The Influence of Strategic Planning Processes on Learning an Internal Model De Novo

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The role of strategic planning processes in motor skill learning has gained considerable attention in recent years, finding that strategic processes play a bigger role than previous thought. However, much of what we have learned has been gleaned from the study of sensorimotor adaptation tasks. It has become increasingly clear that sensorimotor adaptation tasks may only tap into processes related to the recalibration of an existing internal model rather than studying how internal models are formed de novo. As such, there is a need to begin characterizing how strategic planning processes may influence de novo internal model learning. Here, I will present our recent work to establish a model task that requires people to learn a novel and arbitrary action-outcome mapping, which could be considered the elementary beginnings of an internal model for skilled action. First, I will establish what features of training afford acquisition of the novel action-outcome mapping, one that can be used for generalization — a hallmark of an internal model. Next, an open question is whether this capacity is the result of a strategic process or an implicit learning process (other than implicit recalibration). In a follow-up experiment, we attempted to control the influence of strategic processes on learning by limiting preparation during training. Two groups of participants, one with extremely short and one with modest preparation times, attempted to learn a novel action-outcome mapping over two weeks of training. We found that while the operation of strategic processes enhanced learning in the short-term, after two weeks of training, they ultimately had no effect on core features of an internal model: generalization, rapid feedback control, future-state planning, and the speed-accuracy trade-off function. These findings suggest that what we think of as an internal model, or at a minimum a visuomotor mapping, can be established automatically and implicitly. These results can be explained by a dual-process model where learning can arise either through a model-based simulation process (strategic) and a model-free process (implicit) whose relative contributions fluctuate over the course of training or task demands. Finally, once this visuomotor mapping is established, implicit recalibration processes appear capable of adapting the newly learned action-outcome association as long as the imposed perturbation does not require complete restructuring of the mapping. Taken together, the findings from this work suggest that we can study the role of different processes for de novo learning of a visuomotor mapping, as well as maintenance of the mapping once it takes hold. This model task may provide important insights into the fundamental principles of internal model formation and, perhaps, motor skill learning in general.