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The impact of success criteria in low-error practice conditions on motor learning, self-efficacy, and mood states: A challenge to the optimal theory

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Abstract

Background: Identifying the practice conditions that optimize the learning of motor skills is one of the main objectives in the field of human motor learning research.

Aim: Present study aimed to explore the effect of success criteria in low-error practice conditions on motor learning, self-efficacy, and mood states among female students.

Materials and Methods: This practical quasi-experimental study was conducted in a field setting. The participants were 30 female students from Yazd University, selected through convenience sampling. After they completed the consent form, the selected participants were randomly divided into three groups: low-error practice with a large target (n= 10), low-error practice with a small target (n= 10), and a low-error control group (n= 10). Then, mixed ANOVA was applied in order to test the hypotheses and data analysis was conducted using SPSS version 23, with a significance level set at $P < 0.05$.

Results: The findings indicate that both the large (P=0.003) and small (P=0.001) target groups significantly outperformed the control group (P=0.033) regarding the difference in performance accuracy. Moreover, In the small target group, a significant difference was observed only in the happiness subscale considering mood states (P=0.001), while in the large target group, significant differences were found in the tension (P=0.003), depression (P=0.001), and fatigue subscales (P= 0.001). Regarding self-efficacy, significant differences were observed in the power dimension in both the large (P=0.001) and small target groups (P=0.003)

Conclusion: The use of success criteria in low-error practice methods is beneficial, and it is recommended to adopt this approach to improve accuracy and stability in practice sessions.

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1. Introduction

Identification of practice conditions that optimize the learning of motor skills is one of the main objectives in the area of human motor learning research [1]. Realization of the factors that affect motor performance and learning is not only theoretically significant, but also practically highlighted in the settings such as therapy and educational environments. Effective instructional methods can accelerate the learning process and help individuals achieve higher levels of performance [2]. Due to the fact that practice is the most important factor affecting the improvement of motor skills, each practice moment is significantly important [3]. Therefore, the practice sessions should be designed and planned in a way that maximize learning. As a result, coaches and decision makers must be aware of different practice methods and the influential factors in order to be able to plan and manipulate them better, leading to higher levels of learning [4]. Thus, working on optimization approaches in different practice conditions can significantly enhance the potential for motor learning.

In this regard, raising expectations of learners' performance is considered to be an educational method proposed for improving motor learning skills. This approach is supported by the OPTIMAL (Optimizing Performance Through Intrinsic Motivation and Attention for Learning) theory [5]. Based on the principles of the mentioned motor learning theory, the acquisition of motor skills can be facilitated by providing instructions to attract external attention, increasing learners' sense of autonomy in learning, and setting elevated expectations. The OPTIMAL theory has highlighted various factors that are in favor of raising expectations. Regarding this theory, high levels of expectation for success can a) improve positive motivation and self-efficacy, b) prepare the individuals for better performance, and c) enhance working memory and long-term memory [6]. Moreover, various strategies and interventions have been proposed to illustrate that motor performance and learning can be enhanced by increasing expectations for success. These interventions included the provision of relatively easy criteria, visual illusions, and feedback after acceptable performance [6].

In addition, in order to increase learning, the researchers have set the goals and criteria that are more sustainable [7]. Based on the literature in the field of learning, the low-error and high-error practice methods have attracted significant attention during the last decades [8]. Low-error practice is a training approach that facilitates performance and learning by modifying the environment in order to minimize the errors. This method was primarily developed and used by Masters and Maxwell (2004) in the context of learning a golf stroke. According to the principles of this approach, the environment is manipulated and constrained in a way to minimize the errors [9]. For example, in the early stages of learning, the distance is kept short and increased during the acquisition sessions, aiming at the minimization of errors during the initial learning phase [10]. In other words, learning through this method, which is a kind of implicit learning, operates independently of working memory. It allows a large portion of attentional resources to remain intact (even in the case of high decision-making difficulty), enabling individuals to process information in working memory without disrupting skill performance [11].

