infant's corrected age. Eighty-three mothers responded to the follow up questionnaires and the number of respondents to the breastfeeding diary was 48 at discharge, 43 at two months, 22 at six months, and 8 at twelve months. Infants were born at a median (range) gestational age of 32 (28–33) weeks. Breastfeeding patterns were analyzed according to durations, frequencies per 24 hours, and intervals between sessions.

Results: In exclusively breastfed infants the median (range) breastfeeding session frequency was 14 (8–26) times per 24 hours including 4 (1–9) times per night after discharge (n=24) and 10 (6–25) times per 24 hours including 2 (0–5) times per night at two months (n=23). In partially breastfed infants the median (range) frequency was 5 (1–14) times per 24 hours including 2 (0–4) times per night at six months (n=20) and 5.5 (1–12) times per 24 hours including 2 (0–3) times per night at twelve months (n=8).

Conclusion: Mothers reported large variations in breastfeeding patterns, with higher median breastfeeding session frequencies than previously described in term infants in affluent settings.

The Swedish Child Health Fields Treatment of Fathers and its Consequences: A Scope Literature Review

Michael Wells, Ph.D. Child Health and Parenting , Women's and Children's Health, Uppsala University

Nearly all public health care in Sweden, including the child health field, is financed through taxes, allowing people, regardless of their economic status, access to high quality health care. The Swedish child health field is responsible for children's health from pregnancy through preschool age, working toward achieving the same goal – promoting the care and development of the young child. To achieve this goal, they seek to empower parents through various types of advice and support, as they traverse the transition to parenthood. However, just because a program is offered universally, does not mean that it reaches all people. Therefore, the aim of the current scope literature review is to see the extent to which the Swedish child health field both reaches fathers and reaches out to fathers by supporting and meeting their needs.

The scope literature review was completed using various search terms related to fathers and the Swedish child health field, such as combinations of words like father, fathers, fathering, fatherhood paired with the different sectors of the child health field, such as prenatal, antenatal, labor, birth, postnatal, postpartum, child health centers, and child health clinics. Two databases were used to find articles: Scholar Google and PubMed. Only research completed within Sweden was included in the current literature review, and the published works needed to be completed between 2000–April 2015. Manuscripts could be from the fathers', mothers', and/or child health workers' perspective.

The results show that the Swedish child health field consists of four primary sectors: prenatal clinics, labor and birth wards, postnatal clinics, and child health centers. A review of the treatment of fathers within each sector has been conducted. The overall results show that the literature is quite consistent in reporting across the child health sectors that whether from the fathers', mothers', or child health workers' perspective, fathers are treated as secondary and ancillary parents compared to the mother, and they are also not provided with an equal amount of support, nor do many fathers have their parenting and child health needs met through these services. Fathers often feel slighted by staff, as they report not receiving eye contact, not having their questions answered, and not having easily accessible office hours, while child health workers report that fathers can be difficult to work with, are viewed at as less competent parents, and are welcomed, but not typically necessary.

The psychological impact derived from fathers meeting with child health care workers, such as midwives and nurses, can be dramatic for fathers. Fathers can perceive this neglect to mean that they do not need to take greater responsibility in parenthood. This can have the consequence of mothers continuing to take the bulk of child care responsibilities, especially as they relate to the child's health and development, as she is seen by both the father and the child health workers as the expert and is more likely to have positive relationships with the various child health staff.

Barriers and enablers when implementing a structured information transfer related to pre-schoolers' mental health – a grounded theory approach

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Background: Preschool teachers possess unique knowledge about children's behaviour and social skills, but the information has so far not been utilised within the child health-care system. As part of an on-going trial to investigate the effects of universally offering Triple P (Positive Parenting Program), pre-school children's behavioural, emotional and social functioning are assessed using parent- and pre-school teacher reports on the SDQ (Strengths and Difficulties Questionnaire) at the children's annual visit at the child health care centre.

Objectives: To explore nurses, preschool teachers and parents' experiences in assessing children using the Strengths and Difficulties Questionnaire and to describe barriers and/or enablers with this information transfer.

Participants: We conducted 10 interviews with nurses at child health centres, 26 interviews with preschool teachers, 26 interviews with preschool teachers and 11 interviews with parents of 3-, 4- and 5-year-old children. The participants were sampled purposively. Our sample included nurses and teachers recruited from both public and private services and from areas with varying socioeconomic conditions. All study participants were recruited from the same region where the new assessment procedure had been introduced.

Methods: Interview study. The interviews were analysed using Grounded theory. Results: A theoretical model was developed describing the interrelationships of causal conditions, phenomena, context, strategies, enablers and barriers (consequences). Nurses, preschool teachers and parents shared a mutual desire to see the child's health and well-being in a holistic way. However, they had doubts as to whether a reliable way to assess children's behaviour existed. The results provide a picture of causal conditions endorsing information transfer: (1) Nurses thought that all visits after the 18 months check up were unsatisfactory, (2) Preschool teachers wanted to identify and help children with difficulties, (3) Parents viewed preschool teachers as being qualified to assess children. However, different barriers and enablers emerged through the data. Nurses wanted to have an overall view of the child's situation and thought that the SDQ was important for their objective judgement. At the same time they noticed that only a specific group of parents choose to participate, which could be because of the complex assessment procedure. Although the teachers acknowledged the benefits of the information transfer for the preschool, they had concerns about parent's reactions to teachers' assessments. Parents had concerns about how personal information was handled and stressed that they were affected by how the preschool answers were delivered to them. However, both nurses and parents acknowledged that SDQ makes parents reflect on their children.

