Available online at www.pelagiaresearchlibrary.com

Pelagia Research Library

European Journal of Experimental Biology, 2012, 2 (5):1800-1806

ISSN: 2248 –9215
CODEN (USA): EJEBAU

Comparing the effects of Errorless and Error ful and fixed practices on learning of throwing task

Behrouz Abdoli, Alireza Farsi and Fariba Hasan Barani

Department of Physical Education and Sport Sciences, Shahid Beheshti University, Tehran, Iran

---

ABSTRACT

This aim of current research is to study the errorless and Error ful learning in throwing task and also comparing them with constant group. 30femalestudents with range age of 22±2 years old voluntarily participated in this study. The subjects similarly and randomly divided into three error ful, errorless and constant groups (10 subjects in each group). Error ful group participants respectively at 2.5, 2.75, 3, 3.25, 3.5 meters, errorless group, respectively at 2.5, 2.75, 3, 3.25 and 3.5 m and constant group only from 3 meter began to practice. At the end of the acquisition, acquisition testing, one Block of 10 trials from a 3 meter distance was taken from all groups. In the test phase, the fourth day, four tests were held each test consisted of one block of 10 trials. Snellen vision accurately measure and vision gauges machine STEREO OPTICAL 5000 (made in America), to ensure the subjects vision healthy. The statistical test results showed that there wasn't significant differences for throwing skill between experimental groups in acquisition test (P=0.005). Therefore there was significant differences between groups in retention test (P=0.004), secondary transfer test (P=0.001), inside the scope transfer test (P=0.001) and outside the scope test (P=0.002). Based on the study results, concluded that errorless group earned the skills via inactive and Error ful group acted as the explicit learning. Although the constant group was under the secondary cognitive task, acts near the errorless group but, a lot of verbal rules were reported such as the Error ful group.

Key words*: implicit learning, explicit learning, errorless learning, Error ful learning, fixed practice, throwing task*

INTRODUCTION

Conducted studies in the field of motor learning, presented different opinions about the explicit and implicit processes. Some researchers believe that the explicit processes are the critical parts of motor learning and performance and the implicit processes are needed for complete especially when it is necessary to adapt the skills (for example Beek 2000).But others said that the implicit processes form the basis of expert performance(for example, Masters and Maxwell 2004), while both explicit and implicit processes are necessary for learning, the relative contribution of these processes should be adjusted so that the implicit can be used more than explicit processes (Poolton, et al 2006).Therefore There is a perceptual conflict in motor learning resources in about the declarative processes (explicit) and procedural (implicit) in learning and motor function. Maxwell et al. (2004) discussed that on position in a motor learning, the declarative knowledge can be accumulated as a result of hypothesis testing [1-6].

Hypothesis testing behavior included the generation and evaluation of strategies using the outcome feedback in the working memory (Baddeley and Hich 1974).In this role, the working memory is as obvious information temporary storage locations that allow the movements to be adjusted and displayed (Masters and Maxwell 2004). Therefore in the hypothesis testing behavior obtained a large number of declarative knowledge associated with motor skill (Anderson 1982).

In parallel to the accumulation of declarative knowledge, is obtained a large number of procedural knowledge that is difficult to demonstration (Pooltonet al, 2005). In explicit processes, the step by step instructions are given to the learner, while in implicit processes the person to be involved without receiving an instruction in the learning process (Schmidt and Wrisberg, 2008).The advocators of implicit learning suggested many advantages for this process such as independence for the working memory, age and IQ [7-11].

However despite the previous benefits of implicit skill learning processes, researchers found consistently so that in a lot of researches, the explicit learning manifest in better level in relation to the explicit one (McMahon and Masters, 2002; Masters, 1992; Maxwell et al., 2000),For example, the subjects that were learning a golf task with a secondary task (as animplicit), in relation to the subjects that learning without the secondary task, had a bad performance (Bright and Freedman, 1999, Hardy et al 1996, Masters 1992).To address this problem, Maxwell, Masters, Karr and weedon (2001), based on Badeley and Wilson (1994) proposal, assuming that one of the effects of implicit learning may be reducing the learning errors. Badeley and Wilson (1994) described the working memory as a detective and errors correction mechanisms that is essential for the development of declarative knowledge.