Various psychological variables have

been identified that can affect the success and failure of the athletes. One such variable, which has attracted significant attention in sports psychology research, is mood states. In sports psychology, mood state is taken into account as an influential factor in athletic performance, and it is used to predict athletes' performance in a better and more accurate way [12]. In general, mood states are psychological reactions to environmental stimuli and occur periodically as the individual attempts to adapt to the environmental demands. Lane et al. (2005) defined mood as a set of transient feelings that vary in intensity and duration. Moreover, mood is mostly longer-lasting compared to the emotions. They consider mood as an influential factor in a psychological context that can affect the performance [13].

Self-efficacy is the next psychological variable that is favored by the learning specialists. Bandura (1997) believes that self-efficacy beliefs can predict and mediate thought, behavior, and motivation patterns [14]. Self-efficacy expectations deal with an individual's belief in his ability to do a specific task or achieve a particular outcome. These expectations are not concerned with the individual's current skills but rather with the judgment of what he can do with those skills. According to Moritz and Feltz (2000), self-efficacy expectations are taken into account as a type of situation-specific confidence. Individuals with higher self-efficacy expectations focus their attention on the task at hand and attempt more. On the other hand, those with lower self-efficacy expectations may quickly become anxious and divert their attention from available solutions [15]. Bandura (1986) notes that self-efficacy judgments can significantly predict and determine the individual's behavior just in the case that the necessary skills and appropriate stimuli are available [16].

Based on the conducted research, there is a significant relationship between success criteria, error-reduced practice, mood states, and self-efficacy in learning motor skills. Error-reduced practice serves as an effective method that helps learners minimize mistakes and enhance their self-efficacy during the early stages of skill acquisition. This approach, by providing optimal learning conditions and easier success criteria, enables learners to gradually strengthen their skills. Positive mood states act as an influential psychological factor that significantly impacts learners' motivation and focus. These mood states assist individuals in participating in error-reduced practices with greater confidence, thereby facilitating performance improvement.

Additionally, self-efficacy, defined as the belief in one's ability to perform specific tasks, plays a crucial role in determining the level of effort and focus a learner exhibit. Individuals with high self-efficacy generally show greater resilience when facing challenges and errors, utilizing success criteria as a motivating factor for performance enhancement. Ultimately, the combination of error-reduced practice, effective management of mood states, and the enhancement of self-efficacy can lead to the optimization of motor skill learning and significantly impact athletic performance.

Recent research works in this area include the one carried out by Parma et al. (2023). The findings revealed that reduction in the success criterion cannot significantly influence pressure, effort, accumulation of explicit knowledge, or conscious processing. These results challenged the key principles of OPTIMAL theory and questioned the efficacy of success criteria for improving motor learning [17].

Mousavi et al. (2022) revealed that the

provision of relatively easy criteria facilitated motor skill acquisition in children [18]. In a study conducted by Bacelar et al. (2022) a meta-analytic approach was taken into account to measure the mean and individual effect sizes of six types of manipulations to increase expectations. The results showed that increasing learners' expectations could significantly influence skill retention [19].

In addition, the results of the study conducted by Taghiyan Fini et al. (2023) revealed that using the key elements of the OPTIMAL theory during practice may not be an appropriate intervention for learning motor skills in children [20].

Research in the field of motor learning and the identification of optimal training conditions is of paramount importance due to its crucial role in enhancing performance and the acquisition of motor skills, particularly within therapeutic and educational settings. Recognizing the factors that influence motor performance requires careful consideration not only from a theoretical standpoint but also from a practical perspective.

Mood states are recognized as significant influencers of athletic performance, as they can profoundly affect learning outcomes. Understanding how mood states impact individuals' motivation and focus can lead to improved educational and athletic strategies. Furthermore, self-efficacy, as a critical psychological variable in sports psychology, plays an essential role in predicting performance and individuals' responses in challenging situations.

The application of efficient educational methods, particularly low-error practice, can significantly expedite the learning process and the attainment of motor skills. Interventions designed to enhance small successes and positive expectations, especially in motor skill learning, can lead to improved learning quality and performance consistency.

