



The neurobiology of mammalian parenting and the biosocial context of human caregiving



Ruth Feldman

Department of Psychology and the Gonda Brain Sciences Center, Bar-Ilan University, Ramat-Gan 52900, Israel

ARTICLE INFO

Article history:

Received 4 May 2015

Revised 29 September 2015

Accepted 6 October 2015

Available online 9 October 2015

Keywords:

Parenting behavior

Oxytocin

Parental brain

Neurobiology of attachment

ABSTRACT

This article is part of a Special Issue “Parental Care”.

Research on the neurobiology of attachment, pioneered by scholars in the generation that followed the discovery of social bonding, examined the biological basis of mammalian parenting through systematic experiments in animal models and their application to theories on human attachment. This paper argues for the need to construct a theory on the neurobiology of human attachment that integrates findings in animal models with human neuroscience research to formulate concepts based on experimental, not only extrapolative data. Rosenblatt's (2003) three characteristics of mammalian parenting – rapid formation of attachment, behavioral synchrony, and mother-offspring attachment as basis of social organization – are used to guide discussion on mammalian-general versus human-specific attributes of parental care. These highlight specific components of attachment in rodents, primates, and humans that chart the evolution from promiscuous, nest-bound, olfactory-based bonds to exclusive, multi-sensory, and representation-based attachments. Following, three continua are outlined in parental behavior, hormones, and brain, each detailing the evolution from rodents to humans. Parental behavior is defined as a process of *trophallaxis* – the reciprocal multisensory exchange that supports approach orientation and enables collaboration in social species – and includes human-specific features that enable behavioral synchrony independent of tactile contact. The oxytocin system incorporates conserved and human-specific components and is marked by pulsatile activity and dendritic release that reorganize neural networks on the basis of species-specific attachment experiences. Finally, the subcortical limbic circuit underpinning mammalian mothering extends in humans to include multiple cortical networks implicated in empathy, mentalizing, and emotion regulation that enable flexible, goal-directed caregiving. I conclude by presenting a philosophical continuum from Hobbes to Lorenz, which illustrates how research on the neurobiology of attachment can put in the forefront the social-collaborative elements in human nature and afford a new perspective on the mind-brain polarity.

© 2015 Elsevier Inc. All rights reserved.

...“Critical characteristics of mammalian parental behavior are: Simultaneous onset of birth, lactation, and maternal care, **rapid formation of an attachment** of the mother to her offspring, **synchrony in the behavioral interaction** between mother and young during their development until weaning, and the significance of the mother-offspring unit as **the basis of social organization**”.

[J.S. Rosenblatt, 2003, p. 265 (my emphasis)]

In what was to become his last major conceptual paper, Rosenblatt summarizes his perspective on the field he pioneered: the neurobiology of mammalian mothering. Coming of age in a period heavily influenced by psychoanalytic thinking when human mothering was considered mainly a mental phenomenon beginning when mothers first met their newborns (Rosenblatt, 1989, 1994), his creative research program and conceptual clarity helped redirect attention to the physiological basis

of parenting. It placed human mothers in a long line of evolutionary progress and emphasized inter-species comparability in the central function of evolutionary adaptation: the successful rearing of offspring. From research and conceptualization developed by Rosenblatt and his contemporaries (Bowlby, 1953, 1967; Denenberg and Bell, 1960; Denenberg et al., 1962; Harlow, 1958; Hofer, 1970, 1987; Levine, 1957, 1967; Schneirla, 1946, 1958, 1971) – the generation that followed Lorenz' discovery on the biological basis of social bonding in 1935 – a new perspective on mothering and its central role in shaping infant biology and behavior emerged and new understanding of attachment bonds as the basis for social organizations was formulated. In addition to new theories, these researchers also advocated a new methodology to study attachment, one that is based on careful observations, hypothesis testing, and step-by-step uncovering of relevant physiological processes. Following their cumulative effort, the notion of “mothering” as a scientific area of inquiry flourished, became anchored in specific hormonal changes and brain structures, and was seen as a long process that begins with pregnancy and undergoes stage-by-stage preparation for the

E-mail address: Feldman.ruth@gmail.com.

maternal–infant encounter at birth, from which it develops through reciprocal mother–infant exchanges (Feldman, 2012a, 2015a; Rosenblatt, 1980). This generation was also the first to utilize animal models, particularly rodents, to study the biological basis of maternal care.

As can be expected, a research program based on animal models highlights the conserved components of parenting. Two conserved processes were particularly emphasized as markers of mammalian caregiving. First, it was suggested that in all mammals parenting is expressed primarily via behavior; in fact, in species such as mammals *parenting is behavior* (Feldman, 2012b; Hrdy, 1999; Rosenblatt, 1989). This definition of “parenting as behavior” touches upon a central divide of mammals (and some birds) from lower species that accompanied the emergence of viviparity and its concomitant increase in maternal investment (Curley and Keverne, 2005; Hogarth, 1976; Larsson, 1994). The focus on behavior altered the field by postulating that in order to understand parenting one must look closely at bonding-related behavior, find ways to quantify it with precision, and define the physiological systems that support its species-specific expression. The second important contribution inserted a temporal dimension into the neurobiology of parenting by describing gradual processes occurring across pregnancy (Rosenblatt, 1989). The emphasis on time provided a template for later research, which added the generational time-line and showed how mothering is prepared not only across pregnancy but by the cross-generation cycles of females, including Champagne and Meaney's (2001) “like mother like daughter” on the cross generation transmission of maternal behavior, Keverne's (2013) work on matriline effects through the maternal–placental–fetal interface, and epigenetic studies on non-genomic transmission of stressful life events via DNA methylation (Meaney and Szyf, 2005; Meaney, 2010; van Ijzendoorn et al., 2011). Overall, this generation not only redefined parenting but placed it in the forefront; parenting became the most important topic for understanding mammalian social life and was described as rooted in biology and anchored in evolution. Moreover, these studies “demystified” mothering, advocating that the poetic notion of “maternal love” can be given to rigorous science, systematic experiments, and incremental – not only holistic – knowledge.

