Intact Savings in Patients with Cerebellar Degeneration

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Introduction
When a visuomotor perturbation is introduced during a reaching task, good performance can be restored in one of two ways: visuomotor adaptation and the use of aiming strategies. Cerebellar ataxics show deficits in compensating for such perturbations, an effect attributed to impaired adaptation of an internal model by the damaged cerebellum. Although the impairment is limited to the adaptive process, ataxics do not commonly develop aiming strategies to correct for reach errors. Here we show that if cerebellar ataxics are provided with an arbitrary cue indicating the presence of a rotation, they are able to develop an aiming strategy to compensate for it. Moreover, upon encountering the rotation again ataxics recall this aiming strategy to show faster relearning.

Cueing Aiming Strategies

Previous Work
Large Rotations Induce Strategy Use and Savings

In an earlier study, we exposed college-aged participants to a 15° or 45° rotation, in a similar cued rotation trial paradigm. Only the 45° group showed a separation in the second rotation, presumably because participants became more skilled at switching and executing the aiming strategy.

Ataxics Reporting Aim

In a previous experiment, we probed explicit strategy use with a verbal report of aiming location. Cerebellar ataxics showed highly variable strategy use, raising the question of whether strategy development requires the cerebellum.

Strategy Use and Savings

Large Rotations Induce Savings in Patients with Cerebellar Degeneration

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Savings

Mean of all Cued and Uncued trial triplets – Both groups are able to switch between the two trial types, although the age-matched controls had a difficulty switching in the first rotation block. Additionally, Cued trials immediately following an Uncued trial tended to be less successful than Cued trials preceding an Uncued trial. This diminished in the second rotation, presumably because participants became more skilled at switching and executing the aiming strategy.

Hand angle for both trial types in the first rotation - When an arbitrary color cue is paired with a rotation, cerebellar ataxics are capable of using it to reduce errors to a mean level very similar to that of control participants.

Switching

All Switching Trial Triplets

Ataxics

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Aftereffects

First 5 Aftereffect Trials

Verbal Instructions: “Aim and reach directly for the target”

Aftereffects following rotation block - The expected aftereffect is small because adaptation will be centered around the aiming strategy, not the target. We only tested at the target location, however. This lead to an underpowered comparison of implicit adaptation between the two groups. We saw little difference between the first and second rotation block aftereffects, despite the second block having explicit instructions to reach directly for the target.

Summary

• Cerebellar ataxics do not typically employ aiming strategies even when prompted about aiming direction.

• Ataxics can use a cognitive strategy to achieve performance similar to that of controls if one is suggested.

• Ataxics are capable of developing an aiming strategy on their own if an arbitrary color cue is present.

• The contrast of strategy development across task conditions may be due to the role of the cerebellum in recognizing the current state of the motor system.

• Savings in visuomotor adaptation tasks can easily result from recall of a previously successful aiming strategy.

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