Previous research has demonstrated that employing appropriate strategies in designing training programs can yield positive effects on both learning enhancement and performance efficiency. Therefore, this study aims to identify and analyze various dimensions of motor learning and related psychological variables, thereby providing insights for coaches and researchers in the field. By applying scientific findings, they can implement more effective educational and training methods. Ultimately, the results of this research can contribute not only to the development of new theories within motor learning and sports psychology but also to the improvement of policies and approaches in education and training. This is particularly significant for professionals and practitioners in the fields of sports and education, as it will facilitate the practical application of findings and the generation of new knowledge within these domains.

2. Materials and Methods

2.1. Participation

This study is a practical, field-based, quasi-experimental research that was conducted over three sessions: (1) pre-test phase, (2) acquisition and post-test phase, and (3) retention and transfer test phase. The participants were 30 female students from Yazd University, aged between 19 and 22, who were selected through convenience sampling. After completing consent forms, the participants were randomly assigned to three groups: low-error practice with a large target (n=10), low-error practice with a small target (n=10), and a low-error control group with a standard target (n=10). This sample size is based on past studies [21].

Inclusion criteria included no prior dart skill experience (beginner), relative physical and mental health (based on the Goldberg & Williams questionnaire [22]), normal vision (based on the Snellen test), and right-handedness (based on the subjects' self-reports). Exclusion criteria were lack of willingness to continue participation, potential physical injury, and practicing darts outside of the prescribed protocol. The participants were categorized as "inactive" since they had no prior experience with competitive dart playing or training.

2.2. Instrument

2.2.1. Dartboard

A standard-sized dartboard was mounted at a height of 1.73 meters. During the training sessions, the participants in the large and small target groups aimed at yellow circular practice targets with radii of 16 and 7 cm, respectively. These paper targets were attached to the dartboard. No score was taken into account for the darts landing outside these yellow targets. In other words, the throws landing within the yellow target areas were the only scored ones [23].

2.2.2. Brums mood states questionnaire

This questionnaire was utilized to measure the participants' positive and negative mood states. It is composed of 32-Likert-Scale items across six dimensions: vigor, tension, fatigue, depression, anger, and confusion. Each item is scored on a scale from 0 to 5, where 0 indicates "not at all" and 5 indicates "completely".

The total score is the mean of the ones recorded on four items proposed for each dimension. The study by Farrokhi et al. (2023), involving 32 male and female athletes across ten team and individual sports, validated the factorial validity and reliability of the Persian version of this questionnaire [24]. The internal consistency coefficients were recorded as: tension, vigor, confusion, fatigue, happiness, calmness, depression, anger, and overall questionnaire. The internal consistency coefficients were recorded as: tension, vigor, confusion, fatigue, happiness, calmness, depression, anger. Notably, all subscales exhibited internal consistency above 0.72. The test-retest reliability coefficients were recorded as: tension, vigor, confusion, fatigue, happiness, calmness, depression, anger, and overall questionnaire. Notably, all subscales exhibited internal consistency above 0.87. The numerical findings show high levels of validity and reliability for the Persian 32-item version of the Brums Mood States Questionnaire [24].

2.2.3. Bandura's self-efficacy questionnaire

In order to gather the intended data on self-efficacy expectations, Bandura (1997) self-efficacy questionnaire was administered among the participants in all three groups [14]. This questionnaire was adapted for shooting by Gernigon (2000) and consists of two main indices. The first index includes five levels, asking the participants to predict their expected performance in the future tasks. The levels range from hitting the target one, three, five, seven, and nine out of ten shots, respectively. Participants say "yes" at each level until the time that they get to a point where they feel they cannot achieve. For each level they agree with, they also rate their confidence in achieving the result on a scale from 10% (not confident) to 100% (completely confident). This index measures the strength level of self-efficacy expectations. The total number of positive responses deals with the level of self-efficacy expectations, and the average of the confidence ratings for those levels shows the strength level of self-efficacy

expectations. Gernigon reported the reliability of this questionnaire as 69% for the level index and 66% for the strength index [25].

In another study, reported internal reliability using Cronbach's alpha, with 79% without considering the indices and 78% and 71% for the level and strength indices, respectively. Due to the similarity between shooting and dart throwing tasks, the terminology for hitting targets was adapted accordingly [26].

