EFFECTS OF VISION AND PRACTICE ON INTERSEGMENTAL DYNAMICS OF RAPID AIMING MOVEMENTS

Masashi Yoshida1, James H. Cauraugh2, and John W. Chow2
1Graduate School of Human Sciences, Waseda University, Tokorozawa, Japan,
2Department of Exercise and Sport Sciences, University of Florida, Gainesville, USA
Email: myoshida@fuji.waseda.jp

INTRODUCTION

Traditionally, motor learning/control research has focused on kinematic aspects of movements. Recent studies, however, demonstrated that an analysis of intersegmental dynamics could be a useful approach to examine the control mechanisms underlying multisegmental movements (e.g., Schneider et al., 1989). In many rapid aiming tasks found in sports and daily activities, individuals are required to move an object or implement to a specific location in space as “fast and accurately” as possible. Although intersegmental dynamics can be useful in studying rapid aiming movements, only limited attempts have been made. Thus, the purpose of this study was to determine how intersegmental dynamics of rapid aiming movements changes with practice, and as a function of vision.

METHOD

Six females and 14 males participated in this study. The task was a 90-cm rapid aiming movement involving motions at the shoulder, elbow, and wrist joints. Participants performed the task as “fast and accurately” as possible either with or without vision (FV vs. NV) for 28 blocks of 20 trials (i.e., 560 trials) in acquisition. Additionally, they completed two transfer tests under NV condition following 140 and 560 acquisition trials. Occlusion goggles manipulated vision and electromagnetic sensors captured limb movements.

At the shoulder and elbow, three moment profiles: (1) net joint moments (NJM), (2) motion dependent moments (MDM) and (3) generalized muscle moments (GMM), were calculated (Schneider et al., 1989). Average moments were then computed for the acceleration and deceleration phases.

Acquisition was divided into four phases and the first and last blocks of each phase were submitted into a 2 (Vision Condition) × 4 (Acquisition Phase) × 2 (Trial Block) ANOVA with repeated measures on the last two factors. In addition, each transfer test was compared with its preceding trial block using a 2 (Vision Condition) × 2 (Experimental Condition) ANOVA with repeated measures on the last factor. The alpha level was set at .05.

RESULTS AND DISCUSSION

In acquisition, significant main effects of acquisition phase and trial block were found for all moment profiles. To minimize movement time, magnitudes of moments increased with practice (Figure 1). Yet, a main effect of vision condition was not significant, indicating that on-line visual feedback was not critical in developing internal models of intersegmental dynamics.

In transfer, significant interactions between vision and experimental condition were found for all moment profiles of the acceleration phase at the shoulder in the second transfer test. Although vision had little impact on intersegmental dynamics during acquisition, vision removal in transfer resulted in a decrease in moments for FV participants. FV participants were highly accurate because of on-line vision. Therefore, they used this effective source of information to correct endpoint variability during practice. However, when on-line correction was impossible, they appeared to reduce limb dynamics so that less endpoint variability could be obtained. With respect to vision condition, participants used different control strategies to optimize performance, and thus the results supported the optimized submovement model (Meyer et al., 1988).

SUMMARY

Intersegmental dynamics of rapid aiming movements was examined with practice, and as a function of vision. Acquisition results showed that regardless of on-line vision, all moment profiles increased in magnitude with practice to move faster. Moreover, transfer tests revealed that vision removal led participants to reduce moments for accuracy. Findings indicated that rapid aiming movements were optimized by changing intersegmental dynamics depending on abilities to make effective error corrections.

REFERENCES