So Maxwell and colleagues (2001) hypothesized that if errors in motor learning reduced hypothesis testing and working memory participation to the motor output will decrease and working memory decreasing, declarative knowledge accumulation (explicit learning) will be minimized and can be useful for procedural knowledge concentration (implicit learning).They showed that the learning that leads to less error in learners performance an lead to less verbal rules concentration and therefore to the implicit learning.

In the golf task, they showed the group that began to blow from the nearer distance calls the explicit mechanism in relation to the group began task from long distance, therefore concluded that such subjects who have learned the skill under errorless situations, seems to earn the task as an inactive procedure and the persons that learn in the Error ful situation, shows the same characteristics with implicit learning [12-18].

But it seems generalization of the results of Maxwell and colleagues (2001, 2004), is needed more researches, so the first aim of current research was to study the errorless learning in throwing task. in addition, in all research conducted in errorless learning, has been studied the lower error and better performance and in some cases has been compared to random conditions and no one of the researches not compared this effect with the group performance that is practiced from the constant distance to target. Therefore the second aim this study was to comparing the errorless and Error ful groups with constant group. Therefore the present study sought to examine this question, are the former results in Error ful and errorless learning in throwing tasks is generalizable? Also how does it work the practice of constant distance to the target under acquisition, retention and transfer situations in relation to the errorless and Error ful groups?

MATERIALS AND METHODS

Participants

30 female students with range age of 22±2 years old voluntarily participated in this study. All subjects were right handed and were healthy in visual and motor systems. The subjects similarly and randomly divided into three error ful, errorless and constant groups (10 subjects in each group).

Apparatus and tasks

tools used in this study include researcher-made task, 25 tennis balls and Snellen vision accurately measure and vision gauges machine STEREO OPTICAL 5000(made in America), to ensure the subjects vision healthy.

The used task have two targets, so that the second goal (the target), consisting of 10 concentric circles. Each circle had a certain point, the smallest circle are allocated 10 scores and the ninth next circle has score 1 to 9. The first goal was the span of the ball hitting to the ground. This span has a distance from first goal and has same width. The ball should hit first in this range and then to the second goal. The scoring methods were such that if the ball didn't hit to the span, the zero point was considered. If hits the ball inside the area but did not meet the target board the zero Score was considered. If hit the ball within the range and then hits the target page based on the location where hit, the score was tied.

Procedure

In this study due to two reasons the pre-test do not taken. A: pre-test from the less than 2.5 m distances, defines a ceiling effect for performance measurement because all participants hits the goal from near level to distance. B: Pre-test from far distance to the goal, eliminates the effect of errorless group it may lead them base of verbal knowledge to the obvious position (Maxwell et al 2001).

In the present study, the acquisition period including 3 days of training, each day consists of 5 blocks 25 trials with 50 seconds rest between each block. Before the beginning of the first block of first day, five experimental trials were given (Singer et al 1993). Throwing instructions were not given to any of the groups. Error ful group participants respectively at 2.5, 2.75, 3, 3.25, 3.5 meters, errorless group, respectively at 2.5, 2.75, 3, 3.25 and 3.5 m and constant group only from 3 meter began to practice.

At the end of the acquisition, acquisition testing, one Block of 10 trials from a 3 meter distance was taken from all groups. In the test phase, the fourth day; four tests were held each test consisted of one block of10 trials. In the first test of retention, participants was to launch to throwing from a three meters distance, in the second test, the transfer of a secondary cognitive task, the subjects should be associated with the launch of the retention interval, declined three number from 1000in sequentially. It was said that both speed and accuracy is important. Fourth and fifth test, the transfer test has a new space (inside and outside the practice scope) thus the order of the two tests was balanced between both groups. At the end of the test phase, subjects were asked to write all rules and techniques that were used during performance with all details. Two independent estimators were reviewed the number of verbal rules reported by each participant. Estimators were unaware of the test circumstances and counted the phrases that shows aspect of the technique (for example, firstly the right hand bend from the elbow and kept near the body).