2.3. Procedure

One week before the initiation of the intervention, the participants took part in a pre-test of the criterion task. The pre-test was administered to identify the potential differences and ensure homogeneity among the groups in their initial performance. The selected participants stood at a distance of 3.5 m from the dartboard and threw darts towards the target. The average of ten attempts per individual was taken into account as the pre-test score [27]. Subsequently, all groups were proposed to the self-efficacy and mood state questionnaires. Based on the pre-test results in the dart-throwing task, the participants were evenly divided into three groups. In the first session, all the participants were provided with uniform instruction on the skill [26]. During the acquisition phase, which was composed of only one session, all groups completed five blocks of 10 trials (a total of 50 trials) at varying distances (ten throws per distance). The low-error group participants started the trials from a distance of 3.5 m and gradually moved to distances of 3, 2.5, 2, and 1.5 m from the board. To avoid the effect of fatigue, a one-minute break was given after each block. In the acquisition phase, participants were instructed to work for the intended practice target, aiming to land the dart in the yellow zone (which had target areas with radii of 16 and 7 cm). Each trial was scored. Participants could review their scores on a score sheet, between the training blocks, in order to improve their understanding of success or failure and keep engaged in the practice [23]. At the end of the acquisition phase, a post-test and questionnaires were administered. After a one-week no-practice period, participants first performed three warm-up throws (not recorded) followed by ten throws from a distance of 3.5 m without the yellow target areas (standard targets) for the retention test. Then, the obtained results were recorded. On the same day, the transfer test was conducted, with a 10-minute rest after the retention test. For the transfer test, the participants in each group completed ten throws from a distance of 4 m without considering the yellow target areas. The scoring method in darts involves the following:

a) Bullseye

- The center of the board (Bullseye) is worth 50 points.
- The outer bull (Outer Bull) is worth 25 points.

b) Sections 1 to 20

Each section has three scoring areas:

- **Single**: The score of the section (e.g., hitting the 20 scores 20 points),
- **Double**: Twice the score of the section (e.g., hitting double 20 scores 40 points),
- **Triple**: Three times the score of the section (e.g., hitting triple 20 scores 60 points).

2.4. Statistic

Descriptive statistics, including mean and standard deviation, were used to describe the data. The Shapiro-Wilk test was run to

verify the normality of data distribution, and Levene's test was used to evaluate the homogeneity of variances. Hypotheses were analyzed using repeated measures mixed ANOVA for the acquisition, retention, and transfer tests. Data analysis was performed using SPSS software version 23, with a significance level set at $P< 0.05$.

3. Results

Tables 1, 2, and 3 represent the descriptive statistics (means and standard deviations) for the pre-test, post-test, retention, and transfer phases for the three groups: small target, large target, and control.

Table 1. Descriptive results on performance accuracy in the small target, large target, and control groups

	Small target	Large target	Control
Pre-test	61.30±24.80	43.30±27.25	38.80±24.32
Post-test	80.40±21.60	55.80±29.77	42.0±23.66
Retention	68.30±22.39	65.30±22.71	43.10±21.41
Transfer	55.20±22.15	54.30±26.18	37.40±18.44

Table 2. Descriptive results on mood states in the small target, large target, and control groups

	Pre-test			Post-test		
	Small target	Large target	Control	Small target	Large target	Control
Tension	4.00±2.90	5.40±4.85	3.40±1.77	20.3±2.65	4.19±3.70	3.40±2.36
Depression	1.50±1.84	4.20±3.70	20.3 ± 2.82	2.20 ± 2.61	2.70±3.56	3.90±2.37
Anger	2.80±3.36	2.90±3.28	4.10±1.66	2.10±2.13	2.60±3.62	3.40±1.83
Vigor	10.90±2.68	9.80±3.42	7.40 ± 2.22	10.30 ± 2.11	8.90±2.55	7.40 ± 2.22
Fatigue	2.90±3.31	4.27 ± 4.30	2.90 ± 1.79	3.00 ± 3.43	2.90±3.69	3.10±1.91
Confusion	4.60 ± 4.64	6.30±5.05	5.60 ± 3.74	4.08 ± 5.00	4.90±5.32	3.23 ± 5.00
Calmness	8.70±2.62	3.19 ± 9.20	7.20±2.53	8.50±2.06	9.50±3.53	6.50±1.95
Happiness	10.40±2.27	9.10±2.47	9.40±3.02	8.30±1.56	9.10±3.10	8.30 ± 2.26
Total mood States	45.80±12.93	51.20±18.50	43.20±7.16	42.60±13.40	44.30±15.57	41.30±6.81

