Towards a Neurodevelopmental Model of Clinical Case Formulation

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- Neurodevelopment • Case formulation
- Fragile X Syndrome
- Pervasive developmental disorder • Endophenotypes

Rapid advances in molecular genetics and neuroimaging over the last 10 to 15 years have been a catalyst for research in neurobiology, developmental psychopathology, and translational neuroscience.[1] Methods of study in psychiatry are becoming sufficiently sophisticated to effectively investigate the biology of higher mental processes and complex forms of psychopathology.[2] These advances have the potential to add depth to our understanding of psychiatric symptoms and to facilitate more targeted interventions.

Rett syndrome and Down syndrome are examples of conditions thought of as being neurodevelopmental disorders:[3] disorders where the interaction of genes and the environment lead to the biochemical processes involved in pathologic development of the brain and central nervous system. However, aspects of almost all psychiatric disorders likely involve the interaction of multiple genes with environmental factors. Thus, schizophrenia, autism spectrum disorders, attention-deficit hyperactivity disorder (ADHD), Tourette's disorder, and bipolar disorder also can be approached from a perspective emphasizing the importance of neurodevelopment.

Historically, mental health professionals have used heuristic case-formulation models to help organize complex information about psychologic, interpersonal, and

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behavioral problems, and to guide the development of treatment plans.[4] A biopsychosocial formulation, particularly when applied through a developmental lens for children, can bring a rich perspective to the case. However, some cases lend themselves to an even more specific focus, that of the neurodevelopmental formulation, which also brings to bear genetic and neurologic information, which is becoming more readily available to the clinician because of rapidly advancing research in these areas.

A neurodevelopmental model of case formulation has not yet been clearly articulated. This is probably because of the enormous complexity inherent in explaining the relationship between genes and behaviors and our often nascent knowledge base, and skepticism about whether this type of formulation model could improve clinical practice in terms of accuracy, treatment, or cost. The goal of this article, which is written as a clinical case conference, is to begin to articulate a neurodevelopmental model of case formulation, to illustrate its value, and to explore the evolution of clinical psychiatry if this type of case formulation became standard practice.

TOWARDS A NEURODEVELOPMENTAL MODEL OF CASE FORMULATION: BRIDGING THE GAP BETWEEN GENES AND BEHAVIORS

Pennington[5] articulated a model of developmental psychopathology that offers an organizing framework for examining critical elements in neurodevelopment. This framework traces four levels between genes and behavior. Level 1, Etiology, is concerned with the genetic and environmental influences and the role they play in the development of symptoms and disorders. Level 2, the Brain and Central Nervous System, includes development of the neuroarchitecture of the brain. In this model, Level 3, Neuropsychology, performs a "bridging" function between the internal and external manifestations of psychopathology through the use of noninvasive assays of brain functioning, such as neuropsychologic tests. Level 4, Symptoms, consists of observable behaviors. During development, interactions between these four levels are continuous, bi-directional, and interactive.[6] In considering schizophrenia research, Tandon and colleagues[7] suggest that pathophysiology, including neurochemical alterations in brain regions, should be considered as part of Level 2, and that the Symptoms level should be expanded to include treatment. See **Fig. 1** for a schematic diagram of this model. The authors propose that the practice of clinical psychiatry can

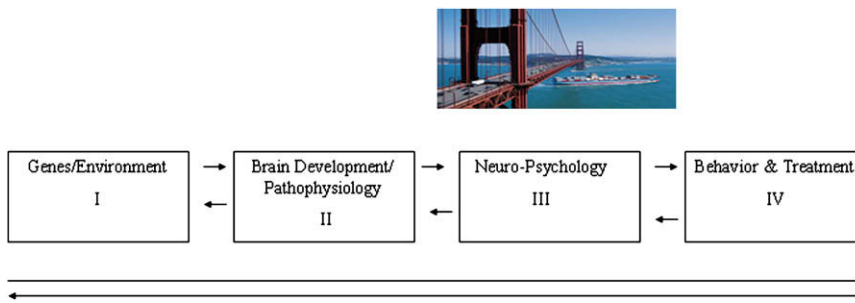

Fig. 1. Four levels in a neurodevelopmental model. (*Adapted from* Pennington BF. The development of psychopathology. New York: Guilford; 2002; and Tandon R, Keshavan, MS, Nasrallah, HA. Schizophrenia, "just the facts," what we know in 2008. 2. Epidemiology and etiology. Schizophr Res 2008;102:1–18; with permission.)