Detecting violations of sensory expectancies following cerebellar degeneration: A mismatch negativity study

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Abstract:

Two hypotheses concerning cerebellar function and predictive behavior are the sensory prediction hypothesis and the timing hypothesis. The former postulates that the cerebellum is critical in generating expectancies regarding forthcoming sensory information. The latter postulates that this structure is critical in generating expectancies that are precisely timed; for example, the expected duration of an event or the time between events. As such, the timing hypothesis constitutes a more specific form of prediction. The present experiment contrasted these two hypotheses by examining the mismatch negativity (MMN) response in patients with cerebellar cortical atrophy and matched controls. While watching a silent movie, a stream of task-irrelevant sounds was presented. A standard sound was presented 60% of the time, whereas the remaining sounds deviated from the standard on one of four dimensions: duration, intensity, pitch, or location. The timing between stimuli was either periodic or aperiodic. Based on the sensory prediction hypothesis, the MMN for the patients should be abnormal across all four dimensions. In contrast, the timing hypothesis would predict a selective impairment of the duration MMN. Moreover, the timing hypothesis would also predict that the enhancement of the MMN observed in controls when the stimuli are presented periodically should be attenuated in the patients. Compared to controls, the patients exhibited a delayed latency in the MMN to duration deviants and a similar trend for the intensity deviants, while pitch and location MMNs did not differ between groups. Periodicity had limited and somewhat inconsistent effects. The present results are at odds with a general role for the cerebellum in sensory prediction and provide partial support for the timing hypothesis. (C) 2008 Elsevier Ltd. All rights reserved.

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