Eye–Hand Coordination of Symmetric Bimanual Reaching Tasks: Temporal Aspects

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Published in Experimental Brain Research, 203(2) 391-405, June 2010

Both synchronous and asynchronous coordination modes have been evidenced in bimanual movements, but psychology and motor control literatures seem to be inconclusive about what factors specifically drive these modes and when one is preferred over the other. The goal of the present study was to determine the relationship between visual feedback and the temporal symmetry/asymmetry of the two hand movements in symmetric bimanual reach movements by a systematic analysis of eye movements and their role in coordination. The coupling/decoupling of hand movements caused by the competing visual demands of each task was analyzed in a bimanual experimental paradigm in which the objects to be transported, tolerances of the placement targets, and inter-target distance were varied. The results show that although temporally symmetric until peak velocity, the extent of synchrony during the terminal phases of hand movements was significantly influenced by the visual demand associated with the experimental conditions. Four distinct eye–hand coordination patterns were identified, based on sequencing of hand movements and timing of gaze shifts from one target to another. These patterns significantly affected the kinematics of hand movements and the degree of temporal synchrony in terminal phases, thus stressing the importance of a rigorous analysis of eye movements in understanding the mechanisms of eye–hand coordination. When faced with competing visual demands, left hand guidance required more foveal visual information of the target, while right hand control could proceed until the terminal stages with the target in the peripheral field of view, thus indicating an asymmetry in the feedback requirements of the two hand systems when accuracy is critical.