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The effect of self-controlled and instructor- controlled feedback after good and poor trials on learning of force-production task in old subjects

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ABSTRACT

This study aimed to compare feedback after good and poor trials in self–control and instructor-control condition on acquisition and learning of force production task in old subjects. Subjects were randomly divided into three groups: instructor-control feedback after good and poor trials and self–control feedback groups. All participants produced 10 kg force in acquisition phase. They couldn't see the produced force and received KR on two trials in each 6-trial block. At the end of acquisition phase, subjects of self–control feedback group were divided into 2 groups of self–control feedback after good and poor trail. After 48 hour, they performed a retention and transfer tests without KR. To analyze data, one – way ANOVA and post Hoc test were used (P≤5%). Results showed there was significant difference between self–control and instructor-control groups, significant different between feedback after good and poor trials in the instructor-controlled group also, but no significant different in self-controlled group.

Key words: instructor-controlled feedback, self-controlled feedback, good trials, poor trials

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INTRODUCTION

A major part of the human life encompasses the different skills. The human being eminent ability to perform skills is an important feature of his existence. Recognizing the factors which influence the performance is one of the issues that the educational scientists are dealing with for centuries. This knowledge has many applications in improving performance in sport and physical activities. Coaches try to use this knowledge in acquisition and performance of skills throughout the teaching process in different ways [10]. In learning motor skills, it is emphasized that the feedback information which make a performer successful in dealing with the desired goal is a crucial factor in acquisition and performance. These comments have been basically studied by the knowledge of the results (KR) that is usually defined as after-response verbal information about some aspects of achieving the goal [11, 17]. During the recent years, attempts have been largely devoted to clarify the role of augmented feedback and its potential benefits in order to reduce the negative effects of feedback. But the contradictory findings in this regard have made it difficult to determine suitable method for giving feedback [14]. Meanwhile, the impact of the relevant frequency of augmented feedback on learning motor skills has been one of the most challenging issues for the specialists in motor learning [6]. In order to explain the effects of frequency of KR on learning motor skills, researchers [13, 15] proposed the concept of guidance hypothesis and stated that in spite of positive effects of the frequency of feedback during the practice, it can also be associated with several negative effects such as: (a) preventing important activities i.e. information processing, detection and error correction, (b) decreasing movement stability, (c) making the learner dependent to feedback [12, 13]. Following the proposal of the guidance hypothesis, some studies did not support it and concluded that learning complex motor skills that require high control, attention and memory are not necessarily

influenced by frequent feedback [2, 16, 19]. Wolf and Shea in a review of the feedback literature, concluded that despite the fact that the guidance hypothesis contributes to better understanding of the influence of feedback on performance and learning of motor skills, it is necessary to determine the nature of interaction between feedback and other factors such as task complexity, skill level, focus of attention and learners' characteristics [1]. On the other hand, many studies supported the guidance hypothesis and in order to prevent the negative effects mentioned earlier, they examined different methods to decrease the frequency of augmented feedback [4, 13, 14]. Thus assuming that feedback with less frequency is more useful for learning motor skills, this question may raise that "which method of reducing frequency of augmented feedback and which way of applying it (whether instructor-controlled or self-controlled) will be more effective?"

