

Savings in human reaching is linked to feedback adaptation

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Savings has been described as the ability of healthy humans to relearn a previously acquired motor skill faster than the first time, suggesting that the learning rate in the brain could be adjusted when a perturbation is recognized. Alternatively, it has been argued that apparent savings were the consequence of a distinct process that instead of reflecting a change in the learning rate, revealed an explicit re-aiming strategy. Based on recent evidence that feedback adaptation may be central to both planning and control, we hypothesized that there existed a feedback adaptation component that could genuinely accelerate the learning in the context of force field. We used a standard velocity-dependent force field paradigm consisting of adaptation-washout-readaptation phases with two groups of healthy volunteers. Each group performed the task with a randomly assigned force field direction (clockwise or counterclockwise). First, we found that readaptation was faster, confirming the presence of savings. Second and most importantly, we demonstrate that the very first readaptation movement displayed the characteristics of better-adapted movements to the perturbation, in the absence of any anticipation or explicit cognitive strategy. Specifically, the first readaptation trial has smaller path length, and higher correlation between commanded and applied forces, compared to the first adaptation trial. Additionally, we verified that the late washout trials were statistically indistinguishable from the baseline trials, suggesting that deadaptation was complete. That is, the online corrections in the first readaptation trial carried imprints of feedback adaptation from the previous sessions without any explicit strategy. Thus the feedback-mediated component contributes to savings in human reaching adaptation. We conclude that feedback adaptation is a medium by which the nervous system can genuinely accelerate learning across movements.