Implicit motor learning, and more

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When our intended movements have unintended outcomes, the human motor system can quickly adapt future movements. Motor output is modified in a way such that motor errors, that is, the difference between the expected and the perceived consequences of any motor output, are reduced. Both explicit and implicit neural processes play key roles in adaptation. Explicit processes, such as the use of conscious strategies to counter a perturbation, can be quickly employed and allow for flexibility in rapidly changing conditions. Implicit processes on the other hand, such as the unconscious updating of internal models, arise slowly and allow for reliable, persistent changes in the motor system. When adapting reaching movements, implicit components of adaptation have been demonstrated to have an upper boundary in the amount by which they alter future movements, regardless of the size of the experienced perturbation [1]; that is, they are thought to be limited in scope. Here, we allow participants to adapt to small, consistent errors, and when they have done so, introduce further small errors. Consequently, we show that the proposed upper boundary on implicit adaptation can be overcome. We also show that the additional implicit learning observed is not caused by simply gradually increasing the perturbation to prevent explicit strategies. This suggests that while additional implicit adaptation is difficult to achieve during tasks with large, salient errors, and in tasks with slowly introduced errors, it may be achievable by evoking multiple distinct error correction steps.

Furthermore, we often find that principles of motor learning and adaptation are difficult to generalize to training and rehabilitation programs. A major contributing factor to this lack of generalizability is the simplicity of our research paradigms. Although simplifying movements is often necessary to properly control our experiments, they may not sufficiently represent the complexity of movements performed in everyday life. In future research projects, we plan to use virtual reality environments to design complex, yet well-controlled experimental paradigms. I will briefly discuss future directions in this line of research.

1. Bond KM, Taylor JA. Flexible explicit but rigid implicit learning in a visuomotor adaptation task. J Neurophysiol. 2015; doi:10.1152/jn.00009.2015