ADAPTATION TO PERTURBATIONS APPLIED IN THE LATTER HALF OF HUMAN REACHING MOVEMENTS Y. Matsuoka[1], M.K. Holden*[2], E. Bizzi[2], The Artificial Intelligence Lab[1] and Department of Brain and Cognitive Sciences[2], MIT, Cambridge, MA.

When human subjects are asked to make one continuous reaching movement to a target, they generate straight hand trajectory. When viscous force perturbations are applied, the movements are initially distorted towards the direction of the forces, however, the hand trajectories are shown to become straight with adaptation. Based on this finding, many models make an assumption that humans use spatial error signals relative to a straight line trajectory to correct their movements during adaptation. We show in this work that when the force perturbation is applied only to one part of a continuous movement, the hand trajectories are not necessarily straight even after adaptation.

Subjects were trained to make 20 cm long reaching movements in one direction. This reaching movement was shown to be straight before any force perturbation. The force field used for training had no perturbation for the first 8 cm of the movement and a velocity dependent perturbation for the last 12 cm of the movement. The initial exposure to this force field showed no distortion for the first 8 cm but was heavily distorted towards the direction of the force for the last 12 cm of the movement. After adaptation, the target was reached consistently at the end of the movement but the trajectory was not straight: The movement included compensation at the beginning of the trajectory where forces were not applied. The direction of this initial bias was to the opposite direction of the force perturbation which is experienced later in the trajectory. During the latter half of the movement, the trajectory was pushed back to the target by the perturbation forces, resulting in arched movements as a whole. This result makes a point that the correction of reaching movement is not necessarily based on the spatial error from a straight movement. Furthermore, distortion in the movement was observed for the areas where no perturbation was applied showing a generalization effect.

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