Chapter 2
Neuropsychological Development and Assessment From Infancy to Adolescence

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ABSTRACT

Significant changes in developmental, cognitive, linguistic, affective, and behavioural domains characterise the continuous process of neuropsychological development from birth to adolescence. This chapter focusues on the stages of neuropsychological development from birth to adolescence outlined in Jean Piaget's Cognitive Development Theory (1936), as well as major contributions in the field by Lev Vygotsky and Alexander Luria. In addition, it describes how some well-known neuropsychological disorders, such as attention-deficit/hyperactivity disorder (ADHD), autism spectrum disorder (ASD), and intellectual disabilities, including Down syndrome can be diagnosed using the milestones of typical child development found in the Cognitive Development Theory. The chapter discusses important factors to consider when deciding whether interventions would be suitable for children with cognitive difficulties.

NEUROPSYCHOLOGICAL DEVELOPMENT FROM INFANCY TO ADOLESCENCE

Neuropsychology as a science has traditionally focused on studying the nervous system's mechanisms and how they relate to cognitive and behavioural functions, such as motor skills, attention, perception, memory, language, as well as their dysfunction in cases of brain injury (Téllez & Sanchez-Jauregui, 2016). Developmental neuropsychology is an interdisciplinary field that brings together the domains of developmental psychology and neuroscience. It looks at how behaviour and brain function relate to one another during the span of a person's life, with a focus on childhood and adolescence, when most of the brain growth takes place. Child development is a continuous process marked by significant changes in

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physical, cognitive, linguistic, socioemotional, and behavioural areas from birth to adolescence (Megari & Miliadi, 2024; Berk, 2013; Hollister Sandberg & Spritz, 2010).

This chapter looks at the main theories of neuropsychological development in childhood and adolescence, such as Piaget's Cognitive Development Theory (Piaget, 1936), Vygotsky's Sociocultural Theory of Cognitive Development (Vygotsky, 1978), and Luria's model of the functional units of the brain (Luria, 1974). In addition, it provides an overview of the main assessment tools and batteries used to measure various functions and abilities in children (Tjossem, 1976). Finally, the chapter looks at some criticisms on Piaget's theories, such as overestimating adolescence's abilities while underestimating infants' capacities, overlooking the importance of cultural and social factors on cognition development, restrictions over the stages taking into consideration variability within and between individuals (intraindividual and interindividual variance) (Megari & Miliadi, 2024).

During the 1930s Jean Piaget's theory on cognitive development provided one of the first models explaining how cognition develops with age. His work, even though not directly linked to brain function and neuroscience, laid the ground for linking neurobiological changes with developmental milestones (Piaget, 1936). During the same period, Vygotsky's Sociocultural Theory highlighted the interconnections between biological and sociocultural factors in cognitive development, the importance of social interactions and how learning is culturally-dependant (Vygotsky, 1978). His Zone of Proximal Development (ZPD) outlining the difference between a child's 'actual developmental level as determined by independent problem solving and the child's potential development as determined through problem solving under adult guidance or in collaboration with more capable peers' influenced assessment of children with intellectual disabilities and neuroplasticity of the cognitive system (Rutland & Campbell, 1996; Vygotsky, 1978). Luria has been credited as the founding father of neuropsychology (Akhutina & Pylaeva, 2011), with his systemic and dynamic views of the brain shaping the field of clinical neuropsychology. His methods, such as syndrome analysis, became essential tools in neuropsychological assessment and rehabilitation (Solovieva & Quintanar Rojas, 2018). His focus on children contributed to the recognition of developmental neuropsychology as a distinct area (Akhutina & Pylaeva, 2011). Luria's work led to the development of standardised tools like the Luria-Nebraska Neuropsychological Battery, which was adapted for children (Crenitte et al, 2011; Myers et al, 1989).

Today, advancements in neuroscience and neuroimaging have significantly enhanced our understanding of how the brain works and adapts, of child development, and has provided detailed insights into the structural and functional maturation of the developing brain. Magnetic Resonance Imaging (MRI) and functional MRI (fMRI), electroencephalography (EEG) provide images of brain anatomy, record brain activity and allow mapping the emergence of neural networks involved in cognitive and emotional processing during childhood and allow identifying deviations associated with neurodevelopmental disorders on infants and children (Lautarescu et al, 2024; Yen et al, 2023; Wedderburn et al, 2020). These technological advancements have deepened our understanding of typical child development but also contributed to the early diagnosis and intervention strategies for various neurodevelopmental disorders.

Generally, clear communication and a child-centered, age-appropriate approach are the fundamental aspects of pediatric neuroimaging research. The age of a pediatric participant should have a significant impact on the research protocol for pediatric imaging (Raschle et al., 2012). Children in preschool may participate in structural and functional neuroimaging studies, where the child must be awake and alert while performing a certain perceptual or cognitive task. Infants are typically enrolled in studies of brain structure or resting state fMRI, which are performed while the participants are asleep. fMRI techniques have been successfully applied in awake infants, but report a very high attrition rate (Raschle et al., 2012). Al-