The research evidence so far had indicated that the presence of feedback after poor trials (informative role of KR) is more effective in improving performance and performer's experience gains by error correction is highly important in acquisition of motor skill. But the results of recent studies have led to different views and stated that giving feedback after good trials (motivational role of KR) has greater effect on learning motor skills. Ilies and Judg (2005) in their research concluded that when learners receive positive feedback they set higher goals and as a result their learning enhances. Chiviacowsky and Wulf (2007, 2009) demonstrated that providing feedback after good rather than poor trials results in better leaning. Such findings seemed to be in contrast with this view that providing feedback after significant errors is more effective. They explained their findings by stating that receiving positive instead of negative feedback results in higher motivation and this feedback consequently leads to more effective learning. Feltz (1992) in his review of literature in self-sufficiency concluded that success or failure in the last performances play a key role in the performer's perception of his or her abilities. These findings suggest that the trainer or the teacher can give feedback in order to influence the performer's perception of success or failure, affecting the stability of person in performing skills and leads to the enhancement of performance [3]. On the other hand, study of request for feedback in self-controlled conditions shows new findings about the strategies applied by the subjects of self-controlled group. Chiviacowsky and Wulf (2002) obtained interesting findings from questionnaires which were filled by self-controlled feedback group. They stated that the subjects of self-controlled group who determine the time of receiving feedback themselves often prefer to receive it after their good trials. This implies that people are efficient in relative determination of their good or poor trials and can distinguish their good trials from bad trials. However, few researches so far have compared the learning benefits in these two groups and whether this tendency toward asking for feedback after good trials in self-controlled condition can make this group superior or not? More researches using this approach can more investigate the findings of Chiviacowsky and Wolf about the effectiveness of feedback after good trials? Also few studies have been carried out on the effect of subjects' age on these changes [8]. There are also few evidences to show that difficulty of feedback (for instance short feedback, average feedback, feedback after good or bad trials, etc.) will improve old people's learning [8]. Since the age is an important variable in performance and acquisition this question should be answered that are teaching methods used in adolescence and young ages suitable for elderly people? In most of the previous researches, the self-controlled feedback group was compared with the yoked group, a group who receives feedback regardless of performance based on the self-controlled group; therefore it seems natural that the self-controlled group is superior from the yoked group [7]. But in the present study in order to enrich the results, not only the self-controlled feedback group was divided into after-good and after-poor trials feedback, but also they were compared to two groups of instructor-controlled feedback after good and poor trials instead of comparing them to yoked group. The feedback given to these groups is purposeful and based on their own performance.

Therefore in addition to controlling the frequency of feedback which is an important issue in this field, the researcher intends to compare the effects of feedback after good and poor trials on force production task in self-controlled and instructor-controlled conditions to reveal that;

1. Can receiving feedback after good trials be more effective than after poor trials in both self-controlled and instructor-controlled conditions?
2. Does letting the subjects decide about the time of getting feedback (self-controlled) play a fundamental role in improvement of learning? Or is it also effective if the feedback is given by a trainer after certain trials (e.g. good and poor trials in this research)?

Then we can provide trainers some information about the impacts of types of feedback, especially self-controlled one on learning motor skills. Obviously, the proper application of feedback in accelerating learning will save expenses and time.

MATERIALS AND METHODS

Participants

The method of this study is Quasi experimental. The population was all the elderly people aged between 58-65 years. The sample of this study comprised of 48 qualified subjects who were randomly selected and divided into three groups: instructor- controlled feedback after good trials (ICG group, N=12), instructor-controlled feedback after poor trials (ICP group, N=12), and self-controlled feedback (N=24). Hence, using a questionnaire at the end of the acquisition phase the subjects of self-controlled feedback group were divided into two subgroups: self-controlled feedback after good and after poor trials. So the sample included 48 subjects who were totally compared in four groups.

Apparatus

The following tools and methods were used to gather the required data:
1- An electric dynamometer (model ED-100N YAGAMI) with reliability of 0.82 that is used to measure the power of grip.
2- A questionnaire which was given to self-controlled group at the end of the acquisition phase to know after which type of trial (good or poor) they prefer to receive feedback [] (Chiviacowsky & Wulf, 2002).

Task

The task was used in this research was 10 force production task by electric dynamometer.