Conclusion: A common tool to assess preschool children's behaviour and social skills is a complex issue in Sweden. The conditions endorse introduction of information transfer, but a successful implementation requires considerable work regarding barriers and enablers.

Keywords: SDQ, Mental Health, Child Healthcare, Behaviour, Assessment

Emotional neglect in childhood: possible contributor to stress-related exhaustion in adulthood

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Background: Development of stress-related mental health is a multifaceted phenomenon involving exposure, cognitive and behavioral perspectives as well as several resilient and vulnerability factors. Early life adversity is one of many factors that have been shown to be of importance for development of mental health problems when stressful life situation is encountered.

Aims: To explore whether patients diagnosed with stress-related exhaustion differ with regard to the prevalence of self-reported childhood trauma compared to healthy controls. We also explored another conceivable vulnerability factor for stress-related mental symptoms, namely poor self-esteem.

Methods: Patients with stress-related exhaustion (n=38) and healthy controls (n=33) were included in the study. Early adversity was measured by using the Childhood Trauma Questionnaire (CTQ) and self-esteem was measured with The Rosenberg Self-Esteem Questionnaire.

Results and conclusion: The total mean score for the CTQ did not differ between patients and controls but the patients scored significantly higher on the emotional neglect subscale. This was also significantly related to symptoms of exhaustion. The patients also reported poorer self-esteem but this does not seem to be related to early adversity. The conclusion is that emotional neglect and poor self-esteem are more common among patients with stress-related exhaustion compared to healthy controls. This could conceivably be vulnerability factors for developing stress-related exhaustion. Regardless of whether they contribute to the illness or not, they need to be considered during treatment since both these factors have been shown to contribute to sustaining stress-related problems and poorer ability to cope with stress.

The neurobiology behind the behaviour of avoidantly attached adolescents, a meta-study

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The purpose of this meta-study was to connect the state of the art in neurobiology and attachment research with common documented deficiencies in avoidantly attached adolescents' interaction with other persons.

If the areas of a growing brain, that are intended to be trained for certain abilities, are not used, the synapses in those areas are not structured well, or may even be pruned. This means that intended abilities are not learned during this phase and that later learning of these abilities will have to be done in 'higher' brain regions. Learning in higher brain regions mean slower and less skilful handling than in dedicated areas, as well as more limited associations to other domains in the brain.

The infant's development of Internal Working Models (IWM) – that is, models of how I function and how my primary caregiver functions – during the early attachment to a primary caregiver, is most intense during the first few years.

Some caregivers (approx. 20–30%) interact very little – or even not at all – with their infant. Some of those caregivers may also be rejecting in the (sparse) interaction with the infant. In these infants the IWMs are developed under very little or no positive training. These infants will get poor and even faulty models of the caregiver's mind, and of the self. Therefore they know very little how to interact in a positive way with the caregiver (e.g. to accomplish closeness) and they appear to avoid emotional contact. We say that they have an avoidant early attachment.

It has also been documented that adolescents with an avoidant early attachment often have deficient abilities to interact with parents, peers and teachers. Is the reason for this that poor IWMs still are controlling the social abilities, including the trust in self, of these adolescents?

The IWMs are founded before the frontal lobe and the hippocampus and hence are not available to our conscious awareness. Therefore, as opposed to many other areas of the brain, the IWMs are not readily available for changes later in life. We can learn, later on, how to interact better with others but the IWMs do – as far as is known – not change. There are, in fact, indications that they remain the same.

A conclusion is that we do, as adolescents and adults, spontaneously learn about how people look, talk and behave, and how to respond to this, but we – i.e. our higher brain regions – do not spontaneously acquire better models of self and others, to substitute for poor IWMs. Does this mean that such deficiencies normally are permanent, if particular actions to improve them are not undertaken?

If true, this conclusion could be applied to research in areas where our abilities to understand other persons's minds (as well as to understand our selves) are important. Examples are: Parenting, therapy, psycho-pathology, antisocial behaviour, drug abuse, stress related syndromes, conflict management and leadership development.

The infant emotional faces database

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Emotions, their expression and their processing, are important for our social cognition and interaction. To understand the phylogeny and ontogeny of emotion processing, as well as identifying the mechanisms and functions of emotions, standardized datasets have been developed. With respect to facial expressions, there are two well-evaluated databases: the "Pictures of Facial Affect" (POFA) database (www.paulekman.com/product/pictures-of-facial-affect-pofa) and the "Karolinska directed emotional faces" (www.emotionlab.se/resources/kdef). The POFA uses adults of all ages whereas the KDEF uses young adults (students, all caucasian). Neither the POFA nor the KDEF have facial expressions of infants. More general databases of emotional stimuli can include infant images but those photos are not standardized for facial expressions, and include only laughing babies, e.g. GAPED (Dan-Glauser & Scherer 2011), the "International Affective Picture System" (IAPS) (Lang, Bradley & Cuthbert, 2008) or the emotional picture set (EmoPicS) (Wessa et al. 2010). However, understanding the emotions of infants is crucial for a healthy parent (caretaker)-child bonding.

Since there is no validated database of infant facial expressions, we created one. Thirteen infants, aged 4 to 12 months old, were photographed in a standard setting. During approximate 30 min interplay with the mother, and tasting something sour, the infants expressed reliable happiness, interest, disgust and sadness. After internal pre-validation adults, aged 18–75, validated the images on identity, intensity, clarity and valence. The database will be made freely available to researchers around the world.