Table 3. Descriptive results on self-efficacy in the small target, large target, and control groups

	Expectations			Power		
	Small target	Large target	Control	Small target	Large target	Control
Pre-test	2.80±1.22	2.80±0.91	3.40±0.51	55.90±19.31	55.80±17.94	71.00±12.18
Post-test	3.20±0.78	3.20±0.78	3.40±0.69	71.40±10.66	60.67±16.50	70.20±8.75

3.1. Performance accuracy

The results from the 3 (small target, large target, control) × 4 (pre-test, post-test, retention, transfer) mixed ANOVA demonstrated statistically significant within-subject effects. In fact, there was a significant main effect for time (pre-test, post-test, retention, transfer; $F(3, 25)= 15.40$, $P < 0.001$), a significant main effect for group (small target, large target, control; $F(2, 27)= 3.86$, $P= 0.03$), and a significant interaction effect between group and time ($F(6, 50)= 2.32$, $P= 0.04$). Due to the significance of the interaction effect, further analyses were carried out to explore these effects in detail.

Regarding the numerical results obtained for the interaction effects, there was a significant difference between the small target group ($F(3, 25)= 12.93$, $P< 0.001$, partial $\eta^2= 0.60$, power= 0.99) and the large target group ($F(3, 25)= 6.08$, $P= 0.003$, partial $\eta^2= 0.42$, power= 0.92).

However, no significant differences were observed in the Control group (F(3, 25)= 1.19, *P*= 0.33, partial η^2= 0.12, power= 0.28). These effect sizes revealed that approximately 60% of the variance in the small target group and 42% of the variance in the large target group can be associated with the use of low-error teaching methods (Table 4).

Table 4. Pairwise comparisons of groups across pre-test, post-test, retention, and transfer

		Small target			Large target			Control		
Time (i)	Time (j)	Mean difference	Standard deviation	P value (sig)	Mean difference	Standard deviation	P value (sig)	Mean difference	Standard deviation	P value (sig)
Pre-test	Post-test	19.10	4.70	*0.001	12.50	4.70	0.01	3.20	4.70	0.50
Pre-test	Retention	7.00	7.30	0.34	22.00	7.30	0.006	4.30	7.30	0.56
Pre-test	Transfer	6.10	6.97	0.39	11.00	6.97	0.12	1.40	6.97	0.84
Post-test	Retention	12.10	6.43	0.07	9.50	6.43	0.15	1.10	6.43	0.86
Post-test	Transfer	25.20	6.09	*0.001	1.50	6.09	0.80	4.60	6.09	0.45
Retention	Transfer	13.10	3.14	*0.001	11.00	3.14	0.002	5.70	3.14	0.08

*P<0.05

3.2. Mood states

The results from the 3 (small target, large target, control) × 2 (pre-test, post-test) × 9 (tension, depression, anger, vigor, fatigue, confusion, calmness, happiness, total mood states) mixed ANOVA revealed that there was a significant main effect for time (pre-test, post-test; F(1, 27)= 10.05, *P*= 0.004), but no significant main effect for groups (small target, large target, control; F(2, 27)= 0.48, *P*= 0.62). Moreover, a significant main effect was observed for mood states (F(8, 20)= 123.13, *P*< 0.001). The results showed that no significant interaction effect was observed between group and time (F(2, 27)= 1.40, *P*= 0.26). On the other hand, significant interaction effects were observed between group and mood states (F(16, 42)= 1.93, *P*= 0.04), time and mood states (F(8, 20)= 2.83, *P*= 0.02), and time, group, and mood states (F(16, 42)= 1.93, *P*= 0.04). Further analyses were run to explore these interaction effects in detail.