Statistical Analysis

Descriptive statistics used for data ordering, and the Kolmogorov-Smirnov test used for normal distribution data. Levine's test was used for homogeneity of variance. Muchley sphericity test was used to check the parity matrix of variance- covariance. To examine the reliability between the two estimators the Pearson correlation test, to analyze hitting carefully in the acquisition phase the analysis of variance with repeated measurements, to compare the groups in secondary task performance (speed and accuracy count) and the number of rules reported in the verbal protocol analysis the one-way analysis of variance (ANOVA) were used. The Bonferroni post hoc test was used to determine significance between groups. The SPSS statistical analysis test version 18 with $P<0.05$ in total and $P<0.01$ and $P<0.017$ in modified status were considered.

RESULTS

Acquisition period

*Table 1 show that the mean and standard deviation of the throwing precision variable in three errorless, Error ful and fixed groups in training days is different. In the third day was higher than second day and in second day was higher than one day in all groups. To determine significant differences the analysis of variance test (3*3) (group*day) with repeated measurements was used (results are summarized in table 2).*

Table1. Throwing precision variable Statistical description in different days of training (acquisition phase) between three (errorless, Error ful and constant) groups (M± SD).

Groups	*Day 1*	*Day 2*	*Day 3*
Errorless	*156.9±10.87*	*178.6±14.4*	*186.6±6.43*
Error ful	*148.9±9.65*	*159.7±8.42*	*173.7±8.73*
constant	*149.3±6.42*	*156.3±7.33*	*165.2±5.15*
Sum	*151.7±9.61*	*164.86±14.23*	*175.16±11.17*

Table2. The results of analysis of variance (3*3) for study the effects of training days in throwing precision variable of errorless, Error ful and constant groups.

Source of changes/ variable	*Sum of squares*	*df*	*Mean sum of squares*	*F*	*Sig*	*Eta squares*
group	*4831.089*	*2*	*2415.544*	*12.748*	*0.001*	*0.486*
Training days	*8301.356*	*2*	*4150.678*	*154.748*	*0.001*	*0.851*
*group*Training days*	*784.244*	*4*	*196.061*	*7.310*	*0.001*	*0.351*

*The results of analysis of variance (3*3) (group*day) showed that the main effect of training groups, the main effect of days of training and interactive effect of group with training days was significant. Bonferroni post hoc test results showed that there are significant differences in training sessions between errorless and constant groups (P=0.001) and errorless and Errorful groups (P=0.001) but, there aren't differences between Errorful and constant groups (P=0.871).*

The test phase

*Table 3 shows that mean and standard deviation of the throwing precision variable of errorless, Errorful and constant groups is different in the acquisition test, retention, secondary transfer, inside and outside the scope and for determining the significant differences, the analysis of variance test significant differences (5 * 3) (test *group) with repeated measure was used.*

Table3. Description ofthrowing precision variable in the acquisition test, retention, secondary transfer, inside and outside the scope in phases of errorless, errorful and constant groups (M± SD).

Groups	acquisition	retention	secondary transfer	inside the scope transfer	outside the scope transfer
Errorless	51.5±7.706	49.4±4.488	46.3±5.271	48.1±5.08	41.6±5.98
Error ful	44.9±9.631	41.9±5.32	31.2±3.359	37.9±11.49	30.4±7.26
constant	43±5.206	40.4±6.84	32.4±4.042	27.1±9.480	25.1±13.076
Sum	46.466±8.328	43.9±6.849	37.96±8.25	37.7±12.36	32.36±11.37

The analysis of variance test results showed that the main effect of group is significant (η^2=0.500, P=0.001, F ($_{2, 27}$) = 13.493), the Bonferroni post hoc test showed that there are significant differences between errorless and Error ful groups (P=0.002), Errorless and constant groups (P=0.001). Main effect of test (η^2=0.239, P=0.001, F ($_{4,108}$) = 31.247), and interactive effect of group with test (η^2=0.239, P=0.001, F ($_{8,108}$) =4.250) was significant.

Comparison between tests shows that there aren't significant differences in groups performance in acquisition and retention tests (P=0.306), for determining the significance effect and interaction the one way ANOVA in the acquisition test, retention, secondary transfer, inside and outside the scope phases were used. The results didn't show the significant differences between experimental groups in acquisition phase (P=0.51) but, there are significant differences in retention (P=0.004), second transfer (P=0.001) and outside the scope transfer test (P=0.002) between groups.