Visual motor integration and hand function at 6 years in relation to neonatal brain volumes in children born extremely preterm

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Background:

Children born very preterm have been shown to have impaired hand function and visual motor integration (VMI), but the extent of problems in extremely preterm children (EPT) and the relation to regional brain volumes have been sparsely studied.

Objective:

To assess visual motor integration and hand function in children born extremely preterm and term born controls, and to relate these to neonatal brain volumes.

Design/Methods:

All children born < 27 weeks gestational age, birth years 2004–2007, in Stockholm, Sweden, without major brain lesions. Magnetic Resonance Imaging of the brain (MRI) was done at term age. Brain volumes were analyzed using automated segmentation and voxel based morphometry, with the SPM software. Assessment at 6.5 years was done with Beerys VMI test, WISC IV, visual acuity chart and Movement ABC (M-ABC). T-test, Fisher's exact test and Pearson's test was used as appropriate. VMI standard scores were used.

Results:

107/117 children did MRI. 6.5 years data were available for 83 (77.6%) EPT and 93 term born children. After exclusion of children with major cerebral lesions 64 EPT remained. Mean VMI standard scores were lower in EPT children than in controls (90.57, SD 13.18 vs 102.96, SD10.80, $p < 0.001$). The differences remained when children with visual acuity below 0.8 was excluded. VMI scores in EPT were significantly correlated to WISC total IQ ($r = 0.72$ $p < 0.001$.) M-ABC ($r = 0.48$ $p < 0.001$) and visual acuity ($r = 0.40$, $p = 0.02$). Girls had a trend towards higher VMI scores than boys even though the difference did not reach statistical significance ($p = 0.05$).

We found no significant correlations between VMI scores and brain volumes. On a global level, M-ABC manual dexterity scores, reflecting hand function, correlated to brain-stem volume ($p = 0.031$). There was also a trend between the M-ABC manual dexterity scores and cerebellum volume ($p = 0.051$). On a regional level there was a correlation between M-ABC manual dexterity scores and grey matter volume in the right parahippocampal gyrus ($r = 0.80$ $p < 0.001$ uncorrected) and the white matter in left occipital cortex ($r = 0.82$ $p < 0.001$ uncorrected).

Conclusions:

Children 6 years old, born extremely preterm, have a decreased hand function and lower visual motor integration compared to term born children. Hand function correlated to brain volumes in areas that interpret visual impressions and regulate motor function.

Can we understand parenting from the child's point of view? A method to elicit preschool children's experiences in a reliable way

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Background

Parenting is often studied from the perspective of adults or through measures of children's development, behaviour, or well-being, as proxies for the effects of parenting behaviours. There are fewer studies investigating how preschool children themselves experience for example the effect of a parenting program within the family. This could partly be explained by the challenge for adults to systematically explore the experiences and opinions of younger children. The need for evidence-based methods to elicit reliable information from young children is clear. In My Shoes (IMS) is a computer-assisted interview developed to help young children talk about their experiences, with special emphasis on their personal relationships.

Aim

To evaluate the ability of In My Shoes (IMS) to elicit 4- and 5-year old children's subjective experiences and accurate accounts of a routine health visit at the Child Health Centre as well as the children's engagement in the interview process.

Methods

Interviews were conducted with 23 children aged 4–5 years, 2–4 weeks after their health visit. The interviews were transcribed verbatim and analysed using a method inspired by Content Analysis to evaluate IMS's ability to elicit statements about subjective experiences. Accurate accounts were assessed by comparing the transcribed interviews with the filmed health visits. The children's engagement was defined by the completion and length of the interviews, and the children's interaction with the software.

Results

All children gave accounts about their subjective experiences, such as their emotional state during the visit, available toys, or rewards they received. All children related to the correct event, they all named at least one person who was present and 87% correctly named at least one examination procedure. The majority of children (91%) completed the interview, which lasted 17–39 minutes ($M=24$), and 96% interacted with the IMS software.

Conclusions

Overall, the results suggest that In My Shoes can be used to help children to describe their health care experiences, with detail, depth and reasonably high accuracy. Identifying methods that help children to describe their experiences reliably is pivotal if we genuinely want to elicit children's opinions and give them a voice in matters that concern them. The In My Shoes computer-assisted interview is a method that can be used to explore parenting from preschool children's point of view.

Application of pulpal stem cell from exfoliated deciduous teeth to study the etiology of Rett Syndrome

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Background and Purpose

Mesenchymal human stem cells from the pupal tissue of exfoliated deciduous teeth (SHED) possess pluripotency. SHED can differentiate into neuron-like cells. It is easy to collect SHED with parents' cooperation and agreement because exfoliated deciduous teeth used to be thrown away.

Rett syndrome (RTT) is a developmental disorder causing autism, epilepsy, and an inability to walk; however, its etiology is still unknown. We previously reported that the abnormal mitochondrial morphology induces an aberration in mitochondrial localization and, consequently, neural-cell dysfunction. Thus, the purpose of the present study is to determine whether an abnormality in mitochondrial morphology is involved in RTT's etiology by comparing the SHED mitochondrial morphology between a child with RTT and a healthy child.

Material and Methods

Exfoliated deciduous teeth were collected from a healthy child and an RTT patient at the Center for Pediatric & Special Needs Dentistry, Kyushu University Hospital, with the permission of the children's respective parents. SHED were prepared from the exfoliated deciduous teeth, and their mitochondria were stained with an antibody against Tom20, an outer membrane protein of the mitochondria. Then, the mitochondrial morphology was observed using a fluorescent microscope.

