

## EDITORIAL

# Neural plasticity, sensitive periods, and psychopathology

DANTE CICCETTI

*University of Minnesota Institute of Child Development and University of Rochester Mt. Hope Family Center*

Neural plasticity is conceived as the ability of the brain to reorganize neural pathways that are based on new experiences encountered throughout the course of life span development (Huttenlocher, 2002). Neural plasticity can occur at multiple levels, including molecular changes, cellular alterations, shaping of neuronal structures and interconnections, and reorganization of functions (Cicchetti & Curtis, 2006; Kolb, 1995; Nelson, 1999; Stiles, 2008; Whitten, 2013). These observable changes in the neural substrate may be translated into changes observable at the behavioral level.

Mechanisms of plasticity are integral to the very anatomical structures of cortical tissue and cause brain development to be an extended malleable process (Cicchetti & Tucker, 1994a). These mechanisms of plasticity cause the brain's anatomical differentiation to be dependent on stimulation from the environment (Cicchetti & Tucker, 1984a). Thus, environmental experiences are considered to be critical to the differentiation of brain tissue (Black, Jones, Nelson, & Greenough, 1998; Greenough, Black, & Wallace, 1987). Sensitive periods are conceived as times during development when experience exerts a very strong influence on the brain and on behavior (Knudsen, 2004). It is during sensitive periods when experience is thought to instruct neural circuits to process or represent information in ways that are adaptive for the individual (Knudsen, 2004).

Advances in the study of neural plasticity and sensitive periods could be utilized as a model for hypothesizing about the genetic and biological underpinnings of psychopathology and resilience (Cicchetti & Curtis, 2006; Knudsen, 2004). Presently it is not known whether the difficulties displayed by individuals who have experienced significant adversity are irreversible or whether there are particular sensitive periods when it is more

likely that neural and behavioral plasticity will occur (Cicchetti & Blender, 2006). Moreover, it is not known whether some neural or behavioral systems may be more plastic than other neural or behavioral systems. Furthermore, it is not yet known whether particular neural or behavioral systems may be more refractory to change or have a more time-limited sensitive window when neural plasticity can occur.

Slightly over 20 years ago, Don Tucker and I coedited a Special Issue of *Development and Psychopathology* devoted to the topic of “Neural Plasticity, Sensitive Periods, and Psychopathology” (Cicchetti & Tucker, 1994b). This topic is revisited in this current Special Issue. Prior to the publication of the Cicchetti and Tucker Special Issue, the vast majority of the articles published in *Development and Psychopathology* were psychosocial in nature. The papers that appeared in the Cicchetti and Tucker Special Issue were multilevel and helped to usher in the multiple levels of analysis approach and the interdisciplinary focus that are now principles inherent to a developmental psychopathology perspective (Cicchetti & Dawson, 2002; Cicchetti & Natsuaki, 2014; Cicchetti & Toth, 2009).

In the interim 20 years, research on neural plasticity and sensitive periods/developmental timing has burgeoned (Knudsen, 2004; Kolb, 1995). The theoretical and empirical papers in this Special Issue are exemplars of the growth of theorizing and research on sensitive periods and neural plasticity. As knowledge in these areas continues to grow, findings can be translated into the design and implementation of interventions that are developmentally appropriate and that can contribute to reducing psychopathology and to promoting resilience.

## References

- Black, J., Jones, T. A., Nelson, C. A., & Greenough, W. T. (1998). Neuronal plasticity and the developing brain. In N. E. Alessi, J. T. Coyle, S. I. Harrison, & S. Eth (Eds.), *Handbook of child and adolescent psychiatry* (pp. 31–53). New York: Wiley.
- Cicchetti, D., & Blender, J. A. (2006). A multiple-levels-of-analysis perspective on resilience: Implications for the developing brain, neural plasticity, and preventive interventions. *Annals of the New York Academy of Sciences*, 1094, 248–258.
- Cicchetti, D., & Curtis, W. J. (2006). The developing brain and neural plasticity: Implications for normality, psychopathology, and resilience. In D. Cicchetti & D. J. Cohen (Eds.), *Developmental psychopa-*

Work on this Special Issue was supported by the Jacobs Foundation.

Address correspondence and reprint requests to: Dante Cicchetti, Institute of Child Development, University of Minnesota, 51 East River Road, Minneapolis, MN 55455; E-mail: [cicchett@umn.edu](mailto:cicchett@umn.edu).

- thology: *Developmental neuroscience* (Vol. 2, 2nd ed., pp. 1–64). Hoboken, NJ: Wiley.
- Cicchetti, D., & Dawson, G. (2002). Multiple levels of analysis. *Development and Psychopathology, 14*, 417–420.
- Cicchetti, D., & Natsuaki, M. N. (Eds.) (2014). Multilevel developmental perspectives toward understanding internalizing disorders: Current research and future directions [Special Issue]. *Development and Psychopathology, 26*(4, Part 2), 1189–1576.
- Cicchetti, D., & Toth, S. L. (2009). The past achievements and future promises of developmental psychopathology: The coming of age of a discipline. *Journal of Child Psychology and Psychiatry, 50*, 16–25.
- Cicchetti, D., & Tucker, D. (1994a). Development and self-regulatory structures of the mind. *Development and Psychopathology, 6*, 533–549.
- Cicchetti, D., & Tucker, D. (Eds.) (1994b). Neural plasticity, sensitive periods, and psychopathology [Special Issue]. *Development and Psychopathology, 6*, 531–814.
- Greenough, W., Black, J., & Wallace, C. (1987). Experience and brain development. *Child Development, 58*, 539–559.
- Huttenlocher, P. (2002). *Neural plasticity: The effects of environment on the development of the cerebral cortex*. Cambridge, MA: Harvard University Press.
- Knudsen, E. I. (2004). Sensitive periods of development of the brain and behavior. *Journal of Cognitive Neuroscience, 16*, 1412–1425.
- Kolb, B. (1995). *Brain plasticity and behavior*. Mahwah, NJ: Erlbaum.
- Nelson, C. A. (1999). Neural plasticity and human development. *Current Directions in Psychological Science, 8*, 42–45.
- Stiles, J. (2008). *The fundamentals of brain development: Integrating nature and nurture*. Cambridge, MA: Harvard University Press.
- Whitten, L. A. (2013). Translational neuroscience and potential contributions of functional magnetic resonance imaging (fMRI) to the prevention of substance misuse and antisocial behavior. *Prevention Science, 14*, 238–246.