The Bonferroni post hoc test results showed that there are significant differences between groups in retention, secondary transfer, inside and outside the scope phases (P<0.017). For determining the differences in performance between groups in secondary transfer test relation to the retention, three independent tests in each of separate stages were used. Results show that there are significant differences in Error ful and constant groups performances in secondary transfer test in relation to retention phase (P<0.017).

Secondary cognitive task performance (accuracy and speed counts)

Table5. Statistical description of secondary cognitive task performance in errorless, Errorfuland constant groups.

Groups	counts accuracy(M± SD)	counts speed (M± SD)
Errorless	0.87±0.77	13.681±2.970
Errorful	0.655±0.129	10.988±5.631
constant	0.889±0.806	10.766±4.355
Sum	0.806±0.144	13.811±6.849

The one way analysis of variance (ANOVA) showed significant differences between groups in counts accuracy (η^2=0.326, P=0.005, F $_{(2,271)}$ = 6.526). This significant differences studied by Bonferroni post hoc test. Based on this test, there are significant differences in counts accuracy between errorless and Errorful(P=0.001) groups, Errorful and constant (P=0.001) groups but there aren't significant differences between errorless and constant (P=1.00) groups.

Verbal protocols (number of reported verbal rules)

Table6. Number of reported verbal rules statistical differences in errorless, Errorful and constant groups

Groups	counts accuracy(M± SD)	counts speed (M± SD)
Errorless	5.1	0.99
Errorful	9.4	1.83
constant	8.7	1.059
Sum	7.73	3.51

The Pearson correlation coefficient test revealed the acceptable internal validity between to estimators (r=0.89, n=24, P<0.001). Then the mean of the reported verbal rules via two estimators, recorded as a subjects score in verbal protocol. The one way analysis of variance test showed the significant results for group effect. The Bonferroni post hoc test used for between groups differences determining and revealed that there are significant differences between errorless and Errorful(P=0.001) groups and errorless and constant (P=0.001) groups.

DISCUSSION AND CONCLUSION

This research aimed to study the errorless and Errorful learning in throwing task and also comparing them with constant group. In the training days (acquisition phase) the results show the performance improvement from earlier

session to last one that this progressive process was prominent in errorless group. Can be said that the errorless group has a faster progression, and these results was consistent with Maxwell et al. (2001) and pooltonet al (2007) finding. For temporary and permanent separation of learning effects, the acquisition and retention tests were compared, the results showed no significant difference between acquisition and retention tests. In retention test the performance of errorless group was better than other two groups, these results are consistent with the results of Maxwell and colleagues (2001) and Poolton and colleagues (2005). Some of the researches, Poolton and colleagues (2007 A), Lamet al (2009 and 2010 b), Liao and colleagues (2000), Masters and Maxwell (2008) and Asgari and colleagues (2010) showed no difference between groups in the acquisition and retention phases [19-25].

In the transfer test with secondary cognitive task, errorless group demonstrated stable performance but Errorful group suffered a severe drop in performance.

The results of this research is consistent with Maxwell and colleagues (2001), Poolton and colleagues (2005) and (2007 b) and Lamet al (2009, 2010 b) findings. These results suggest that implicit motor processing is resistant to a secondary task pressure. The cognitive secondary task results showed that groups had no significant difference in speed counts but significant differences were observed in the counting accuracy.

The significant differences were between Errorful and other groups. Errorless and constant groups well-run the secondary task that showed the same attention of errorless and constant groups to the secondary cognitive task. But in Lamet al. (2009) study, explicit and implicit groups showed no differences in accuracy and speed counts. These study resultis in consistent with the research study Lam, et al (2010 b) findings and suggests that errorless and constant groups did not processing a lot of information in running the skills [26-30].

Another factor that in the research (for example, Liao and Masters, 2001) has been assigned as a sign of launching implicit process, is count verbal rules reporting related to skills implementing. The verbal rules counting is as indicators of no performance independency to verbal rules and resulting in the release of the working memory from explicit rules processing when implementing skill.