Results

1. The mitochondrial morphology of SHED from the child with RTT was similar to that of the healthy child.
2. However, the mitochondria of the RTT patient were abnormally located around the nuclei, while those of the healthy child were distributed properly throughout the whole cell.

Discussion

The abnormal localization of mitochondria observed in SHED from the child with RTT suggests a mitochondrial decline in the axons and synapses of neural cells. Mitochondrial invasion of the axon is essential to the formation of the neural spine. Moreover, the existence of mitochondria in synapses is crucial to the secretion of the neurotransmission substance. An aberration of mitochondrial localization might be involved in the pathology of RTT.

Minor neurological dysfunction (MND) was associated with psychomotor development in extremely preterm children

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Background: There is increasing evidence that preterm children who survive without Cerebral Palsy (CP) are at risk of minor neurological impairment, which may be associated with cognitive and/or behavioural problems.

Objective: To investigate incidence of Minor Neurological Dysfunction, MND (Hadders-Algra, 2010) and associations with motor and cognitive function in extremely preterm (EPT) children compared to term born children at age 6.5 years.

Method: Population-based cohort study including 75 children born < 27 weeks' gestation and 91 term born children assessed at 6.5 years with WISC-IV, Movement-ABC, and the modified Touwen examination. 9 preterms with CP and 4 with CNS infection/malformation were excluded. MND was classified as MND-1 (simple) or MND-2 (complex), depending on number of dysfunctional clusters. Student's t-test, ANOVA, Chi-square test or Spearman correlation-coefficient was used for statistical analysis.

Results: 48 % of the EPT had normal neurology, 42.7 % MND-1, 9.3 % MND-2 compared to 87.9 % with normal neurology, 12.1 % MND-1 in the term born group. In EPTs occurrence of MND was associated with both performance on the M-ABC and the WISC-IV (total M-ABC scores $r=-0.56$, $p < 0.001$, WISC-IV total scores $r=-0.33$, $p=0.004$). EPT children with both MND-1 and MND-2 had significantly lower mean WISC-IV scores than children with normal neurology ($p=0.04$, $p=0.007$). Total M-ABC scores in EPT children with both MND-1 and MND-2 were significantly lower ($p<0.001$) than in children with normal neurology.

Conclusion: MND-1 and MND-2 occurs more frequently in EPT than in term born children and are associated with cognitive and motor impairment.

Physical health and breastfeeding problems in the early postpartum period: effect on maternal psychological well-being

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Background: Anecdotally, it is known that physical health and breastfeeding problems are distressing for new mothers, yet there is little empirical evidence to describe the nature of the relationship between physical health, breastfeeding problems and mothers' well-being, including fatigue, distress, anxiety and depression symptoms.

Objectives: The aim of this study (MOAT) was to investigate the contribution of breastfeeding problems, (e.g. mastitis, nipple and breast pain), and common postpartum physical symptoms (e.g. back pain, perineal pain, constipation), to maternal psychological wellbeing at 8 weeks postpartum,

Methods: MOAT was a prospective study of breastfeeding mothers (n=229) recruited during late pregnancy from a public and a private maternity hospital in Melbourne. Self-report data were collected at recruitment (baseline) and participants were followed up at 1,2,3,4 and 8 weeks postpartum. Participants completed a standardised assessment of mood, the Profile of Mood States (PoMS; McNair et al. 1971) at baseline, 4 and 8 weeks. Information about physical health and breastfeeding problems was collected. Participants were classified as having a 'high burden' of physical health problems if they experienced ≥ 3 physical health problems for ≥ 2 weeks. A 'high burden of breastfeeding difficulties' was classified as experiencing ≥ 2 breastfeeding problems, ≥ 2 weeks. Multivariate linear regression was performed to examine the relationship between high burden of breastfeeding, high burden of physical health problems (or both), and the PoMS total score at 8 weeks postpartum, adjusting for established determinants of maternal mood.

Results: By 8 weeks postpartum 20% (n= 45) of women had reported a high burden of breastfeeding problems only, 24% (n=53) reported a high burden of physical health problems only and 11% (n=26) reported a high burden of both physical health and breastfeeding problems. In fully adjusted models, women with a high burden of physical health, breastfeeding or combined problems reported significantly more psychological symptoms than those with fewer or no problems. The poorest mood was reported by those women experiencing high burdens of both physical health and breastfeeding problems.

Conclusion: Physical health and breastfeeding problems are an under recognised contributor to worse maternal mood in the early postpartum period and need to be considered during psychosocial assessment.

Singing kangaroo – a family centered music therapy intervention for infants born preterm

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Background: Infants born preterm are at risk for neurodevelopmental impairments including behavioral problems and language delay. Requiring good enough language skills is depending on attachment and bonding between the infant and the caregiver. In the beginning of life the communication between the infant and the caregiver is based on preverbal communicative skills including gestures, vocalizations, facial expressions and tactile input. Communication by infant directed singing is a natural and genuine way for parents to create security and comfort, to share love and tenderness. Earlier research has shown positive effects of music therapy on early physiological and behavioral responses and maternal anxiety but language development and attachment have not been evaluated previously.

Aim: To examine if early music therapy intervention by supporting parental singing during initial kangaroo care for preterm infants improves language development, parent-child attachment and parental anxiety early in life.