The interaction effects illustrated significant differences in the small target group for the Happiness dimension (F(1, 27)= 14.20, *P*< 0.001, partial η^2= 0.34, power= 0.95), indicating that 34% of the changes in happiness can be associated with the application of small target in low-error training. On the other hand, no significant differences were observed for Tension (F(1, 27)= 1.05, *P*= 0.31, partial η^2 = 0.03, power= 0.16), depression (F(1, 27)= 1.68, *P*= 0.20, partial η^2= 0.05, power= 0.24), Anger (F(1, 27)= 0.90, *P*= 0.35, partial η^2= 0.03, power= 0.15), Vigor (F(1, 27)= 1.01, *P*= 0.32, partial η^2= 0.03, power= 0.16), fatigue (F(1, 27)= 0.03, *P*= 0.86, partial η^2= 0.001, power= 0.05), confusion (F(1, 27)= 0.12, *P*= 0.72, partial η^2= 0.005, power= 0.06), calmness (F(1, 27)= 0.05, *P*= 0.81, partial η^2= 0.002, power= 0.05), and total mood states (F(1, 27)= 2.14, *P*= 0.15, partial η^2= 0.07, power= 0.29).

In the large target group, significant differences were observed for tension (F(1, 27)= 4.76, *P*= 0.03, partial η^2= 0.15, power= 0.55), depression (F(1, 27)= 7.71, *P*= 0.01, partial η^2= 0.22, power= 0.76), fatigue (F(1,

27)= 6.23, *P*= 0.01, partial η^2= 0.18, power= 0.67), and total mood states (F(1, 27)= 9.97, *P*= 0.004, partial η^2= 0.27, power= 0.86). These results show that 15% of the changes in tension, 22% in depression, 18% in fatigue, and 27% in total mood states were affected by the use of the large target in low-error training. However, no statistically significant differences were reported for Anger (F(1, 27)= 0.16, *P*= 0.68, partial η^2= 0.006, power= 0.06), vigor (F(1, 27)= 2.29, *P*= 0.14, partial η^2= 0.07, power= 0.30), confusion (F(1, 27)= 1.54, *P*= 0.22, partial η^2= 0.05, power= 0.22), calmness (F(1, 27)= 0.12, *P*= 0.73, partial η^2= 0.004, power= 0.06), and Happiness (F(1, 27)= 0.001, *P*= 1.00, partial η^2= 0.001, power= 0.05).

In the control group, no significant differences were observed for any of the dimensions: Tension (F(1, 27)= 0.001, *P*= 1.00, partial η^2= 0.001, power= 0.05), depression (F(1, 27)= 1.68, *P*= 0.20, partial η^2= 0.05, power= 0.24), anger (F(1, 27)= 0.90, *P*= 0.35, partial η^2= 0.03, power= 0.15), vigor (F(1, 27)= 0.25, *P*= 0.61, partial η^2= 0.009, power= 0.07), fatigue (F(1, 27)= 0.12, *P*= 0.72, partial η^2= 0.005, power= 0.06), confusion (F(1, 27)= 0.28, *P*= 0.59, partial η^2= 0.01, power= 0.08), calmness (F(1, 27)= 0.66, *P*= 0.42, partial η^2= 0.02, power= 0.12), happiness (F(1, 27)= 3.89, *P*= 0.05, partial η^2= 0.12, power= 0.47), and total mood states (F(1, 27)= 0.75, *P*= 0.39, partial η^2= 0.02, power= 0.13, (Table 5).

