Motor Imagery in Postural Adjustments

L.A. Imbiriba\textsuperscript{1}, G. R. Leite\textsuperscript{1}, A. P. Fontana\textsuperscript{2}, E. C. Rodrigues\textsuperscript{1}, L.D. Facchinetti\textsuperscript{2}, E.S. Almeida\textsuperscript{2}, G.G.L. Souza\textsuperscript{2}, V. R. Rocha\textsuperscript{2}, D. F. Guimaraes\textsuperscript{3}, M.A.C. Garcia\textsuperscript{1}, J. Magalhaes\textsuperscript{1}, D.S.A. Gouvêa\textsuperscript{4}, L.F. Oliveira\textsuperscript{1}, C.T. Ferreira\textsuperscript{3} and C.D. Vargas\textsuperscript{2}.

\textsuperscript{1}Laboratory of Biomechanics, Federal University of Rio de Janeiro (UFRJ), RJ, Brazil. 
\textsuperscript{2}Laboratory of Neurobiology II of the IBCCFo, UFRJ, RJ, Brazil. 
\textsuperscript{3}Neurology Dept. of the University Hospital Clementino Fraga Filho, UFRJ, RJ, Brazil. 
\textsuperscript{4}Dept. of Electrical Circuits, Federal University of Juiz de Fora, MG, Brazil.

Introduction

Motor imagery consists in the mental representation of a given movement without producing any overt motor output. Motor images are thought to share the same neural mechanisms as those that are responsible for the preparation and programming of actual movements (Jeannerod, 1995), with minimal or no activation of the motor output. There is now ample evidence that motor imagery improves motor skill learning. This phenomenon has been attributed to the central reorganization of motor programs (Yue & Cole, 1992). In the present study we compare the time spent in the mental representation of a task that involves postural adjustment with that spent in the actual performance of the same movement. We also analyze the pattern of antero-posterior (AP) and medial-lateral (ML) body sway during the imagination and execution of the task.

Methods

The subjects in the experiment were 32 (22 male and 10 female) University students in Physical Education (age, 18-26 years). They were asked to stand up on a vertical force platform and instructed either 1) to stand up quietly during 20 s. (ST), 2) to imagine themselves executing a bilateral plantar flexion and return to the original position for 15 times (IM), 3) to execute the same movement for 15 times (EX), or 4) to count mentally from 1 to 15 (CO).

![Figure 1. Experimental conditions.](image)

Subjects were instructed to warn experimenters at the beginning and the end of each task. Task order was randomized in order to examine the effects of prior imagination or execution of the movement. ML and AP displacements of the center of foot pressure (CFP) were measured through a vertical force platform. LabView (National Instruments, Austin) and Matlab 5.2 (Math Works) were employed to perform data acquisition and analysis, respectively. Sampling was done at 200Hz. Quantitative analysis of the stabilometric signal was performed calculating the mean velocity (MV), peak frequency (PF) and the power in the frequency range (PFR) of the movement execution (±1Hz) along the ML and AP axes, as well as the elliptic area (EA) displacement of each subject’s CFP. Analysis of variance (ANOVA) and Tukey’s HSD post-hoc analysis were compared for the four experimental conditions.
Results & Discussion

Results show that, as previously described for other motor tasks (Decety et al., 1989; Sirigu et al., 1995), in subjects performing a new non-trained task that involves postural adjustments, the mean time spent in the IM condition is similar to that of EX (p=0.957, n.s.), differing significantly from ST and CO (p<0.001) (Figure 3). We observed, however, a substantial spread in the difference between the time spent in imagining and executing the movement, indicating a high inter-individual variability (figure 4). This variability could be due to the fact that the subjects were not previously selected on their ability for mental imagery nor previously trained on that task (Decety et al., 1989). Thus, subjects seemed to differ in their mental imagery ability. No significant effect of the sequence performance was detected upon the time spent in imagining or executing the movement (p=0.88, n.s., not shown). For all the analyzed stabilometric parameters, IM was similar to CO and ST (n.s.) and statistically different from EX (p<0.01), as can be seen in the example below (figure 5). Thus, no overt motor response, at least for the analyzed stabilometric parameters, was observed during the motor imagery of a movement that involves postural adjustments. Although the circuits responsible for the intended movement seem to be facilitated during motor imagery, the existence of an inhibitory mechanism that blocks execution has been postulated (reviewed in Jeannerod, 1995). This inhibition could by at play during the plantar flexion's mental representation, explaining the absence of any effect upon the analyzed stabilometric parameters.

![Figure 2. Example of a subject's CFP displacement. Task order: ST, EX, CO and IM.](image)

![Figure 3. Mean time spent per condition.](image)
Figure 4. Difference between the time spent in EX and IM.

Figure 5. Mean velocity of CFP in the AP direction. The same pattern was observed for all analyzed stabilometric parameters.

References