Method: This is a randomized prospective cohort study where kangaroo care is combined with parental singing. 160 stable preterm infants born <32 GA and their parents will be included in a collaborative study. They are randomized to intervention or control group. Both groups will see the music therapist for 8 sessions (40 min each time) over 4 weeks. Focus in the intervention group is on how to sing, what to sing, to get inspiration and information from the music therapist about infant directed singing and early communication. Focus in the control group will be on kangaroo care alone. The parents fill in a diary on how much time they spend in kangaroo care and how much time they spend singing. A subset of these data will be evaluated by recordings using LENA™. Outcomes that will be analyzed are singing behavior, auditory discrimination skills by magnetoencephalography at 40 weeks, interaction and attachment between child and parent at 4 month corrected age (CARE-index), language development and neuromotor development at 2 years (Bayley III), parental anxiety (State trait anxiety inventory Index) and the parents experiences of the intervention (qualitative interview).

Preliminary results: In a pilot study (n=9) we analysed the diaries to study if the intervention led to parental singing. Maternal singing during the first 28 days was 25.0±8.7 hours in the intervention group vs 8.9±6.6 hours in the controls. Paternal singing was 12.7±3.1 hours in the intervention group vs 6.9±6.5 in controls. Thus there was a non significant trend to longer singing times in the intervention group.

Auditory discrimination paradigm using magnetoencephalography has been applied in four infants so far. Inclusion to the study is ongoing.

Social roles for parenting

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Background: Social roles for parenting for mothers and fathers have changed. The aim was to explore what thoughts Swedish fathers had about parenting difficulties at two months after the birth of their baby.

Methods: A mixed method approach included closed and open ended questions answered in mid pregnancy and two months after birth of their baby. Descriptive and inferential statistics and content analysis were applied for the data analysis.

Results: In total, 827 fathers were included in the study, and of these 30% reported thoughts about the difficulties of parenthood. The theme 'Managing the demands of being a father' was explored and was based on concerns about how to raise the baby, having enough money, health issues, lack of time and finding balance in the new family pattern. Financial worries, feeling less positive about expecting a baby, and self-reported poor emotional health were related to fathers who perceived parenthood as difficult.

Conclusions: Experienced fathers as well as first time fathers expressed similar concerns about parenthood. Specialized preparation classes for men may provide important support for fathers. This is especially important for fathers who may have poor emotional health or who may not be feeling positive about expecting a baby. Policy-makers and health care providers should recognize that offering support for all fathers benefits not only men, but also their children, and their partners and can help encourage egalitarian practices at home and work.

Marketing Parenting Program by Triggering Pain or Pleasure?

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Background: Parenting programs are effective in promoting positive changes in both parents and children; however, low attendance rates are often a problem, reducing these programs' benefits. To maximize involvement in parenting programs, it is necessary to develop more effective marketing strategies to increase public awareness of these programs and promote parental participation. Self-regulatory focus theory suggests that some people are motivated by promotion concerns, while others are motivated by prevention concerns. Similarly, participation in parenting programs may differ based on whether parents perceive a program as a prevention strategy (e.g. to reduce the risk of attention problems in children) or as a promotion strategy (e.g. to increase children's social skills).

Objectives: We compare a promotive and a preventive strategy in recruiting parents to parenting programs via two studies. In study I, we compare the two strategies in generating interest in parenting programs. In study II, we examine whether parents perceive the two strategies differently based on their own self-regulatory focus.

Method: We designed two ads inviting parents to participate in a free universal parenting program; one ad designed to engage parents by triggering their need for development and nurturance (promotion focused) and the other by triggering their need to avoid possible loss and pain (prevention focused). In study I, the two ads were run online simultaneously. Those who clicked on an ad were directed to a website where they could read about the program and sign up for it. In study II, a large community sample of parents answered a set of questions measuring their perception of the two ads and their own self-regulatory focus.

Results: In study I, over 85 days, more people clicked on the prevention ad compared to the promotion ad. There was no difference in the number of pages visited on the website nor in the number of parents who signed up for the program. In study II, the results showed that though the prevention ad was rated higher by prevention-oriented parents compared to promotion-oriented parents, the promotion ad was favoured by most parents regardless of their self-regulatory focus.

Conclusion: A prevention strategy might be more effective in drawing public attention in general. However, a promotion strategy is more likely to reach parents in particular and inspire them to consider participating in the program.

FinnBrain Birth Cohort Study: Effects of prenatal maternal stress on stress reactivity in the developing brain

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Background. Prenatal maternal stress may lead to altered development of infant stress regulation systems and contribute to the onset of childhood illness and predispose the individuals to develop diseases as adults. We lack knowledge of the pathophysiology linking adverse maternal health to the onset of disease in the child, especially regarding how prenatal challenges might affect brain development. Finnish FinnBrain Birth Cohort of 4018 families (www.finnbrain.fi) aims to identify biomarkers to develop treatment and prevention of stress related illnesses.

Aim. Study the effects of maternal stress comprising reported depression and anxiety during pregnancy to the functioning of the hypothalamus-pituitary-adrenal gland axis (HPA-axis) of the child during the first year of life. We compare the children of the stressed mothers with the control children of non-stressed mothers.