Procedure

After that the subjects learned how dynamometer (force-producing device) works, in order to ensure the similarity of groups, a pretest revealed that there was no significant difference in absolute errors between the groups at the beginning of the study. Then during the acquisition phase each group practiced producing a force of 10 kg in 10 six-trial blocks. It should be mentioned that the subjects were not allowed to see the dynamometer, not only during the acquisition phase but also in all other phases of the study and they received KR on only two trials of each 6-trial block (feedback frequency =33%). It was arranged in such a way that the subjects of the KR after good trials group received feedback after each three trials for the closest performance to the set target force 10 kg (good trial) whereas the KR after poor trials group received it after each three trials for the trial with the most distance from the 10 kg force (poor trial). Finally the self-controlled group asked for feedback on two of their trials whenever they wanted in every 6-trial block. Then at the end of acquisition phase, these subjects (self-controlled) were asked to fill out a questionnaire in which there were some questions about the time or reason of requesting feedback. Based on the response given by the participants, they were divided into two subgroups; self-controlled group which asked for feedback after their good trials (SCG KR group) and subjects who asked feedback after their poor trials (SCP KR group). The retention test was taken upon the termination of the acquisition phase, two days later with the same force as acquisition phase and the transfer test was done with the production of 15kg force in a 6-trial block and without any feedback.

The gathered data was first analyzed using descriptive statistics methods (such as mean, standard deviation, etc.). Then Kolomogrov-Smirnov, One-way ANOVA and Tukey post hoc tests ($p \leq 0.05$) were used in order to examine the effect of interventions done. All of the statistical analyses were administered using SPSS Version18.

RESULTS

As it was previously mentioned, at the end of acquisition phase, the self-controlled group which included 24 subjects was asked to complete a questionnaire. 10 subjects (41.66%) of self-controlled group asked for feedback after their good trials (SCG), 6 subjects (25%) after their poor trials (SCP), 5 subjects (20.83%) equally after both good and poor trials and finally 3 subjects (12.5%) requested feedback randomly. It should be explained that the ones who select both or no conditions in the questionnaire were eliminated from the study procedure. Four groups which were studied in this research are shown in table 1.

Table 1. Number, mean and standard deviation of the subjects' age

		N	Age mean	Std. deviation
Instructor-controlled feedback	After good trial	12	61.5	2.02
	After poor trial	12	61.83	2.6
Self-controlled feedback	After good trial	10	60.9	1.93
	After poor trial	6	62.5	2.07

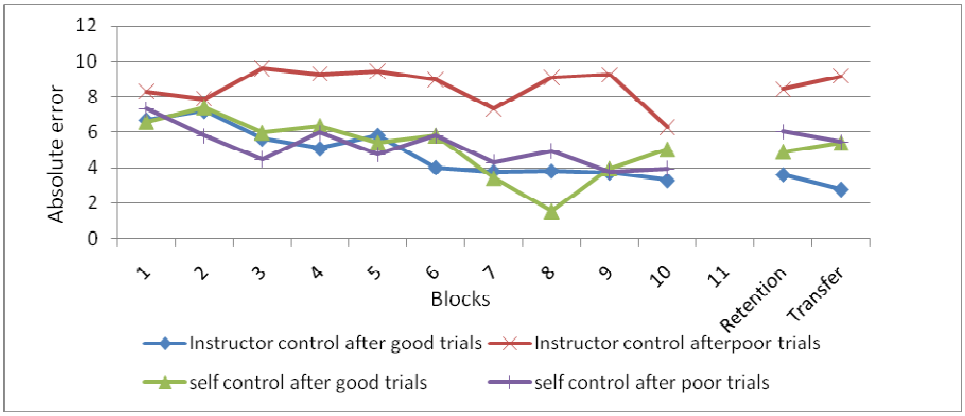

Figure 1. The of absolute errors of study groups in the acquisition, retention and transfer phases

According to figure 1, the study groups reduced their errors in force production task during acquisition phase but they have performed differently in acquisition, retention and transfer tests.

Table 2. Results of ANOVA test for comparison of groups' performances in the acquisition, retention and transfer tests

	F	P	Result
Acquisition	86.77	0.001*	Sig
Retention	86.77	0.001*	Sig
Transfer	18.59	0.001*	Sig

** The difference is significant at a≤ 0.05*

As it can be seen in table 2, the results of ANOVA test are significant between the study groups in the acquisition, retention and transfer phases (p≤0.001). It means that there is a significant difference between the four groups in learning force production task in these phases. The results of the post hoc test are shown in table 3.