The results of this study showed that errorless group reported a fewer rules in the verbal protocol compared to other groups but, there was no significant difference between errorless and constant groups.

These results are consistent with the results of McMahon and Masters (2002), Poolton and colleagues (2006, 2007), Masters et al. (2008) and Lam, et al. (2009). But Maxwell and colleagues (2001) did not show the significant differences in verbal rule reports between errorless, Errorful and constant groups. Inside the scope test results revealed that the errorless group has a better performance than other groups but, there are significant differences between Errorfuland constant groups. In this test in relation to the retention test only the performance of constant group demonstrate a declination and justified so this group has practice only from a fixed distance and in the outside the scope test, the errorless group has a better performance than other two groups.

But there was no significant difference between errorless and Errorful groups, but all three groups were experienced a drop in the retention test and also this is because the distance totally different experience than training conditions but, what is important is that less drop of errorless group is affected by new situation experiencing. This result is consistent with Maxwell et al. (2001) and Masters et al. (2008) findings but, in are inconsistent with Asgari (2010) and Orell et al. (2006) findings. They believed where learners is not forced to process additional information, none of the groups hasn't prominence to other one.

On the other hand one of the reasons for the sharp drop in performance in the Errorful group in the secondary transfer group can be explained according to the cognitive load theory [31-34].

Due to the higher number of verbal rules of the explicit learning group to explicit group, perhaps one of the reasons for the decline in the performance of explicit group is creation of cognitive overload on the participant's attention sources via these two ways of learning. On the other hand, perhaps errorless learning methods due to the error hypothesis testing reduction, error correction and keeping empty the working memory capacity provide the proper environment for schema making and providing automatic skill. Maxwell et al. (2003) showed that the cause of explicit group decline is indicator the participant's dependency on verbal knowledge.

Also Poolton et al. (2006), Masters and colleagues (2008) showed that implicit skills learning preserves the learner against the backdrop of the performance under the high complexity decisions conditions. In general, according to the results of this study can be said that also in the throwing task results the assignment of Maxwell and colleagues (2001, 2004) can has a generalization. So that the errorless group acquired skills with a passive mode and Errorful

group acted as the explicit learning. Although the constant group acts near the errorless group under the secondary cognitive task but reported a lot of verbal rules alike the Error ful group, for further study it is recommended further research in this area with other constant groups from interval distances were done.