Materials and methods. Study is aiming at recruiting 500 children from the nested case-control Focus Cohort within the FinnBrain. Maternal prenatal stress is measured during pregnancy weeks 14, 24 and 34 by Edinburgh Postnatal Depression Scale, Symptom Checklist 90-R (anxiety) and Pregnancy Related Anxiety Questionnaire-Revised. Also mothers using selective serotonin reuptake inhibitors during pregnancy are included. HPA-axis reactivity of the children is studied using a stress test for the children at the age of 10 weeks, 6 months and 14 months. Pediatrician examination and blood and nasopharynx sampling are used as a stressor. Children's cortisol responses to the stress are analyzed from the five saliva samples: baseline before the stress test and reactivity and recovery phases from the samples of 0, 15, 25 and 35 min after the stressor. Amount and timing of the crying are also measured.

Results. Data collection is in progress. The number of children attended the study since October 2012 so far is 340 (10 weeks), 135 (6 months), and 130 children (14 months). Participation rate is 70%. Results on saliva cortisol profiles and the possible role of prenatal stress in the variance of profiles will be presented.

Thinking and Doing: The Effects of Dopamine and Oxytocin Genetics and Executive Function on Mothering Behaviours

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Translational research has demonstrated that no single brain transmitter, structure, or system controls the complex array of maternal behaviours. However, animal research and human studies suggest that some components of maternal behaviour depend on oxytocin and dopamine systems. Oxytocin associates with the onset of maternal behavior, 'maternal motivation', and warmth, most likely exerting greatest influence early in motherhood involving bonding, close contact, and nursing. Previous research has found several oxytocin SNPs to associate with specific maternal behaviours and the quality of maternal care with 3–6 month old infants (Jonas, Mileva-Seitz et al. 2013, Mileva-Seitz, Steiner et al. 2013). Dopamine may differ from the oxytocin system in becoming more relevant later in motherhood, when the reward and attentional systems are more strongly implicated in maternal behavior. Previous research has also found several dopamine SNPs associate with specific maternal behaviours, such as orienting away, and infant-directed vocalizing with 3–6 month old infants (Mileva-Seitz, Fleming et al. 2012). Much research has focused on the effects of oxytocin and dopamine system polymorphisms on maternal behaviour in the early life of the infant, but it is unknown how these systems affect maternal behaviour as the child becomes more mobile, fluent, and independent.

There is also a developing literature on the relationship between maternal sensitivity and maternal cognition. Previous work has demonstrated a link between attention and spatial working memory tasks and maternal responsiveness to 2–6 month old infants (Atkinson, Leung et al. 2009, Steinhauer, Villiani et al. 2009, Gonzalez, Jenkins et al. 2012). We have also found that there are substantial associations between maternal sensitivity at 3–18 months and spatial working memory, cognitive flexibility, and decision-making (Plamondon, Wade et al. submitted). As mothering becomes more complex at later developmental stages, we expect the relationship between maternal responsiveness and maternal cognition to become more salient. To determine the effects of genetic variation in the oxytocin and dopamine systems on executive function and mothering at 48 months postpartum, we tested the tagged and functional SNPs (DRD1 rs686, DRD1 rs265976, DRD2 rs6277, OXTR rs237885, OXTR rs2254298) against executive function, assessed with the CANTAB measures attentional set-shifting, spatial working memory, stop signal task, and decision-making. A structured mother-child interaction at 48 months postpartum, the Etch-a-Sketch task, was coded and factored into Physical Control, Negative Assessment, Positive Parenting, and Verbal Control and Instruction. Using regression analyses, we found no significant associations between dopamine system SNPs and either executive function or maternal behaviours, contrary to our hypotheses. However, we found several significant direct effects of oxytocin receptor

SNPs on executive functions and on maternal behaviours, as well as significant interactions between oxytocin SNPs and executive functions on maternal behaviours. Specifically, oxytocin SNPs predict CANTAB decision-making but not other CANTAB executive functions. Further, oxytocin SNPs interact with CANTAB decision-making to predict maternal Physical Control. Other maternal behaviours were predicted by executive functions, but not by genotype. These results present an interesting dissociation of both genetics and executive functions on maternal behaviours at 48 months postpartum.

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Case studies to highlight the value of the Newborn Behavioural Observation (NBO) as a tool to enhance parent baby interactions following a pre-term birth

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The impact of pre-term birth on the parents is intense. For most it is a time of great fear, anxiety and extreme vulnerability, which makes the transition to parenthood a steep hill to climb. The point of discharge from the neonatal intensive care unit (NICU) can be especially stressful for parents when they regain full responsibility for the care of their child. Intervention during this critically sensitive period can be beneficial in helping parents to successfully take on this role and to enable them to adopt a positive parenting style that is intuitive and sensitive to the needs of their baby. This article describes 3 occasions where the NBO was used as a tool to enhance parent-baby interactions with families on a neonatal unit.

The poster will include the mother's reflections of her experience of pre-term birth:

A mother's reflections

"It's not right – when your baby is in the NICU"

Two months after the NBO was carried out Sarah agreed to be interviewed to reflect on her own personal experiences of her babies journeys. She reflected on how the pressure began as soon as she realised that she was expecting twins. Sarah remembered her G.P saying that they would plan to 'get her to 35 weeks'. She spoke of the expectation hanging over her. When the babies arrived at 32 weeks gestational age she experienced 'a sense of failure'. She described the very 'medical' environment and stated that although everyone was very kind and the standard of care excellent it felt 'negative' and 'just not right'. The fact that her babies were in such a highly technical setting led her to thinking that 'something was wrong', 'everyone's expectations were different' and that she felt acutely aware that things were 'not normal'. The question "what does this mean for their development?" was never far from her mind. Sarah described constantly experiencing high levels of anxiety and remained medically unwell with high blood pressure for several weeks. She spoke about how other parents were not always helpful influences and how she sometimes felt the 'burden' of witnessing their own painful experiences. Sarah revealed how terrifying it felt when preparations were being made to discharge James and Tiffany. She and her husband 'didn't feel prepared'. She recalled the one thing they were very carefully prepared for when given basic life support training made her feel particularly alarmed. She felt there was a 'focus on danger'.

