

( $F_{(1,76)} = 42.355$ ,  $p < 0.001$ ) and a significant interaction of time of measurement and mode of instruction ( $F_{(4, 318)} = 47.629$ ,  $p < 0.001$ ).

The presented results do not confirm our assumption. Verbal cues did not result in differential effects for either performance or internal representations. The differential effect of the mode of instruction on the development of performance and internal representations is remarkable.

#### Notes

<sup>1</sup> $\epsilon$ -corrected

#### References

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### The ambivalence of self-controlled (motor) learning: A model-guided psychological analysis

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Self-controlled learning (SCL) is a relative new topic in the field of motor learning and simply means that the learner has control over (at least) one aspect of the learning situation. Results of studies who typically compared a group of self-controlled learners to a yoked group of externally controlled learners, show that self-control, in fact, enhances the effectiveness of motor learning. Thus, there is some 'self-control effect' (Bund & Wiemeyer, 2005). However, this effect consistently occurs delayed: While both groups show similar performance during acquisition, the self-control group outperforms the externally controlled group in the retention test. To explain this delay of the self-control effect, a model was developed which contrast the cognitive and motivational processes of self-controlled learning and externally controlled learning. The basic assumptions of this model are:

1. Self-control learners have to organize their learning process by themselves. Therefore, their cognitive load is higher than the cognitive load of the externally controlled (yoked) learners.
2. Self-controlled learners are more intrinsically motivated than externally controlled (yoked) learners. This compensates the cognitive disadvantage and leads to similar acquisition scores of both groups.
3. In the retention test, self-controlled learners benefit from their individual learning during the acquisition phase and outperform their externally controlled counterparts.

The present study was conducted to evaluate the model.

*Participants:* 48 students, 32 men and 16 women ( $M = 23.5$  years), participated in this study. None of them had previous experience with the task, and all were naive as to the purpose of the experiment.

*Task and dependent variables:* The learning task was to throw a standard tennis ball to a 1x1m-target with the nondominant hand. Throwing form and throwing accuracy were the dependent measures.

*Experimental groups and procedure:* Participants were randomly assigned to one of four experimental groups: 1. Self-control (SC), 2. Yoked (YO), 3. Self-control + Training (SC+T), 4. Yoked + Training (YO+T). Participants of the SC groups determined autonomously the frequency of augmented feed-back. Prior to the experiment, subjects in the SC+T group took part in a special training with the objective to reduce the cognitive load during self-controlled learning. Both SC groups were paired with yoked groups. All participants completed two acquisition sessions (each with 100 throws), separated by an 1-day-interval and were then given a no-treatment retention test (20 throws) 4 days later.

According to the model, the SC+T group should outperform the yoked groups not only in the retention test but also (already) in the acquisition phase. *Throwing accuracy:* A 2 (control of learning) x 2 (training) x 20 (blocks of 10 trials) indicate that all groups enhanced their throwing accuracy during acquisition,  $F(19,836) = 4.36$ ,  $p < 0.05$ ,  $\eta^2 = 0.06$ . However, the effects of control of learning,  $F(1,44) < 1$ , and training,  $F(1,44) < 1$ , were not significant. Analysis of retention data yielded a significant effect of control,  $F(1,44) = 5.37$ ,  $p < 0.05$ ,  $\eta^2 = 0.08$ , with the SC groups showing more accurate throws than the YO groups. The effect of training was not significant,  $F(1,44) < 1$ . *Throwing form:* All groups improved clearly their throwing form during acquisition,  $F(19,836) = 17.26$ ,  $p < 0.001$ ,  $\eta^2 = 0.21$ . Again, the main effects were not significant, both  $F(1,44) < 1$ . Across retention, the form scores of all groups were similar, i.e., the effects of control and training were not significant, both,  $F(1,44) < 1$ . Due to the fact that the SC groups were (partly) superior to the YO groups in the retention test, the results of this study verify prior research. However, the SC+T group did not show better acquisition performance than the other groups, which is contradictory to our model. Possible reasons are discussed in the presentation.

#### References

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