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## REVIEW

# PARENTING BEGETS PARENTING: A NEUROBIOLOGICAL PERSPECTIVE ON EARLY ADVERSITY AND THE TRANSMISSION OF PARENTING STYLES ACROSS GENERATIONS

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**Abstract**—The developing brains of young children are highly sensitive to input from their social environment. Nurturing social experience during this time promotes the acquisition of social and cognitive skills and emotional competencies. However, many young children are confronted with obstacles to healthy development, including poverty, inappropriate care, and violence, and their enhanced sensitivity to the social environment means that they are highly susceptible to these adverse childhood experiences. One source of social adversity in early life can stem from parenting that is harsh, inconsistent, non-sensitive or hostile. Parenting is considered to be the cornerstone of early socio-emotional development and an adverse parenting style is associated with adjustment problems and a higher risk of developing mood and behavioral disorders. Importantly, there is a growing literature showing that an important predictor of parenting behavior is how parents, especially mothers, were parented themselves. In this review, we examine how adversity in early-life affects mothering behavior in later-life and how these effects may be perpetuated inter-generationally. Relying on studies in humans and animal models, we

consider evidence for the intergenerational transmission of mothering styles. We then describe the psychological underpinnings of mothering, including responsiveness to young, executive function and affect, as well as the physiological mediators of mothering behavior, including hormones, brain regions and neurotransmitters, and we consider how development in these relevant domains may be affected by adversity experienced in early life. Finally, we explore how genes and early experience interact to predict mothering behavior, including the involvement of epigenetic mechanisms. Understanding how adverse parenting begets adverse parenting in the next generation is critical for designing interventions aimed at preventing this intergenerational cycle of early adversity.

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**Key words:** early adversity, intergenerational effects, gene-environment interactions, mothering, parenting styles.

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**Abbreviations:** ERP, event-related potentials; fMRI, functional magnetic resonance imaging; GxE, gene by environment; HPA, hypothalamic–pituitary–adrenal; mPFC, medial prefrontal cortex; MPOA, medial pre-optic area; OXT, oxytocin peptide; OXTR, oxytocin receptor.

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## INTRODUCTION

Early childhood is a period of unprecedented change and integration at both the biological and social level characterized by a high degree of plasticity in brain organization (Kolb et al., 2003; Marshall and Kenney, 2009). Young children's rapidly developing brains are highly sensitive to input from the social world, which allows for the rapid acquisition of language, cognitive skills, and emotional competencies. Nurturing social experiences in the early years have lifelong benefits, including an increased ability to learn, greater achievement, involvement in community activities, active participation in the labor market and overall quality of life (Ermisch et al., 2012; Boivin and Bierman, 2013). Unfortunately, too many infants and young children are confronted with adverse experiences, such as poverty, inappropriate care, and violence, which pose enduring obstacles to their healthy development (Boivin et al., 2005; Evans and Kim, 2007; Wadsworth and Santiago, 2008; Brown et al., 2009). Disparities emerge early in life in children's physical, social/emotional, and language/cognitive development that are largely attributable to the interplay of genetic factors and systematic differences in the nurturing qualities of their early environments: nutrition, bonding/attachment, stimulation, and opportunities for participation (Grantham-McGregor et al., 1997; Boyden and Levison, 2000; Barker et al., 2008; Côté et al., 2009; Forget-Dubois et al., 2009; Petitclerc et al., 2009, 2011; Lacourse et al., 2014; Battaglia et al., 2015). During these early years, a dense, hierarchically connected series of sensitive periods occur in the brain, such that early experiences can embed themselves in brain circuitry and other biological systems (Hertzman and Boyce, 2010).

Young children's enhanced sensitivity to their social world means that they are highly susceptible to adverse social experiences, including short-term, dramatic events such as discrete episodes of physical or sexual abuse, as well as chronic daily stressors within the home and community. One source of social adversity in early life can also stem from parenting behavior that is harsh, inconsistent, non-sensitive or hostile. Generally perceived as the cornerstone of early socio-emotional development (Bornstein, 1995), parenting behaviors are especially important in the early years when the maturation of neurophysiological systems makes the infant particularly receptive to, and dependent on sensitive parenting care for his/her emotional and behavioral regulation (Kochanska et al., 1998). In most cases, a child's parents and immediate family provide the early and influential proximal environment through which a child's potential for "effective psychological function" begins to evolve and manifest (Bronfenbrenner and Ceci, 1994). Unfortunately, not all children benefit from this nurturing contribution. Early signs of adjustment problems have been associated specifically with inconsistent, non-sensitive, and hostile parenting behaviors (Lyons-Ruth et al., 1991; Wakschlag and Hans, 1999; Tremblay et al., 2004; Huijbregts et al., 2008). Furthermore, epidemiological studies demonstrate that children who are exposed to early adverse experiences associated with

disrupted bonding and attachment are at a higher risk for developing anxiety, depression, and other stress-related illnesses during adolescence (Rey, 1995; McCauley et al., 1997; Martin et al., 2004) and adulthood (Enns et al., 2002; Putnam, 2003).

There is a growing literature showing that one of the most powerful predictors of parenting behavior is how parents, especially mothers, were parented themselves. In this review we examine the relationship between early adversity and parenting behavior and its intergenerational perpetuation. We begin by outlining our conceptual perspective on parenting, focusing particularly on mothering. We then review evidence for the intergenerational recurrence of mothering styles relying on evidence from both human and animal studies. This is followed by a description of what is known about the psychological underpinnings of mothering, including perception, executive function, and emotion and the impact of early adversity on offspring development in these domains of psychological functioning. We then discuss the putative physiological mediators associated with mothering, including the role of hormones, key areas of the brain, and neurotransmitters, and we examine how early adversity influences these physiological mediators. A final section explores what is known about how specific genes and the early environment interact to predict mothering behavior, as well as the potential involvement of epigenetic mechanisms through which early adversity may affect the mechanisms of mothering. We close the review with a summary of the material presented and some tentative conclusions aimed at informing targeted interventions to break intergenerational cycles of problematic parenting behaviors.

## CONCEPTUALIZATION OF PARENTING

Parenting is embedded in a complex social system. It is influenced by parent and child characteristics, but also by contextual stressors and supports (Belsky, 1984). Parents bring their personality and personal history to their early interactions with the young child, and this background, as well as more immediate environmental constraints, may influence their beliefs and expectations about parenting and their parenting practices (Boivin et al., 2005). The concept of normative-adaptive or species-typical parenting behavior is implied throughout the present review, but we acknowledge that among all species, especially humans, there are large individual and cultural differences in parenting behaviors, in feelings and attitudes toward infants, as well as in the motivation to parent. In fact, individual differences are the hallmark of human behavior within and across cultures, and it is important to understand how both environmental and genetic factors, as well as their interactions, contribute to these individual differences. This review points to features of parenting that create an environment in which healthy development can occur, but always with the view that both 'positive' and 'negative' parenting, as well as 'desirable' child outcomes cover a range of approaches,

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