Once home she initially felt 'out of her depth'. As a first time mother, when the twins began doing different things she would question "which one is right?" Sarah was also acutely aware of all the things that could be wrong- "would they be hyperactive?"

"Would they have cerebral palsy?"

Reflecting on her NBO experience Sarah said that she had been reassured as it was a 'proper examination' 'thorough- hands on, and not just a visual check'. She was pleased there 'was a process to follow – a check list'. Sarah stated that she trusted the therapist as she was 'experienced in working with premature babies'. She reported feeling 'more confident' and 'completely reassured' that the session had 'put things into perspective' and that she could 'relax and enjoy her babies'. Sarah recalled the 'huge sense of relief'.

Prevention and Relationship Education Program (PREP) in transition to parenthood

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Background: A decline in relationship quality upon transition to parenthood is a recognized phenomenon, but little is known how this might be prevented.

Aim: To compare the change in dyadic adjustment among participants in Prevention and Relationship Education Program (PREP) (n = 89 couples) and non-participants (n = 51 couples and 5 women) upon their transition to parenthood.

Methods: This is a quasi-experimental study, where PREP was offered to couples through maternity services at a family health center, allowing self-selection of participants into the program. Dyadic adjustment was measured using Dyadic Adjustment Scale (DAS) during pregnancy and then when the child was 6 and 18 months old. The change of DAS over time was analyzed using Linear Mixed Model.

Results: Mothers and fathers both participating and not participating in PREP reported a decline in DAS. The pattern of change over time was not different between the two groups.

Conclusions: Both PREP participants and non-participants reported similar change in DAS from their transition to parenthood to the child's age of 18 months. This result must be seen in the context of differences the groups reported at baseline, which indicated several risk factors for course of relationship satisfaction in the group of PREP participants.

Behavioral consequences of CDH13 deficiency and early life stress

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Introduction: Disorders like ADHD, autism or childhood depression have long been seen as disorders of neuronal development. Changes in connectivity, axonal growth and overall neuronal survival are suspected to play a key role at the anatomical and molecular level of these diseases. Genome-wide association studies have linked a novel genetic risk factor to these neuropsychiatric and neurodevelopmental disorders: cadherin 13 (*CDH13*), a member of the calcium dependent cell adhesion protein family. CDH13, like other cadherins, is an important molecule for tissue formation, proper cell adhesion and neuronal growth in the adult brain, which has been shown to affect synapse density in the hippocampus. Recently, we were indeed able to show, that CDH13 deficient mice revealed learning and memory problems in a number of behavioral tests. Interestingly, *Cdh13* is also upregulated due to chronic stress in rodent models.

Aim: the aim of this study was to investigate the interaction of CDH13 and stress in these animals and study if *Cdh13* KO animals are more severely affected by early life stress during their development.

Method: Newborn pups were separated from their mothers for 3h during postnatal days P1-P15 in a controlled environment. After maternal separation (MS), the animals were left to mature to the age of 56 days upon which they were subjected to a battery of behavioral tests, to assess the effects of MS on several behavioral domains. Among the used tests were anxiety related tests like the Elevated-Plus-Maze, Light-Dark-Box and Open field, as well as memory-related tests like the Novelty-Object-Recognition, the Barnes Maze and Fear Conditioning.

Findings: we were overall able to replicate findings from our previous study and show that CDH13 deficiency affects learning and memory. Moreover, we were also able to show that MS affects the behavior of all groups, but that CDH13 deficient animals are differently affected by early life stress than their wild-type siblings. This was most pronounced in tests for anxiety and approach behavior.

Behavioral flexibility in the maternal responses of lactating rats raising overlapping litters

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Maternal behavior in the rat adapts to the environment and to the changing needs of pups across the postpartum period. This behavioral flexibility involves the active participation of neural substrates, which are modulated by the endocrine profile of females and by stimuli provided by the pups. We recently developed the overlapping litters model (OL) in rats, in which as a result of mating at the postpartum estrus the mothers simultaneously takes care of two successive litters in different developmental stages. The objectives of this study were to investigate how the maternal behavior of the females adapts to this unique and challenging condition of raising overlapping litters, and to explore some of the factors involved. To this aim we analyzed 1) the maternal behavior toward neonates and juveniles in the home cage and 2) the relative incentive value of junior versus senior litter assessed in an Y shaped preference maze of: a) mothers with OL (raising pups of different ages - 2–4 and 22–24 days-old simultaneously, n=10), b) multiparous females in early postpartum period (2–4 days-old pups, n=6) and c) multiparous females in late postpartum period (22–24 days-old pups, n=10). We found that mothers with OL took care of both litters; however, juvenile pups were less licked, retrieved and nursed than newborns. Interestingly, the levels of maternal care received by juveniles were higher than those raised in single litters (no newborns present). Moreover, when an aversive stimulus, such as an unknown adult male was introduced in the maternal cage, the mothers eagerly retrieved the juveniles and reunited them in the nest. On the other hand, when tested in the preference maze, early postpartum mothers strongly preferred the neonates over the juveniles, whereas OL and late postpartum mothers did not show preference for newborn or juvenile pups. Despite of female's preference, OL and early postpartum mothers that experienced recent hormonal priming of gestation and parturition, made more effort to obtain the newborns compared to late postpartum mothers. From these results we can conclude that during the overlapping of litters, the juveniles have similar incentive values than newborns for the mothers, and therefore the low levels of maternal care display toward the juveniles seem to be the result of a maternal adjustment to take care of these "less demanding" pups. Previous studies from our lab support a role for the endocrine influence of gestation and parturition in the behavioral adaptation of mothers raising overlapping litters. In addition, present study indicates that the traits or demands of the developing pups as well as the context, contribute to this behavioral flexibility.