Table 3. The results of Tukey's test for significance of between study groups in acquisition, retention and transfer test

Group	P value		
	Acquisition	**Retention**	**Transfer**
ICG ICP SCG SCP	0.001* 0.34 0.35	0.001* 0.44 0.09	0.001* 0.03* 0.07
ICP SCG SCP	0.001* 0.001*	0.02* 0.10	0.001* 0.006*
SCG SCP	0.99	0.70	1.000

** The difference is significant at a≤ 0.05*

DISCUSSION

The purpose of the present research was to compare the effects of feedback following the good and poor trials in self-controlled and instructor-controlled conditions in acquisition and learning of a force production task in elderly people. It was reviewed in three different phases (acquisition, retention, and transfer tests). The results indicated some significant differences between the study groups during the acquisition phase. In this phase the guiding effects of augmented feedback improved the performance of subjects in force production task (Figure 1), but as it was shown in tables 2 and 3, three groups (i.e. self-controlled feedback after good and poor trials and the instructor-controlled feedback after good trials) performed better than instructor-controlled feedback after poor trials (ICP) in the acquisition phase. In a similar study on the elderly people, Wulf and Chiviacowsky (2009) explored the effect of instructor-controlled feedback after good and poor trials. Their findings showed no significant difference between these two types of feedback during the acquisition phase. The results of present study are inconsistent with Wulf and Chiviacowsky's research results. The reason is that the feedback after good trials has a high motivational role for the

subjects [](Chiviacowsky & Wulf, 2005; Schmidt & Lee, 2011). Therefore the subjects who received feedback after good trials in the acquisition phase could enjoy this advantage and had a better performance comparing to the instructor-controlled feedback after poor trials. The subjects of the latter group lost the ability to be actively involved in problem solving and they were somehow confused and could not benefit from the motivational role of the feedback after good trials. This can be justified by the developmental changes, as the age goes up the cognitive abilities of elderly people reduces and will be a reason for incapability in using informative role of the feedback after poor trials. Wulf et al. (2005) examined the effects of self-controlled feedback on learning of jump shot in basketball and Hartman (2005) also conducted a research in order to give the theoretical as well as the empirical explanation of advantages of learning with self-controlled method. The results of these studies showed no significant differences between the various methods of feedback and the self-controlled method. In this regard Friedrich & Mandl (1997) also claimed that according to the cognitive view, the self-controlled method exerts more pressure on the subjects. They have to make decision based on their knowledge of the task and their ability, about when and how to ask for feedback, when and how much they change the task and so on. In other words, the responsibility of the subject increases more during the self-controlled practice. The learner has to make several decisions and control many degrees of freedom. This imposes high cognitive pressures on the learner and leads to dividing his/her attention capacity between the learning and self-controlling processes. These opposite effects of cognitive and emotional processes imposed on the self-controlled learner during the acquisition phase result in a performance similar to the instructor-controlled group. But in the retention and transfer tests, all four groups experience similar conditions (i.e. the self-controlled group will not face cognitive pressure anymore and can demonstrate the positive effects of self-controlling). Comparing the groups in the retention and transfer tests indicated that in instructor-controlled condition the group which received feedback after good trials showed better performance which means giving feedback after good trials will result in more effective learning. Cauraugh et al. (1993) and Wright et al. (1997) came up with the conclusion that giving feedback to out-of-range trials (poor trials) will lead to better and more integrated performance. These findings are not trended with the results of the present study. The reason for such inconsistencies may be the application of different methods in evaluating and specifying good and poor trials and having no control on the frequency of feedback in these researches. Most of these researches have used the range approach to define the poor and good trials. In this approach, the more a learner comes closer to the end of practice, the more improvement in performance occurs and his performances will be more acceptable in the range. Therefore, if an individual is in the group of feedback after good trials (close to the target), he/she repeatedly receives feedback and is bound to the dependency effects of feedback and will demonstrate a poor performance in retention and transfer tests in which no feedback is given, while in the present study, the criterion for defining the poor or good trials was the best or the worst performance of a person in a 6-trial block. This probably is the reason for the inconsistencies of these research' findings with the findings of the present study. Ahmadi et al. (2011) showed if feedback is provided after a good trial rather than a poor or good-poor trial enhanced learning. Badami et al. (2011) also examine the effect feedback on more accurate trials on sport skills. Their results indicated that feedback on more accurate trials resulted in more effective learning. These findings are interpreted as evidence for a motivational function of feedback and are trended with our research.