In the following, I wish to pay tribute to Rosenblatt, whose research has been instrumental to my theory on *bio-behavioral synchrony* (Feldman, 2007a, 2007b, 2012a, 2012c, 2012d, 2014, 2015a, 2015b), by highlighting the relevance of his work to current models on the neurobiology of human parenting. The three principles of mammalian parenting he outlined – the rapid formation of attachment, the behavioral synchrony, and the role of synchrony as providing the basis for social organization – will guide our discussion on parental care. Yet, this paper focuses on the neurobiology of *human* parenting and discusses it not only as comparable to mammalian parenting but also as distinct from it. It appears that the pendulum has swung far into the biological and away from the mental, and current models on the neurobiology of parenting emphasize the conserved elements while paying much less attention to the uniquely human. Current technical and empirical advances enable us to study the neurobiology of human parenting without the split faced by previous generations, between human studies relying solely on self-reports and low-tech observations while only animal models can provide a window into the underlying physiological mechanisms. New imaging studies of the human parental brain, genetic and epigenetic human research, and the exponential increase in research on the role of oxytocin in human social functions, whose central role in priming the maternal brain for parenting was discovered by Rosenblatt and colleagues, among others (Kendrick and Keverne, 1989; Pedersen et al., 1982; Poindron et al., 1988; Rosenblatt et al., 1988), afford new integration of insights from animal research with human neuroscience experiments. Future technological advances will undoubtedly allow an even greater precision in human neurobiological studies. Such biologically-based human research requires a new theoretical framework, one that is based on prior conceptualization and findings in animal models yet addresses the neurobiology of human

parenting from an experimental, not only extrapolative standpoint. The polarity of mind and brain, body and soul, the physical and the mental has puzzled philosophers and scientists since the ancient Greeks. Each generation drafts a somewhat different answer that reflects, in my opinion, how that generation perceives what it means to be human. The neurobiology of human parenting, by providing a central framework to address the biological basis of human social life, may afford one integrative perspective particularly relevant to our generation.

As such, the following discussion is divided into four sections, each presenting a continuum of polarized opposites. The first three describe continua from animal models to human parenting in the three central aspects of parenting; Parenting behavior, oxytocin (in crosstalk with other hormones), and the parental brain. The fourth addresses a philosophical continuum from Hobbes to Lorenz, depicting the polarity between viewing the biological basis of human nature as solipsistic, self-serving, and directed toward accumulating power and resources to models that highlight the social and collaborative elements in Man's biology.

The model on the human parental caregiving context, based on Rosenblatt's three principles derived from research in rodents, is presented in Fig. 1.

As seen, components of the mammalian-general constellation are uniquely expressed in humans in each of the three principles, and their inter-connections are depicted in both red/dotted arrows (mammalian-general) and blue/filled arrows (human specific). The immediate formation of attachment is expressed in humans by the exclusive bond, which is not observed in rodents (Feldman, 2015b), the expression of human-specific parenting behavior immediately after birth, the openness of the human infant's physiological systems to organization by maternal contact, and the special role of oxytocin in this process (Feldman, 2012a; Galbally et al., 2011). These elements, in turn, lead to the development of interaction synchrony (red/dotted and blue/filled arrows), which in humans is dyad-specific, based on the pace and rhythms of each parent and child, and assembles from the same behavioral building blocks in the gaze, affect, vocal, and touch modalities in culture-specific ways (Feldman and Masalha, 2007; Feldman et al., 2006). Interaction synchrony supports the formation of human social life via multiple mechanisms that are both general (red/dotted arrows) and human-specific (blue/filled arrows) as shown in cross-sectional and longitudinal research from infancy to adolescence (Feldman, 2007c, 2012a, 2012c, 2012d). However, in humans there is also a feedback loop from social organization back to attachment formation, which is not so clearly seen in other mammals. This implies that humans, more flexibly than non-human mammals, adapt attachment patterns to diverse social organization, such as permanent versus nomadic habitat, nuclear versus extended family constellation, single versus multiple caregivers, and minimal versus extensive father involvement. Such human-specific arrow also leads from the module of social organization, which is mammalian-general, to the human-specific module of culture, which serves as an overarching organizing principle of human attachment. Large brain primates, particularly humans whose associative cortex is significantly larger than that of chimpanzees, our closest relatives (Rilling, 2014), live in complex social organizations composed of multi-level social relationships, and navigating such complex social ecologies rely on later-evolving associative, executive, and mentalizing brain networks that enable the diversity of human cultural societies (Broad et al., 2006; Dunbar, 2014). Culture-specific factors involving both immediate living conditions, such as co-sleeping, continuous contact, or culturally-accepted amounts of parent–child gaze, touch, and positive arousal, as well as cultural meaning-systems and perceptions of optimal parenting, are both shaped by the neurobiology of attachment and shape it in return, rendering the parent–child interface a flexible platform for evolutionary adaptation.

Our discussion is based on the wealth of research in animal models that described the neuroendocrine and brain networks implicated in parental care and the expression of parental behavior (Numan and Insel, 2003; Numan et al., 2006). These studies highlight the unique

Download English Version:

<https://daneshyari.com/en/article/323052>

Download Persian Version:

<https://daneshyari.com/article/323052>

[Daneshyari.com](https://daneshyari.com)