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The Effect of Subject-Oriented and Experimenter-Imposed Feedback Schedules on Skill Acquisition in Children

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Abstract: Though it is common coaching practice to provide augmented feedback after Poor performances, recent literature suggest that allowing individuals to receive Feedback when they request it (a self-controlled schedule) enhances motor learning. The purpose of this study was comparison between effect of feedback after good, poor, good-poor trials and self-control Condition In acquisition and learning of force production task. To achieve this goal, 40 subjects (21 men, 19 women) with mean age of 10.5 years were divided into four groups of feedback after good, poor, good-poor trials and self – control feedback group. All four groups produced 10 kg force in 12 blocks of 6 trials (12×6). All participants received knowledge of results (KR) on two trials in each 6-trial block. While one group (KR good) received KR for the two most effective trials, another (KR poor) received KR for the two least effective trials, third group received KR for one most effective and least effective trials and self control group was provided with feedback whenever they requested only for three trials. We use two-way ANOVA in acquisition stage and one way ANOVA in retention test. There were no group differences in acquisition phase. However, the KR good group showed learning advantages on a delayed retention test. And the good group has better performance than self-control condition group. This result indicated that in experimenter control condition, learning is facilitated if feedback is provided after good trial rather than poor or good-poor trial. Also feedback schedule based on coach oriented method is more effective than subject oriented method. The finding is interpreted as evidence for a motivational function of feedback. Overall, we can conclude that given feedback after good trial is very effective for skill learning. Hence, this approach can be used as a best method of given feedback for athletes and coaches.

Key words: Challenge Point · Self-Control · Knowledge Of Result

INTRODUCTION

One goal of motor learning research is to identify factors that optimize the acquisition of motor skills and in doing so, to better understand the underlying processes that influence the learning process. Although many factors have been shown to be important for motor learning, feedback schedule is a particularly powerful variable [1].

Recently however, the learning advantages demonstrated by individuals controlling a portion of their practice context have rejuvenated a theoretical interest in further understanding the processes facilitating motor skill acquisition. It has been suggested that giving learner control of the practice regimen might increase their motivation, promote the use of self-regulation strategies and encourage them to take charge of their learning process. Researchers suggested that self-control

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feedback might result in more effective learning, because it encourages learners to explore different movement strategies to a greater extent than practice without self-control [2, 3].

Chiviacowsky *et al*. [4] examine the effects of different self-selected feedback frequencies on motor learning in 10-year-old children. Participants who requested relatively little feedback (i.e., less-KR group: 8.4% KR) clearly showed less effective learning than those who asked for feedback more frequently (i.e., more-KR group: 39.3% KR). They used the task Similar to the study by Chiviacowsky *et al*. [5].

According to Chiviacowsky and Wulf [2] study, self-control participants requested KR more frequently after relatively successful trials, compared to poor trials, as indicated by the higher accuracy on KR relative to no-KR trials. The interviews (with adults) conducted by Chiviacowsky and Wulf [2] indicated that participants-both self-control and yoked-clearly preferred to receive KR after good trials. Interestingly, the adult participants in their study [2] and the children also chose KR more often after good trials [5]. Thus, self-controlled learners appeared to ask for KR primarily to confirm they were on the "right track." It also indicates that learners-both adults and 10-year-old children-had a relatively good "feel" for how they performed on a given trial. This results only inferred by interview without any experimental study [5]. So, some studies demonstrate that feedback schedules including some form of self-control enhance the learning of motor skills in children [4]. Other studies inferred children who received feedback after good trials maybe KR after "good" trials resulted in more effective learning compared to KR provided after "poor" trials [5- 7]. In other hand, given feedback after good trials increase the learner motivation and after poor trial reinforce the informational aspect of feedback. Then if learner receives feedback on good and poor trials, he can impart from motivational and informational aspects of feedback [2, 6, 8, 9].