Wulf and Chiviacowsky (2009) concluded that for old people, feedback after good trials leads to better retention than after poor trials. Wulf attributed this superiority to the motivational role of the feedback after good trials, which supports our findings in the present study. However, the results of this study are compatible with West et al (2005), Chiviacowsky and Wulf (2007). However, they (2007, 2009) claimed that if the trainer or instructor gives feedback after the good trials, it can result in more learning. These results were contradictory with the guidance hypothesis that says "feedback following large errors is more important." They justified their findings by saying that giving feedback to the subject following his good trials can be a confirmation that the movement has been correct and it may help setting the harmony for the movement by reducing unnecessary changes. Thus such information can be as important as the error feedback or even more. In addition, it is also possible that positive feedback is more motivating for the learner than the negative feedback and cause more effective learning. The self-controlled group after good trials had a better performance in retention test when compared to instructor-controlled group after poor trials. The high motivational conditions in self-controlled group and also giving authority to the subjects and their more involvement in the problem solving process are the reasons for this advantage. The self-controlled subjects make different decisions and strategies that influenced their performance. In this regard Chiviacowsky and Wulf (2002) stated that the self-controlled subjects are often willing to ask for feedback after their good trials. However, no research had been done to compare this group with another group who was willing to ask for feedback after their poor trials.

An important point in the current study was that no significant difference were observed between self-controlled feedback group after good and poor trials and this is contradictory with the results of the studies mentioned above. In those studies the reason for the superiority of feedback after good trials was attributed to motivation and momentum increase, and the superiority of feedback after poor trials to setting lower goals. Feedback after poor

trials also has informative role which is useful for learning. In the current study the researcher found out the same effect of these two factors on learning. Considering that researchers like West et al (2005), Alice and Judge (2005) and Chiviacowsky and Wulf (2007) had shown that the learning would increase if the feedback was given after good trials in instructor-controlled condition, it was expected that the same thing happened in the self-controlled condition, but the results were different in self-controlled condition i.e. there was no significant difference between self-controlled groups after good and poor trials. In self-controlled group after poor trials, in addition to motivating role of self-controlled feedback the subjects tended to use informative role of the feedback, too and get some information about the error so that they can achieve optimum performance by correcting those errors and increase their learning. Thus, in addition to using other advantages they benefited from motivational and informative role of the augmented feedback simultaneously. However, the self-controlled group who ask for feedback after their good trials were willing to use the motivational role of the augmented feedback again despite using the motivational role and the advantages mentioned about self-controlled feedback.

