Influence of the training schedule on intermanual transfer in the cart-pole balancing task

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Characters (excl. spaces): 2230 (max 2300)

INTRODUCTION:

A current topic in motor learning is how multiple learning and control mechanisms interact to produce overall improvement. In this study, we examined the intermanual transfer of control knowledge subsequent to different training schedules for the acquisition of the cart-pole balancing skill.

METHODS:

17 right-handed subjects have been examined in the computer-simulated cart-pole balancing task. Continuous lateral forces were applied to the cart by the subjects using a joystick-like device in order to balance a pole which is attached to the cart. Subjects trained for 90 minutes using their right hand and switched afterwards for 30 minutes to the left hand. We tested two training schedules for the right-handed training: (i) gravity was gradually (g_inc=0.1) increased after every successful trial starting on g_0=1.0m/s^2 up to a maximum level of g_max=3.5m/s^2; (ii) subjects started directly on the maximum gravity level (g_max). Trials were counted as successful, if the pole angle and cart position remained within the valid ranges for 30 seconds. In addition to trial success or failure, subjects received up to 10 points per second depending on the system state and applied force. During the post-training phase gravity was constant (g_max) and performance of left-handed control was examined.

RESULTS:

First analysis shows that subjects in group (ii) instantaneously transfer the balancing skill to the left hand and do not further improve (N=9, $p \approx 0.57$, paired). In contrast, subjects in group (i) still improve during the left hand examination (N=8, $p<0.01$, paired). Accordingly subjects in group (i) tend to be worse at the beginning of the left hand examination. We did not find a significant performance difference at the end of the right-handed training between groups. Comparing group (i)'s left hand performance with the right-handed training of group (ii) yields that even though group (i) is better at the very beginning (first 10 minutes, $p<0.05$, unpaired) the performances are similar after 30 minutes.

CONCLUSION:

Previous studies suggested (Obayashi 2004, Anguera 2007) that control knowledge might be shared between both hands. We hypothesize that the tested training schedules lead to the maintenance of different representations which allow intermanual transfer to a different extend. Brain imaging and stimulation techniques might provide further insight in which brain areas are involved and responsible for the representation in the tested conditions.

REFERENCES:

Obayashi S (2004), The Cerebellum 3 (4), pp. 204–211.

Anguera JA et al (2007), Brain Research 1185, pp. 136–151.