Table 5. Pairwise comparison of groups in pre-test and post-test of mood states

			Small target			Large target			Control		
	Time (i)	Time (j)	Mean difference	Standard deviation	P value (sig)	Mean difference	Standard deviation	P value (sig)	Mean difference	Standard deviation	P value (sig)
Tension	Pre-test	Post-test	0.80	0.77	0.31	1.70	0.72	0.03	8.88	0.77	1.00
Depression	Pre-test	Post-test	0.70	0.54	0.20	1/50	0.54	0.01	0.70	0.54	0.20
Anger	Pre-test	Post-test	0.70	0.73	0.35	0.30	0.73	0.68	0.70	0.73	0.35
Vigor	Pre-test	Post-test	0.60	0.59	0.32	0.90	0.59	0.14	0.30	0.59	0.61
Fatigue	Pre-test	Post-test	0.10	0.56	0.86	1.40	0.56	0.01	0.20	0.56	0.72
Confusion	Pre-test	Post-test	0.40	1.12	0.72	1.40	1.12	0.22	0.60	1.12	0.59
Calmness	Pre-test	Post-test	0.20	0.86	0.81	0.30	0.86	0.73	0.70	0.86	0.42
Happiness	Pre-test	Post-test	2.10	0.55	0.001	0.01	0.55	1.00	1.10	0.55	0.05
Total mood states	Pre-test	Post-test	3.20	2.18	0.15	6.90	2.18	0.004	1.90	2.18	0.39

*$P<0.05$

3.3. Self-Efficacy

The results from the 3 (small goal, large goal, control) × 2 (pre-test, post-test) × 2 (level and strength) mixed ANOVA indicated a significant main effect for time (pre-test, post-test; F(1, 27)= 11.25, *P*= 0.002), no significant main effect for group (small goal, large goal, control; F(2, 27)= 1.45, *P*= 0.25), and a significant main effect for self-efficacy (F(1, 27)= 733.89, *P*< 0.001). Regarding the interaction effect, a significant interaction effect was observed between group and time (F(2, 27)= 3.48, *P*= 0.04), and time and self-efficacy (F(1, 27)= 9.52, *P*= 0.005). However, no significant interaction effect was recorded between group and self-efficacy (F(2, 27)= 1.25, *P*= 0.30). In addition, a marginally significant three-way interaction was observed between time, group, and self-efficacy (F(2, 27)= 2.99, *P*= 0.06). Further analyses were run to explore these interaction effects in detail.

The numerical results obtained on the interaction effects showed that, in the small

goal group, there was no significant difference in the Level dimension (F(1, 27)= 1.89, *P*= 0.18, partial η^2= 0.06, power= 0.26). On the other hand, there was a significant difference in the strength dimension (F(1, 27)= 10.67, *P*= 0.003, partial η^2= 0.28, power= 0.88). Regarding the effect sizes, it was revealed that 28% of the changes in the strength dimension in the small target group could be attributed to the use of the low-error teaching method. Similarly, in the large goal group, no significant difference was reported for the level dimension (F(1, 27)= 1.89, *P*= 0.18, partial η^2= 0.06, power= 0.26). On the other hand, a significant difference was observed in the strength dimension (F(1, 27)= 6.18, *P*= 0.01, partial η^2= 0.18, power= 0.66). Regarding the effect sizes, it was revealed that 18% of the changes in the strength dimension in the large target group could be attributed to the use of the low-error teaching method. By contrast, in the control group, no significant difference was reported for Level (F(1, 27)= 0.001, *P*= 1.00, partial η^2= 0.001, power= 0.05) and strength dimensions (F(1, 27)= 0.02, *P*= 0.86, partial η^2= 0.001, power= 0.05), (Table 6).

Table 6. Pairwise comparison of groups in pre-test and post-test of self-efficacy

			Small target			Large target			Control		
	Time (i)	Time (j)	Mean difference	Standard deviation	P value (sig)	Mean difference	Standard deviation	P value (sig)	Mean difference	Standard deviation	P value (sig)
Level	Pre-test	Post-test	0.40	0.29	0.18	0.40	0.29	0.18	4.44	0.29	1.00
Power	Pre-test	Post-test	15.50	4.74	0.003	11.80	4.74	0.01	0.80	4.74	0.86