The self-control benefits for learning appear to be a robust phenomenon. However, previous studies have exclusively used adults as participants. Thus, it is unclear whether the effects of this variable generalize to different motor development levels. An interesting question is whether children would also benefit from feedback after good trials. A potentially limiting factor in generalizing this effect to children lies in their information-processing capabilities [10]. A number of studies suggested there are differences between children and adults in their capability to process information [11, 12]. According to Connolly [13, 14], changes in motor development during childhood can be attributed to two classes of variables [15]. The first refers to "hardware" changes that occur as a function of growth. This includes such physical changes as increased strength and height as well as central nervous system changes, all of which are considered structural. The second is related to "software" changes and pertains to improvements in the capacity to use the structures. These are considered cognitive and they occur as a consequence of developing processing-information capabilities [14, 16, 17].

Previous studies used beanbag-toss task that were performed with the non-dominant hand [5]. Participants in the present study practice force production task. This task is more difficult than toss beanbag. Hence, coaches need to find the most effective way for given feedback to learner, the purpose of the present study was the effect of feedback after good, poor, good-poor trials and higher frequency of self-control condition in acquisition and learning of force production task in children.

MATERIALS AND METHODS

Participants: Forty undergraduate students (21 boys, 19 girls; mean age=10.5 years, SD=2.0, range=8–12) voluntarily participated in this experiment. Prior to participating in the experiment, informed consent was provided by parental and child assent were obtained for the children who participated. They had no prior experience with the experimental task and were not aware of our specific study purpose.

Apparatus and Task: We use a force production task (Dinamometr) in order to collect data. This apparatus (TYPE ED-100N, CLASS-1.5 and NO.3E7) consist of a dial and a handle that subject pressed it in order to produce a criterion force. This device shows the amount of force produced to 100 kilograms by the claws.

Procedure: Participants were randomly assigned to the “KR good”, “KR poor”, “KR good-poor” and “self-control”, with 10 subjects in each group. All four groups produced 10 kg force in 12 blocks of 6 trials (12×6). All participants received knowledge of results (KR) on two trials in each 6-trial block. While one group (KR good) received KR for the two most effective trials, another (KR poor) received KR for the two least effective trials, third group received KR for one most effective and least effective trials and self-control group was provided with feedback whenever they requested only for three trials. KR was written on a board and presented for 10 s. it consisted of the trial number and produced force. A digital chronometer was used to control the timing of the trials and KR presentation. All participants performed 72 trials during the practice phase and 1 day after practice they performed a retention test consisting of 12 trials without KR. Absolute constant error and variable error were calculated for each of these trial blocks and constituted the dependent variables for analysis. Previous research enabled generation of distinct hypotheses for the variable error analyses (Lee & Carnahan, 1990; Sherwood, 1988), but the analyses involving absolute constant error were only included for exploratory purposes.

Data were analyzed in 4 (group) × 12 (blocks of 6 trials) analysis of variance (ANOVA), with repeated measures on trial block were conducted for both variable and absolute constant error for acquisition data. Retention data were analyzed using a one-way ANOVA, again for both variable and absolute constant error. The data analysis was performed using SPSS (16) and the probability level was set at 0.05 for results to be regarded as significant.

RESULTS

Acquisition

Variable Error: The two-way ANOVA yielded a main effect of trial block, $F\ (12, 484) = 120.65$, $p<0.05$, $\eta^2=0.73$. Neither the main effect of group, $f\ (3, 24) = 1.7$, $p>0.05$, nor the Group × Block interaction, $f\ (33, 484) = 0.51$, were significant. Means and standard deviations for the interaction and main effect are presented in Table 1.

Absolute Constant Error: The two-way ANOVA elicited only a main effect of trial block $F\ (11, 484) = 91.93$, $p<0.05$, $\eta^2=0.73$. The first block of trials (M= 2.88, SD=0.86) had a significantly larger response bias than other blocks. No other effects were statistically significant.

Retention

Variable Error: The two-way ANOVA yielded a significant group effect, $F\ (3, 47) = 10.8$, $p<0.05$, $\eta^2=0.3$. The means and standard deviation for these significant effects are presented in table 2. Follow-up pairwise comparisons (Tukey's HSD) revealed that participants in the KR good and self-control condition performed more consistently than any other group, $p < 0.05$.

Absolute Constant Error: No statistically significant effects were found.

