The following synopsis summarizes an article which appeared in the August, 2003 issue of Scientific American. The article is 7 pages in length and can be obtained through Scientific American, Inc., 415 Madison Avenue, NY, NY 10017-1111.

Rethinking the Lesser Brain

By James Bower? and Lawrence Parsons?

Located upon the brain stem is a small mass of brain tissue that scientists have rigorously studied, attempting to explain its purpose for over four decades. Scientists have revealed that this mysterious area, the cerebellum, not only plays an important role in controlling movement but also contributes to a variety of activities not related to movement. Cognitive neuroscience has found the cerebellum may play an imperative part in short-term memory, attention, impulse control, emotion, higher cognition and the ability to schedule and plan tasks. There is a growing amount of research suggesting that the cerebellum may be more involved with sensory input than motor output.

Further evidence regarding the importance of the cerebellum has been documented by experiments involving people that have had cerebellar damage. Jeremy Schmahmann of Massachusetts General Hospital found that patients that have had cerebellar damage had difficulties regulating their emotions. These patients, which included both children and adults, were either unable to react or overreacted to a stimulus. Other research has shown that people with cerebellar damage have problems with spatial reasoning tests; they have problems determining whether the shapes of objects seen from different views match. Rod Nicolson, a researcher at Sheffield University in England found a link between people that have cerebellar damage and dyslexia. Dyslexics and people with cerebellar damage have similar difficulties with learning. It was found that dyslexics have reduced cerebellar activity, which would suggest an abnormal cerebellum could be the root cause of why people have spelling, reading and writing difficulties.

Dyslexia is not the only learning difficulty an underdeveloped cerebellum has been linked to. In 2002, a study conducted by Xavier Castellanos and Judith Rapoport and the National Institute of Mental Health found that children with ADHD had a cerebellum that was smaller in size compared to children without ADHD. Children with ADHD usually have a lack of impulse control, which has been cited as one of the key symptoms of having an underdeveloped cerebellum. Concurrent with that theory, Jordan Grafman and his co-workers at the National Institutes of Health noted that people with cerebellar problems had trouble with attention, impulse control, working memory, and mental functions such as planning and scheduling. If this is the case, individuals with an underdeveloped cerebellum could suffer from learning difficulties such as dyslexia, dyspraxia or ADHD. If an underdeveloped cerebellum could be normally developed, it is possible that many of the key symptoms of learning difficulties, such as problems with short-term memory, acquisition of skills involved in language, reading and writing and attention problems could be reduced or eliminated.

Intensive study of the brain has led key researchers to believe the traditional motor control theory of the cerebellum is insufficient due to new evidence that the cerebellum is active during touch. A technique called micromapping recorded the electrical activity of small patches of neurons in the brains of rates as they were touched on various parts of their body. The cerebellum was activated during the tactile stimuli in a fractured structure on the touch map with various data coming in from different parts of the body. This supports that the cerebellum was comparing the sensory information coming from different parts of the body. A new hypothesis formed from that which involved the cerebellum s role in coordinating sensory data. To support the hypothesis, experiments involving human subjects were conducted by Peter Fox at the University of Texas Health Science Center. There was an intense cerebellar response when subjects used their fingers for evaluating sensory information. According to this research, the cerebellum plays a central role in processing sensory information rather than controlling movement.

The cerebellum appears to act as support structure for the rest of the brain. That support involves monitoring incoming sensory data and making continuous adjustments to how information is processed. On going research regarding the cerebellum s function will enable us to learn even more about the brain. If there truly is a link between an abnormal cerebellum and short-tem memory, cognition, and sensory integration among others, then the possibilities of remediation are endless.

The authors James Bowe?r and Lawrence Parsons? are both at the Researching imaging Center at the University of Texas Health Science Center in San Antonio.