Financial support: CSIC, PEDECIBA, ANII_FCE 2014

Affect and mothering of incarcerated mothers in Uruguay

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The situation of imprisonment is associated with high levels of stress that may negatively impact women's affective state and mothering. The primary aims of this study were to: (a) characterize the affective state and maternal sensitivity of incarcerated pregnant and postpartum women cohabiting with their children, and (b) promote mentalizing, emotional regulation of the infant and a secure attachment between the mother and her child through group sessions. First, we conducted individual semi-structured interviews to gather relevant background and socio-demographic information. Women's anxiety state and mood were assessed by the State-Trait Anxiety Inventory (STAIT-S and STAI-T; Spielberger, 2010) and the Edinburg Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987) and mothers' sensitivity in a dyadic context was evaluated by the CARE-Index (Crittenden, 1997, 2004). Infants' psycho-functional development was evaluated by a Pediatrician. Nine monthly group sessions of one hour each, led by two therapists, were held in two Feminine Reclusion Centers in Montevideo, Uruguay. Four to eight women and their children participated in the sessions. Mothers and infants' photographs, videos and open questions about emotions were employed to guide the discussions aimed to encourage mentalizing, emotional regulation and secure attachment. Mean scores of state and trait anxiety of pregnant (stai-s: $46.2 \pm SE 7.4$ and stai-t: 40.6 ± 5.8 , n=6) and postpartum (stai-s: 45.4 ± 4.1 and stai-t: 52.6 ± 4.2 , n=7) women were higher than those typically reported for the general population. Regarding mood, the means of EPDS scores were 9.4 ± 2.9 for pregnant and 14.0 ± 2.5 for postpartum women. Seven of twelve women scored over 12 (over 50%), suggesting a high probability of mood alterations. Although anxiety and mood scores suggest affective alterations in these women, non one received a score considered "at risk" on the CARE-Index Synchronic Dyadic scale. In accordance, all infants showed an adequate psycho-functional development in a pediatric assessment. When mothers were asked about their emotions of fear, joy and anger, the majority of the answers was related to their children. One putative interpretation of these results is that the close contact with the infant can override the negative effects of anxiety and low mood on the interaction between mothers and infants. However, these results should be considered as preliminary and taken with caution as this study comprised a small number of mothers who were heterogeneous regarding several factors that could influence affective states and motherhood. It represents a first step towards characterizing the affective state and the quality of mothering of women in prison in Uruguay and a contribution for reflection and future research of this highly vulnerable group of mothers and children.

Financial support: CSIC

Who was Berzelius?



Jöns Jacob Berzelius, one of the most prominent natural scientists of the 19th century, was born in 1779 in Väversunda, in the county of Östergötland in southern Sweden, a region with rich cultural traditions.

Orphaned at an early age, he went to several foster-homes and received his schooling in nearby Linköping. After graduating in medicine at the University of Uppsala, he moved to Stockholm, where he became assistant master without pay at the so-called »Surgical School«, and earned his keep by working as a doctor for poor people. At the age of 28 he became professor of medicine and pharmacy.

In 1808 Berzelius was one of the seven men who founded The Swedish Society of Medicine »For the perfection of science through mutual mediation of knowledge and collective experience, for the promotion of friendly confidence between doctors«.

Berzelius have enriched our knowledge of nature of life phenomena, established the atomic weights of most of the known elements, presented his electrochemical theory for the understanding of the nature of chemical compounds and laid the foundation for the sciences of the chemistry of rock types.

He also found that elements combine with each other according to fixed numerical relationships. In addition to this, in his striving for order and method, with his talent for simplicity and clarity in expression, he created the chemical symbolic language in 1813, which since that time has been an essential instrument of chemistry.

With time he became a practised lecturer but preferred to express himself in writing and this he did superbly. Impressive are the great scientific works where he also demonstrated his interest and ability to spread knowledge about the latest advances of natural sciences.

Berzelius delight in research and debate was united with a great humility before the great scientific questions. Both his attitude and artistry of formulation is illustrated by the following passage in his *Manual of Chemistry* (vol 3, 1818):

»All our theory is but a means of consistently conceptualizing the inward processes of phenomena, and it is presumable and adequate when all scientifically known facts can be deduced from it. This mode of conceptualization can equally well be false and, unfortunately, presumable is so frequently. Even though, at a certain period in the development of science, it may match the purpose just as well as a true theory. Experience is augmented, facts appear which do not agree with it, and one is forced to go in search of a new mode of conceptualization within which these facts can also be accommodated; and in this manner, no doubt, modes of conceptualization will be altered from age to age, as experience is broadened, and the complete truth may perhaps never be attained. But even if the goal can never be reached, let us never abandon our endeavor to get closer to it.«

Parts of this text is found in: Berzelius – Creator of the chemical language, by Carl Gustaf Bernhard, the Royal Swedish Academy of Sciences



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