DISCUSSION

The present study examined the effects of performance-determined and self-controlled feedback schedules on the learning. The present results showed a learning advantage if feedback was presented after trials with relatively small errors, or high accuracy scores (KR good), compared to trials with relatively large errors, or low accuracy scores (KR poor group). The finding showed self-controlled and good trials groups had better performance than other groups. There seems to be evidence that the main benefit of self-controlled feedback and feedback after good trials may be motivational. We can conclude that motivation is a very important factor in motor learning. Weinberg and Jackson [9, 17] gave participants false success or failure feedback for their balancing ability, success feedback enhanced intrinsic motivation and failure feedback had the opposite

Table 1: variable error scores in acquisition for the feedback condition by trial blocks interaction and trial blocks main effect

	Trial blocks																							
	1		2		3		4		5		6		7		8		9		10		11		12	
Feedback condition	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
KR good	2.65	.35	2.29	.46	1.84	.41	1.37	.18	1.45	.09	1.47	.09	2.6	.35	2.45	.45	1.84	.45	1.37	.16	1.49	.17	2.73	.35
KR poor	2.72	.41	2.37	.32	2.25	.66	1.67	.39	1.43	.15	1.43	.15	2.76	.42	2.57	.33	2.25	.57	1.67	.28	1.56	.29	2.76	.41
KR good-poor	2.64	.46	2.50	.44	2.17	.25	1.67	.39	1.67	.25	1.67	.27	2.73	.45	2.39	.45	2.17	.25	1.67	.37	1.76	.37	2.71	.46
Self-control	2.63	.31	2.29	.51	1.87	.32	1.66	.45	1.55	.16	1.55	.16	2.57	.31	2.38	.52	1.87	.32	1.66	.41	1.55	.41	2.56	.31
Total	2.63	.38	2.33	.43	2.13	.44	1.65	.44	1.54	.19	1.53	.17	2.72	.38	2.33	.45	2.13	.45	1.65	.37	1.63	.33	2.72	.38

Note. M= mean; SD= standard deviation

Table 2: variable error scores in retention for the feedback condition

	Trial block	
Feedback condition	M	SD
KR good	2.58	.25
KR poor	2.56	.38
KR good-poor	2.72	.49
Self-control	1.68	.76
Total	2.42	.64

Note. M= mean; SD= standard deviation

effect. The motivational role of KR for learning [19] has been downplayed somewhat in recent years [7]. In fact, according to the predominant theoretical view of feedback the guidance hypothesis [20, 21], which focuses on the information properties of KR [10] feedback should be particularly important after poor trials when it is assumed to guide learners to the correct response. After good trials, feedback is seen as less important. Our findings, as well as those of Chiviacowsky and Wulf [22] with adult participants, seem to contrast with this view by showing that KR after good trials can, in fact, be more important than KR after poor trials presumably because of its motivational effects.

Our interpretation is that the feedback after relatively successful trials would encourage learners to repeat a (successful) movement rather than change the movement pattern to correct the errors. That is, a performer's attempts to correct even small response errors are viewed as resulting in unproductive response variability and preventing learners from developing a stable movement representation.

It appears participants in the present study developed an error-detection-and-correction capability, as evidenced by the smaller changes after good trials. But this capability was developed similarly under KR good and self-control conditions. Our finding is in line with the results of Chiviacowsky and Wulf [21]. Chiviacowsky and Wulf [22] found that KR after good trials indeed resulted in superior learning in young adults. They generalized the effectiveness of feedback after good trials in older participants. They replicated the experiment by Chiviacowsky and Wulf [5], using same experimental design, but used 65-year-old adults as participants. The finding were replicated with older adults, group who was provided KR for the most accurate trials demonstrated more effective retention performance than the group who received KR for the three least accurate trials [23].

Our study demonstrated that motor learning in children benefited from this type of KR as well. It indicates that learners-both adults and 10-year-old children had a relatively good "feel" for how they performed on a given trial.

Generally, we can conclude that given feedback after good trial is very effective for skill learning in children. Hence, this approach can be used as a best method of given feedback for athletes and coaches. The use of this procedure can be a new method used to improve athletic performances which should be the focus of attention of coaches and researchers. In future experiments, it might be interesting to examine the generalizability of the present findings to different tasks.

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