REFERENCES

*[1] Barry. Kaufmana. Scott. (**2010**). Implicit learning as an ability.Cognition,116(3): **2010**, 321-340.*
*Berry,D.C., Dienes, Z.(**1993**). Implicit learning: Theoretical and empirical issues. Hove,England: Lawrence Erlbaum. [۲]*
*[3] Baddeley, A. D., Wilson, B. A. (**1994**). When implicit learning fails: Amnesia and the problam of error elimination. Neuropsychologia, 32: 53-68.*
*[4] Francesconi, D.(**2011**). Implicit and explicit learning in motor cognition: issues for movement education, the international journal of sport &society, 2(1).*
*Gabbet& Masters. (**2011**). Challenges and solutions when applying implicit motor learning theory in a high performance sport environment: examples from rugby league, international journal of sports science &coaching, 6(3). [۵]*
*Green,T.D.,Flower,J.H.(**1991**).Implicit versus explicit learning processes in a probabilistic, continuous fine motor catching task.Journal of motor behavior,23: 293-300. [۴]*
*[7] Hilde H, (**2011**). An old problem: How can we distinguish between conscious and unconscious knowledge acquired in an implicit learning task?, Consciousness and Cognition, 20(3): 658-672*
*[8] LamW.K.(**2008**). Cognitive demands of error processing associated with preparation and execution of a motor skill, Consciousness and cognition, Volume 19(4): 2010, 1058-1061.*
*[9] Lam, W.K, (**2009a**). Analogy versus explicit learning of a modified basketball shooting task: performance and kinematic outcomes. Journal of Sport Science, 27(2): 179-191.*
*[10]Lam, W.K.(**2009b**). Analogy learning and the performance of motor skills under pressure.Journal of sport and exercise psychology, 31: 337-357.*
*[11]Lam, W. K., Masters, R. S. W., & Maxwell, J. P. (**2010a**).Cognitive demands of error processing associated with preparation and execution of a complex movement. Consciousness and Cognition, 19: 1058-1061.*
*[12]Lam, W.K. (**2010b**). Probing the reaction time of attention (motor) learning.journal of sport science, 28(14):1543-1554.*
*[13]McMahon, K.M.A., Masters, R.S.W. (**2002**). The effects of secondary tasks on implicit motor skill performance. International Journal of sport psychology,33: 307-324.*
*[14]Masters,R.S.W. (**1992**).Knowledge,knowers and know-how:The role of explicit versus implicit knowledge in the breakdown of a complex motor skill under pressure. The British journal of psychology,83: 343-358.*
*[15]Masters, R.S.W. (**2000**).Theoretical aspects of implicit learning in sport. International Journal of sport psychology,31: 350-541.*
*[16]Masters,R.S.W. (**2008a**). Implicit motor learning and complex decision making in time constrained environments.Journal of motor behavior,40: 71-79.*
*[17]Masters, R. S. W., Poolton, J. M., Maxwell, J. P. (**2008**). Stable implicit motor processes despite aerobic locomotorsfatigue. Consciousness and Cognition, 17: 335-338*
*[18]Maxwell,J.P. (**2000**). From novice to know-how: A longitudinal study of implicit motor learning. Journal of sport science,18: 111-120.*
*[19]Maxwell,J.P. (**2001**). The implicit benefit if learning without errors. Quarterly Journal of experimental psychology,54A: 1049-1068.*
*[20]Maxwell,J.P. (**2003**).The role of working memory in motor learning & performance, consciousness and cognition, 12: 376-402.*
*[21]Maxwell,J.P.(**2006**). Performance breakdown in sport: The roles of reinvestment and verbal knowledge. Research Quarterly for Exercise and Sport, 77: 271-276.*
*[22]Orell,A.J. (**2004**). Implicit motor learning of a balancing task, Institute of Human performance.University of Hong Kong, China.*
*[23]Poolton, J. M., J. P. Maxwell, R. S. W. Masters. (**2005**). the relationship between initial errorless learning conditions and subsequent performance.Human movement science 24: 362-378.*
*[24]Poolton, J. M., Maxwell J. P., Masters R. S. W.(**2007b**). Passing thoughts on the evolutionary stability of implicit motor behavior: Performance retention under physiological fatigue.Consciousness and cognition, 16: 456-468.*
*[25]Pollocka. Cynthia L. Huang. (**2011**). Development of implicit and explicit category learning. Journal of Experimental Child Psychology, 109(3): 321-335.*
*[26]Reber, A. S. (**1992**). The cognitive unconscious: An evolutionary perspective. Consciousness and Cognition, 1: 93-133.*

*[27]Rendell.(**2011a**).implicit practice for technique Adaptation in Expert performers, international journal of sport science &coaching, and 6(4).*
*[28]Rendell. (**2011b**). an implicit basis for the retention benefits of random practice, journal of motor behavior, 43(1).*
*[29]Sekiya, H. (**2006**).Contextual interference in implicit and explicit motor learning. Perceptual and motor skills,103(2): 333-343*
*[30]Vinter,A. Perruchet,P.(**2002**). Implicit motor learning though observational training in adults and children. Memory &cognition,30(2): 256-261.*
*[31]Wulf and Schmidt, R.A. (**1997**).Variability of practice and implicit motor learning.Journal of experimental psychology, learning, memory and cognition, 23(4):987-1006.*
*[32]Abdoli B, ModaberiSh and Shamsipour D. P. (**2012**). Comparison of the quality of life for healthy active and sedentary elderly and with osteoarthritis. Annals of Biological research, 33, 5: 2337-42.*
*[33]Mostafai A. (**2012**). The Comparison between athlete women and non- athlete women regarding to mental health and happiness. Annals of Biological research, 33, 5: 2144-47.*
*[34]Omidi M, Yousefi M, Ahmadi M, Farzanfard F. (**2012**). An investigation of the relationship between cardiorespiratory fitness and body fat with coronary risk factors in adolescent girls. Annals of Biological research, 3, 6: 2975-78.*