Transcending the Nature-Nurture Debate through Epigenetics: Are We There Yet?

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For sheer interdisciplinary impact and paradigm-shifting potential, few areas of scientific inquiry currently rival the study of *epigenetics*. Interest in this subfield of biology has skyrocketed of late, generating buzzword status within both scientific and lay discourse [Haig, 2012; Moore, 2015]. As a term “epigenetics” has been around for decades and, in its broadest sense, parallels the concept of epigenesis – the idea that increasingly complex structures and functions are built over the course of development through the processes of development itself [Gottlieb, 1992; Griffiths & Stotz, 2013; Haig, 2004; Müller & Olsson, 2003]. However, as a contemporary discipline, epigenetics targets the idea of epigenesis much more narrowly. In particular, epigenetics focuses on the *molecular* study of mechanisms by which extragenetic factors regulate and modify gene expression during development, as well as on the transmission of such epigenetic modifications in gene expression across generations, all in the absence of changes to the DNA sequence [Holliday, 2002; Jablonka & Lamb, 2002; Müller & Olsson, 2003]. Over the last decade, research in epigenetics has enjoyed increasingly widespread influence across the life sciences, boldly controverting orthodox views of the genome as exclusive source of biological inheritance and as foremost repository of information for constructing organisms in development [Griffiths & Stotz, 2013; Meloni, 2014; Moore, 2015]. Nowhere, however, have the implications of this work resonated more strongly than within psychology and the study of human development.

The promise that epigenetics holds for psychological and developmental science is nothing short of a resolution to – or dissolution of – that most ubiquitous and pernicious of debates: the nature-nurture debate. For Stotz and Griffiths [2016], epigenetics “seems to transgress the boundary between nature and nurture ... in an attempt to uncover the underlying ‘nature’ of organisms, molecular biology has instead revealed the interdependence of organism and environment” (p. 22). In a similar vein, Moore [2015] has argued that “because epigenetic events happen at the interface between DNA and its environment, they can help us to see how our features always arise from both nature and nurture” (p. 6). Traditional dichotomies presupposed by

the nature-nurture debate – dichotomies such as “innate” and “acquired” or “heredity” and “experience” – seem obsolete when faced with epigenetic research demonstrating extragenetic, and not just genetic, contributions to developmental and evolutionary stability, or when faced with epigenetic research demonstrating genetic, and not just extragenetic, contributions to developmental and evolutionary plasticity [Griffiths & Stotz, 2013; Jablonka, 2016]. In effect, for increasing numbers of scientists, epigenetic research is on the verge of delivering a death knell to the nature-nurture debate by undermining the dichotomous thinking that all too commonly conditions questions about how structures and functions both develop and evolve [e.g., Gonzalez-Pardo & Alvarez, 2013; Masterpasqua, 2009; Meaney, 2010; Moore, 2015].

However, one major problem looms for those who champion epigenetic research along these lines. Epigenetic research per se cannot resolve the nature-nurture debate, because resolving such a debate is *not* fundamentally an empirical exercise. Over 40 years ago, Overton [1973] argued convincingly that the nature-nurture debate operates, first and foremost, at the level of metatheory. It specifically involves a *conceptual* dispute over how to characterize the process of interaction *between* nature and nurture, with disputants in the debate at odds with one another over such basic ontological issues as “the nature of substance and change” [Overton, 1973, p. 79; see also Lerner, 1978, and for a recent elaboration of the conceptual dispute, see Tabery, 2014]. Consequently, the core question underlying the nature-nurture debate is not whether factors of nature (i.e., genes) alone, factors of nurture (i.e., the environment) alone, or some combination of both factors drive the process of development. As Tabery [2014] has asserted, “we have moved beyond versus ... it is a truism that these complex human traits arise from both nature and nurture” (p. 1). Instead, at the heart of the debate lies the metatheoretical question of how to conceptualize the interactions that *necessarily* occur between nature and nurture.

On one side of the conceptual divide are those who regard developmental interactions as decomposable into distinct nature and nurture components playing distinct roles in the formative process, such that, for example, some components serve as the informational source for construction of a developmental product whereas other components merely serve to actualize (or not) that source information. This reductionist view has been couched as a “weak” [Lerner, 2002], “middle ground” [Allen & Bickhard, 2013; Spencer et al., 2009], or “variation-partitioning” [Tabery, 2014] approach to interaction. On the other side of the conceptual divide are those who view the process of developmental interaction itself as the source of developmental form, yielding genuinely emergent products irreducible to the components of the interaction themselves, to their differential informational content, or to their additive mixture. This alternate, holistic view has been couched as a “strong” [Overton, 1973], “developmental systems” [Lerner, 2002; Spencer et al., 2009], or “mechanism elucidation” [Tabery, 2014] approach to interaction. For a growing consensus of developmental scientists, only a holistic view of developmental interaction – a relational, process-oriented approach to the study of development – effectively transcends the nature-nurture debate and its dualist framing [e.g., Allen & Bickhard, 2013; Gottlieb, 1992; Lehrman, 1970; Lerner, 1978; Overton, 2015; Oyama, 1985; Spencer et al., 2009; Stotz, 2008].

The purpose of this special issue of *Human Development* is to examine the *conceptual* potential of epigenetics for resolving the nature-nurture debate. Each of its contributors explores the conceptual underpinnings of the biological discipline and

evaluates the extent to which these underpinnings render the study of epigenetics consistent with a holistic – rather than a reductionist – view of developmental interaction. Moore [this issue] reveals how easily epigenetics research can be assimilated to reductionist, statistical conceptualizations of developmental interaction and stresses the need to focus attention within the epigenetics literature on the actual dynamics of process underlying phenotype development, underscoring historical and systems-based uses of the term “epigenetics.” Saunders [this issue] frames Waddington’s broad treatment of epigenetics and the epigenetic landscape in terms of probabilistic accounts of epigenesis and contrasts this original treatment with today’s increasingly narrowed, molecular treatment, arguing that views of epigenetics as regulation of gene expression are ill equipped to overturn the neo-Darwinist paradigm and its reductionist, nondevelopmental focus. Robert [this issue] applies a developmental systems perspective on epigenetics (and the holistic conceptualization of developmental interaction that such a perspective entails) to the specific study of obesity, articulating the biological embedding of context that both arises from and conditions – in dynamically flexible and complex ways, across the life span – people’s ongoing relations with their ecological surrounds. Emphasizing the conceptual ambiguity and inadequacy of terms like “interaction” and “mechanism,” Lerner and Overton [this issue] call for more judicious use of language in the process relational conceptualization of epigenetics research and argue that such research readily demonstrates the absurdity of all explanatory models that appeal, in one fashion or another, to any degree of genetic reductionism. Finally, we end this special issue with an integration and extension of the major themes evinced [Lickliter & Witherington, this issue], proposing that a *developmental* epigenetics will be required to achieve a fully realized situated, embodied, and relational psychobiological theory of phenogenesis.

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