Directional preferences of arm movements: A window to factors influencing formation of multi-joint movements

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Tasks demonstrating biased performance are fruitful for distinguishing factors influencing movement formation. We used a free-stroke drawing task to study preferences in the selection of arm movement direction. The task required production of a series of strokes while selecting movement directions in a random order. Even though our instructions encouraged the uniform distribution of movement directions, subjects demonstrated consistent directional preferences, frequently producing strokes in some directions and avoiding some other directions. Factors causing the revealed preferences were studied through experimental manipulations and by exploiting the optimal control framework. Results suggest that the directional preferences emerged from a tendency to minimize active interference with interaction torque exerted at the subordinate joints due to leading joint motion. This interpretation points to minimization of neural effort for control of inter-segmental dynamics as a factor that influences formation of arm movements.