Chapter 6
The Light Side of Preterm Behavioral Epigenetics: An Epigenetic Perspective on Caregiver Engagement

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ABSTRACT
Preterm infants need long-lasting hospitalization in the Neonatal Intensive Care Unit (NICU). On the one hand, the NICU stay constitutes an early adverse experience, due to highly stressful experiences. On the other hand, Developmental Care (DC) interventions, including caregiver engagement, can exert neuro-protective effects for preterm infants. Recent evidence in the field of behavioral epigenetics is revealing the biochemical pathways through which adverse and care experiences are embedded in early human development through epigenetic mechanisms. Nonetheless, the application of behavioral epigenetics to preterm birth and NICU stay is still at its beginning. In the present chapter, insights are provided for the application of behavioral epigenetics to the study of the biochemical underpinnings of NICU-related stress and care, with a specific focus on caregiver engagement. This contribute should be intended as a preliminary roadmap to guide future behavioral epigenetic research on the adverse and protective effects of early NICU care of preterm infants.

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INTRODUCTION

Preterm birth is a major concern for healthcare services, ranging from about 5% to 18% worldwide (Field et al., 2009). Preterm birth is associated with a heightened risk for long-term detrimental consequences for development, including sensorial, behavioral, neurological, and emotional disorders (Stoll et al., 2010). Notably, even in absence of severe illness condition, preterm infants are especially fragile and they require long-term hospitalization and specialized multi-disciplinary interventions in a medical environment (i.e., Neonatal Intensive Care Unit, NICU), which clearly is not a surrogate of the maternal womb.

Specific features of NICU environment are sources of multiple stress for preterm infants, including painful stimuli, disruption of sleep, excessive noise and light levels, frequent handling associated with medical or nursing procedures, maternal separation and disrupted parenting (Peng et al., 2009). Effects of early exposure to NICU-related stress may be at least partially alleviated by caregiver engagement interventions. Despite there is considerable variations in caregiver engagement among different NICUs, Samra and colleagues (Samra et al., 2015) recently proposed a comprehensive definition. Caregiver engagement should be considered as a complex, dynamic, goal-oriented, and guided multifaceted process through which parents participate in the care of their infant to influence the outcome within a specific period and context (Samra et al., 2015). As such, caregiver engagement is a process aimed at enhancing parent parents’ situational awareness (understanding of health care communication, awareness of cues in the environment, realistic perception of their infant’s condition and cues), ability to problem solve, set goals, make appropriate care decisions, and acquire skills and knowledge to support their infant health needs. The caregiver engagement process in the NICU appears to be aimed at least at two main directions: engaging parents as partners of NICU staff and engaging parents in interacting with their own newborn and infant (Provenzi, Barello, & Graffigna, 2016a).

Caregiver engagement interventions encompass different Developmental Care (DC) practices (Westrup, 2007). DC includes a broad category of interventions designed to minimize the effects of NICU stress exposure encompassing control of external stimuli (vestibular, auditory, visual, tactile), kangaroo care and parental involvement (e.g., breastfeeding, policies of NICUs toward parental visiting, promoting infant-parent bonding), developmental activities of daily living (i.e., nesting, swaddling, prone position) and infant pain management (Symington & Pinelli, 2006). During last decades, parents have been increasingly engaged by NICU staff through a set of family-centered actions (Provenzi et al., 2016a). Caregiver presence in NICU has been shown to be beneficial for both the infants and their parents (Montiroso et al., 2012a). Specific ways of engaging parents in the NICU, such as skin-to-skin contact and kangaroo care, are able to exert positive long-lasting neuro-protective effects for the neuro-behavioral and psycho-biological development of preterm infants (Altimier, Kenner, & Damus, 2015). Hence, caregiver engagement in the NICU holds the potential to be a low-cost and high-quality intervention to provide positive influence on health outcomes of preterm infants (Samra et al., 2015).

Although several mechanisms may potentially link neonatal stress exposure with altered neurodevelopment, emerging evidence suggest that epigenetic changes are likely implied in the precocious programming of biological and physiological stress regulation systems in preterm infants (Montiroso & Provenzi, 2015). More specifically, behavioral epigenetic research (see below) is the study of environmental-driven modifications of the genotype resulting in long-lasting alterations of neuro-behavioral phenotype (Lester et al., 2011). In animals and humans, behavioral epigenetics is starting to provide insights about such biochemical mechanisms involved in the embedding of stressful and caring experiences in the developing biology of young individuals, programming the risk of health and disease later in life (Griffiths &