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Evaluation of an Antagonistic Modell of Self-Controlled Skill Learning

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TABLE 1. Results of studies of self-controlled practice

Study	Advantage of SC over Yoked?	
	Acquisition	Retention
Titzer, Shea & Romack (1993)	Yes	Yes
Chen, Hendrick & Lidor (1993)	No	Yes
Janelle, Kim & Singer (1995)	No	Yes
Janelle et al. (1997)	No	Yes
Wiemeyer (1997)	No	No
Wulf & Toole (1999)	No	Yes
Wulf et al. (2001)	No	Yes
Chiviakowsky & Wulf (2002)	No	No
Wrisberg & Pein (2002)	No	Yes
Bund & Wiemeyer (2004)	No	Yes
Wulf, Raupach & Pfeiffer (2005)	No	Yes

Introduction

⇒ Self-controlled learning (SCL) is a relatively new topic in the field of motor learning.
⇒ SCL means here that the learner has control over (al least) one aspect of the learning situation.
⇒ Typically, in the studies one group of self-controlled learners (SC) is compared to a paired group of externally controlled learners (Yoked).
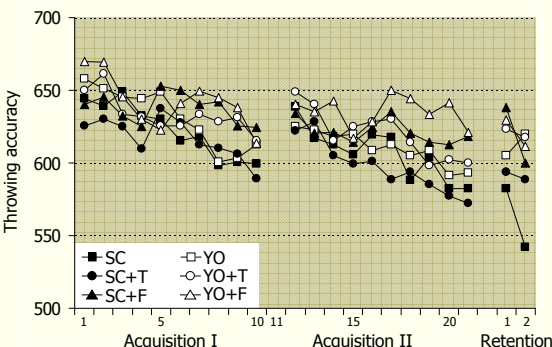
⇒ The results of these studies indicate that self-control enhance the effectiveness of motor skill learning. Thus, there is some "self-control effect".
⇒ However, this effect consistently occurs delayed, i.e., in the retention tests (see TABLE 1).
⇒ Previous explanations of the self-control effect have been adapted from the verbal or cognitive learning domain and refer to cognitive (e.g., use of individual learning strategies, deeper processing of information) and/or motivational processes (e.g., intrinsic motivation, perception of self-efficacy).
⇒ However, none of these explanations are able to affirm why the effect typically occurs with a delay. Thus, they are deficient.

FIGURE 1. An antagonistic model of self-controlled learning

⇒ The antagonistic model trys to explain the empirical findings by comparing the cognitive and motivational processes of self-controlled learning and externally (yoked) controlled learning (see FIGURE 1).
⇒ The basic assumptions are:
1. Self-controlled learners have to organize their learning process by themselves. Therefore, their cognitive load is higher than the cognitive load of the externally controlled learners.
2. Self-controlled learners are more (intrinsically) motivated than externally controlled learners. This compensates the cognitive disadvantage and leads to an analogue acquisition performance of both groups.
3. In the retention test, self-controlled learners benefit from their individual learning during the acquisition phase and outperform their yoked partners.

TABLE 2. Experimental groups and their treatment

Group	Treatment
1. Self-Control [SC]	Control over KP
2. Yoked [YO]	Externally controlled KP based on the KP regimes in the SC group
3. Self-Control + Training [SC+T]	Control over KP + training of learning strategies
4. Yoked + Training [YO+T]	Externally controlled KP based on the KP regimes in the SC+T group + training of learning strategies
5. Self-Control + Negative feedback [SC+F]	Control over KP + negative performance feedback
6. Yoked + Negative feedback [YO+F]	Externally controlled KP based on the KP regimes in the SC+F group + negative performance feedback

Method

⇒ Participants
Participants were 72 students (44 men, 28 women; M = 23.5 years) of the University of Technology (Darmstadt, Germany).
⇒ Task and dependent variables
The learning task was to throw a standard tennis ball to a 1x1m-target with the non-dominant hand (see FIGURE 2). Throwing form and throwing accuracy were the dependent measures.