The result of this study showed that there is no difference between these two groups that use different methods learning in acquisition, retention and transfer phases. These findings rules out the hypothesis that says "the better performance of the learner in self-controlled condition is only due to motivational role" and confirms the hypothesis purposed by Chiviacowsky and Wulf (2005) claiming that "individuals in self-controlled method ask for feedback when it conforms to their needs". Therefore observing no difference in these two groups should be attributed to the nature of the people and giving them authority to ask for feedback according to their internal needs. We will discuss about it later. The interesting point was that the results showed no difference between two conditions of instructor-controlled after poor trials and self-controlled after poor trials in the retention test. Both groups were using informative role of the feedback. This reveals that in self-controlled after poor trials the motivational role (self-controlled feedback naturally has motivational role) along with informative role did not cause any progress in learning comparing to the instructor-controlled after poor trials condition. But different results were obtained in transfer test and the self-controlled feedback group after poor trials and instructor-controlled feedback group after poor trials seemed to be significantly different. These results confirm the efficacy of giving feedback in the self-controlled manner. Another interesting result of this study was to observe no significant difference between the groups of self-controlled and instructor-controlled feedback after good trials in the retention test. In the present study, in order to harmonize the frequency of feedback between the subject groups, feedback was only given to 33% of each subject's trials. This was somehow similar to the research conducted by Chiviacowsky and Wulf (2005). They stated that this method may have acted as a limiter for self-controlling subjects and kept them away from pure self-controlled condition and ruin some advantages of self-controlling. On the other hand the reason of this result can be attributed to the benefit of giving feedback after good trials in instructor-controlled condition. The instructor-controlled group that received feedback after good trials could improve to the extent that they became to the same level of self-controlled group after good trials. This shows that if the feedback is given after suitable and needed trials (here good trials) in the instructor-controlled condition, it can be as effective as a self-controlled feedback. Also the fact that motivational role of feedback is more important in the beginning of learning can be considered as another justification for this lack of difference. When subjects start learning a new skill they seek motivational role more. In the transfer test the self-controlled revealed significantly better performance than instructor-controlled condition. That is the self-controlled group after good trails showed better performance than instructor-controlled after good and poor trials and the self-controlled group after poor trails also performed better than instructor-controlled after poor trials. Here the motivational role of the self-controlled feedback and giving authority to them for getting more actively involved in problem solving caused better acquisition. However, seeing no difference between the two self-controlled group in retention and transfer tests shows the similarity of the motivational role of feedback after good trials and informative role of it after poor trials in the self-controlled group. This was not observed in the instructor-controlled group and the feedback after good trials was better than after poor trials (an approval for the superiority of motivational role). This incoherence is due to the nature of the two groups. In the self-controlled group the subject discretionally asks for feedback after his good or poor trials (individuals who seek motivation). The ones who tended to more support and motivation took benefit of the feedback after good trials and those looking for the information about their errors used advantages of feedback after their poor trials and enhance their learning (individuals looking for performance error). Therefore both groups gained considerable progress according to their internal characteristics. But this freedom did not exist in the instructor-controlled situation and because of the lack of compatibility between the feedback and internal needs of the subjects, they were confused. So those who got feedback after their good trials enjoyed the least motivational advantage. According to Wulf and Chiviacowsky (2009), various results might be obtained for different age groups and in the old people studies have shown conflicting results. Also different findings were observed in young age group in the present study.

CONCLUSION

The results of this study indicates that in instructor-controlled condition motivating subject resulted from giving feedback after good trials causes more and better learning and is more effective than the information given to the subjects by providing feedback after their poor trials. But in the self-controlled condition they showed similar performances, which we attributed it to the nature of the subjects, i.e. the group that naturally needed more motivation requested feedback after their good trials and the one that needed informative role for progress asked for feedback after their poor trials and the results were the same. We can conclude that the nature of the subjects is the most important factor for progress in the task. Finally, the self-controlled feedback made better learning comparing to the instructor-controlled feedback. This prominence was in self-controlled feedback group after good trials comparing to instructor-controlled condition and in feedback group after poor trials to instructor-controlled condition after poor trials. The reason here was considered to be due to letting subjects decide about asking feedback according to their need. Considering the results of this research, it is suggested that the trainers encourage their old learners, through taking special measures and by providing trainings prior to practice, to ask for feedback in the self-controlled condition so that they can adopt the feedback to their intrinsic needs. However, if the trainer is to give feedback to the trainees during the practice (instructor-controlled condition), they are suggested to give it upon their good trials.

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