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# Cerebellar-Subcortical-Cortical Systems as Modulators of Cognitive Functions

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## Abstract

Over the past few decades, research has established that the cerebellum is involved in executive functions; however, its specific role remains unclear. There are numerous theories of cerebellar function and numerous cognitive processes falling under the umbrella of executive function, making investigations of the cerebellum's role in executive functioning challenging. In this review, we explored the role of the cerebellum in executive functioning through clinical and cognitive neuroscience frameworks. We reviewed the neuroanatomical systems and theoretical models of cerebellar functions and the multifaceted nature of executive functions. Using attention deficit hyperactivity disorder and cerebellar tumor as clinical developmental models of cerebellar dysfunction, and the functional magnetic resonance imaging literature, we reviewed evidence for cerebellar involvement in specific components of executive function in childhood, adolescence, and adulthood. There is evidence for posterior cerebellar contributions to working memory, planning, inhibition, and flexibility, but the heterogeneous literature that largely was not designed to study the cerebellum makes it difficult to determine specific functions of the cerebellum or cerebellar regions. In addition, while it is clear that cerebellar insult in childhood affects executive function performance later in life, more work is needed to elucidate the mechanisms by which executive dysfunction occurs and its developmental course. The limitations of the current literature are discussed and potential directions for future research are provided.

**Keywords:** Attention; Attention deficit hyperactivity disorder; Brain tumor; Cerebellum; Cognitive flexibility; Executive functions; Inhibition; Planning; Processing speed; Working memory.