FIGURE 2. Learning task

Target (1x1 m)
Throwing lane (9 m)

FIGURE 3. Experimental procedure

Acquisition I 10 x 10 — 1 day — Acquisition II 10 x 10 — 4 days — Retention 2 x 10

⇒ Experimental groups
Participants were randomly assigned to one of six groups (see TABLE 2). To reduce the cognitive load of self-controlled learning, participants in the SC+T group complete a training of learning strategies. According to the model, the SC+T group had to outperform all other groups already during the acquisition phase. To cancel the motivational benefit of self-control, participants in the SC+F group received negative feedback during the acquisition. The model postulates that this group shows worse performance than the other SC groups. All SC groups were paired with yoked groups.

⇒ Procedure
All participants completed two acquisition sessions, separated by an 1-day-interval and were then given a no-treatment retention test 4 days after the second acquisition session (see FIGURE 3). Each acquisition session consisted of 100 throws which were divided into 10 blocks. The retention test consisted of 20 throws.

FIGURE 4. Throwing accuracy for all experimental groups

Results and discussion

⇒ Request of KP
Participants in the SC group requested KP on only 4.3% of the total acquisition trials. Participants in the SC+T and SC+F group asked for KP on 6.5% and 4.6% of the acquisition trials. Analysis (ANOVA) revealed a significant mean effect of Group, $F_{(2,33)}$ = 5.13; $p < .05$, $\varepsilon = 0.56$.
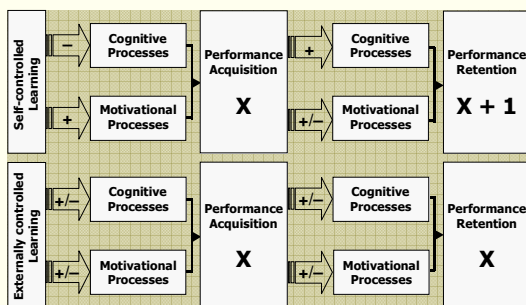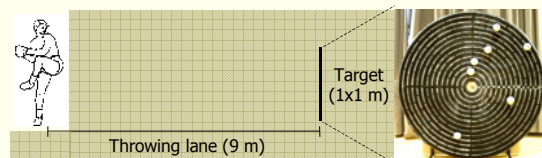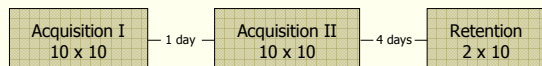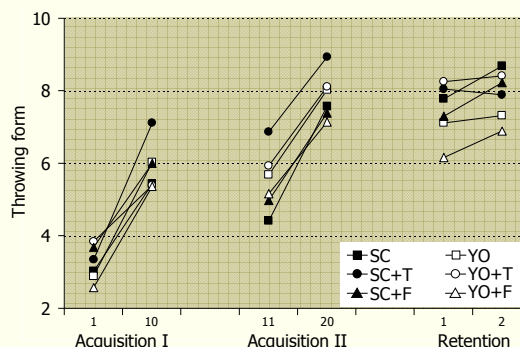
FIGURE 5. Throwing form for all experimental groups

⇒ Throwing accuracy (FIGURE 4):
Analysis (MANOVA) of the throwing accuracy scores during acquisition yielded a significant main effect for Groups, $F_{(5,66)}$ = 2.11; $p < .05$, $\varepsilon = 0.40$. Post hoc-tests (Scheffé) revealed that participants in the SC+T did not (as expected) demonstrate superior accuracy ($p > .05$). However, participants in the SC+F group performed (as expected) significantly worse compared to the participants in the other SC groups ($p < .05$). Thus, relating to throwing accuracy the predictions of the antagonistic model were partially accurate.

⇒ Throwing form (FIGURE 5):
Analysis (MANOVA) of the throwing form scores during acquisition yielded a significant main effect for Groups, $F_{(5,66)}$ = 1.95; $p < .05$, $\varepsilon = 0.38$. As expected, post hoc-tests revealed that participants in the SC+T group outperformed participants of all other groups ($p > .05$). However, subjects in the SC+F group did not (as expected) perform significantly worse than subjects in the other SC groups ($p < .05$). Again, the predictions of the antagonistic model were partially accurate.

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