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EDITORIAL

Gene–environment interaction

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This Special Issue of *Development and Psychopathology* is devoted to the topic of gene–environment interaction (G × E) and developmental psychopathology. G × E, one of several distinct forms of gene–environment interplay (Rutter, Moffitt, & Caspi, 2006), refers to behavioral effects that are attributable to the interdependence between a specific identified variation in the DNA sequence and a specific, well-defined, and carefully measured environmental pathogen (Moffitt, Caspi, & Rutter, 2006; Rutter et al., 2006). (See Rutter et al., 2006, for a description of the remaining distinct forms of gene–environment interplay and a discussion of how G × E differs from other forms of gene–environment interplay.) In G × E, environmental experiences moderate genetic effects (or vice versa) on normal, psychopathological, and resilient developmental outcomes. For example, genetic effects on functioning outcomes may be observed only under certain environmental contexts or in conjunction with different histories of experience; conversely, experience may only relate to outcomes among individuals with specific genetic characteristics.

Advances in molecular biology and molecular genetics, including the completion of the DNA sequencing of the human genome (Collins, Morgan, & Patrinos, 2003; Cowan, Kopnisky, & Hyman, 2002) and the publication of the map of human haplotypes that provides valuable information about individual genetic variation (Crawford & Nickerson, 2005; Insel & Quiron, 2005), have helped to engender renewed interest in the contribution that studies on G × E can make to unraveling the complex pathways to normality, psychopathology, and resilience (Cicchetti & Blender, 2006; Kendler & Prescott, 2006; McGuffin, Riley, & Plomin, 2002; Plomin & Crable, 2000; Plomin, Rende, & Rutter, 1991; Plomin & Rutter, 1998; Rutter, 2006). As Rutter et al. (2006) eloquently articulated: "an understanding of the complexities involved . . . may also help in avoiding misleading types of biological reductionism and stigma, whilst at the same time emphasizing the importance of genes in all risk and protection pathways" (p. 252). (See also Curtis & Cicchetti, 2003, and Hinshaw & Cicchetti, 2000, in this regard.)

The empirical contributions of a molecular genetic approach, which enable us to discover the genetic elements that contribute to the development of mental disorders without requiring foreknowledge of the underlying biochemical abnormalities, make the search for the intermediate developmental mechanisms in the gene–environment–behavior interconnection more accessible than ever before (Gottesman & Gould, 2003; Gottesman & Hanson, 2005; Hanson & Gottesman, 2007; Moffitt et al., 2006). Moreover, progress in molecular genetics raises hope of increasing our understanding not only of normality, psychopathology, and resilience, but also of developing interventions to prevent and remediate mental disorder and to promote resilience (Cicchetti & Blender, 2006; Cicchetti & Curtis, 2006; Luthar & Brown, 2007; Luthar & Cicchetti, 2000; Luthar, Cicchetti, & Becker, 2000).

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Over a relatively short period of time, the discipline of developmental psychopathology has progressed from a field that predominantly focused on behavioral and psychological processes to one characterized by an increasing incorporation of genetic and neurobiological processes and their interdisciplinary interaction. This multiple levels of analysis perspective has contributed to an increased fidelity between the developmental systems theory concepts that undergird the field of developmental psychopathology and the empirical investigations undertaken (Cacioppo, Bernston, Sheridan, & McClintock, 2000; Cicchetti, 2002; Cicchetti & Blender, 2006; Cicchetti & Curtis, 2007; Gottlieb, Wahlsten, & Lickliter, 1993; Masten, 2007).

The papers in this Special Issue provide a variety of contributions that enhance the knowledge base of G×E. These contributions on G×E range from the historical, to the review of extant nonhuman primate and human psychopathology research, to the replication of critical G × E effects in an updated meta-analysis. A number of different genes are examined in empirical studies that address varying high-risk conditions (e.g., child maltreatment, speech sound disorder, temperament quality, low socioeconomic status) and mental disorders (e.g., depression, anxiety, internalizing and externalizing problems, attention-deficit/hyperactivity disorder, incarcerated youth, substance use). In addition, a number of developmental periods are represented, spanning infancy to adulthood. Finally, although the level of analysis predominantly focuses on the individual, the family system is also utilized as the unit of analysis.

Taken together, the articles in this Special Issue add substantially to the growing literature on G × E. All of these studies share in common a strong developmental theoretical framework, clear testable hypotheses, and the inclusion of well-defined environmental pathogens. G × E research has witnessed a range of reactions, from enthusiasm to skepticism, in the scientific community. To the credit of researchers conducting G × E investigations, careful and respectful attention has been paid to the concerns raised by scientists who have expressed doubts about the paradigm and its utility for advancing research in the field of developmental psychopathology. Clearly, continued work must be conducted before we will learn the ultimate fruits of G × E for understanding psychopathology and for translating the research into the development and implementation of timely interventions to prevent psychopathology and to promote resilience. Given the excitement engendered by research utilizing the G × E paradigm, as well as the talented group of scientists who have embarked upon work in this area thus far, there is great potential for G × E research to transform our understanding of typical and atypical development throughout the course of epigenesis.

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