*P<0.05

4. Discussion

Practice can be considered the most important factor in enhancing the capability to perform motor skills. As a result, the application of effective methods in practice sessions is important. Efficient practice can lead the participants to an improved learning process and facilitate the individual's progression to a higher level of skill proficiency [28]. The current study was carried out to explore the impact of success criteria under low-error practice conditions on the learning of a motor skills, self-efficacy, and mood states. The obtained findings revealed that there was a significant difference in performance accuracy between the small target and large target groups, with the small target group showing a greater impact. On the other hand, no significant difference was observed in the control group. Considering the psychological variable of mood state, significant difference was observed in the happiness subscale for the small target group. In the large target group significant differences were reported in the tension, depression, fatigue, and total mood state subscales. No significant differences were observed in other subscales for these groups. Moreover, in terms of the self-efficacy variable, significant differences were observed in the power dimension for both the small and large targets, but no significant differences were observed in the level dimension. It is worth noting that the significant differences found in the variables were influenced by the use of the low-error training method.

The findings of this study are in line with the research conducted by Chiviakowski et al. [7], Ong et al. [23], Mousavi et al. [18], Bacelar et al. [19], and Ong et al. [29]. On the other hand, they are inconsistent with the findings of Ziv and Lidor [30], Ong and Hodges [31], and Parma et al. [17].

In the study conducted by Chiviacowsky et al. (2012), the criteria for success were manipulated to influence participants' perceptions of success. Participants practiced under one of three conditions: (1) a difficult target criterion (an error of 4 milliseconds or less was considered a good trial), (2) a less difficult or more attainable target criterion (an error of 30 milliseconds or less was considered good), and (3) a control group that was not informed about what constituted a good trial. Participants who practiced with the difficult target criterion were more accurate than the other groups [7].

Ong et al. (2015) found that participants in the large target group reported more successful performances and higher levels of confidence (or self-efficacy) compared to the small target group [23]. In a subsequent study by Ong et al. (2019), the findings indicated that the participants throwing darts at a large target had higher expectations of success than the ones at a small target [29]. However, no significant difference was observed between the two groups in performance.

Mousavi et al. (2022) indicated relatively easy criteria facilitated motor skill acquisition in children [18]. In their meta-analytic study, Bacelar et al. (2022) worked on the mean and individual effect sizes of six types of manipulations designed to raise the expectations. The findings showed that, as a whole, enhanced learners' expectations had a significant effect on their skill retention [19]. Ong and Hodges (2018) reported that while manipulations affected competence and arousal, they had no significant effect on balance outcomes [31]. These results are in contrasts with the claims made by the OPTIMAL theory, which posits that the perception of success mediates motor learning.

In another study in the area of motor learning, Ziv and Lidor (2021) worked on the effect of success criteria on different tasks and found that changes in success criteria influenced expectations of success but it could not enhance actual performance or learning in golf tasks [34]. Parma et al. (2023) conducted a study which indicated that lowering success criteria did not benefit pressure, effort, explicit knowledge accumulation, or conscious processing. As mentioned above, such kinds of findings challenge key principles of the OPTIMAL theory and significantly question the efficacy of success criteria in motor learning [17]. The discrepancies between the present study's results and the findings of the aforementioned studies may be attributed to differences in physical activity type, training protocol, participant gender, age range, and training duration.

On the other hand, expectations of self-efficacy that align with an individual's actual capabilities in a task contribute to improved psychological well-being and positive changes in personal coherence. In this regard, a study by Jones et al. (2010) examined the role of expectations and self-efficacy in sports activities, concluding that realistic expectations enhance success, which in turn helps prevent the potential negative effects of failure in performance [32]. Additionally, a study by Coffee et al. (2009) investigated the effects of failure on self-efficacy beliefs, as well as the impact of controllability and stability on these

beliefs. The results indicated that failure accompanied by a lack of control over performance outcomes leads to lower self-efficacy and poorer performance [33].

Mohammadzadeh and Heydari (2012) investigated the relationship between failure or success and self-efficacy expectations in shooting tasks. The findings of this study are consistent with Bandura's theory regarding the effects of successful experiences on enhancing self-efficacy [34]. Therefore, according to the research conducted and the results of the present study, self-efficacy expectations, as a type of situational self-confidence, are influenced by previous experiences, and its changes can have a significant impact on an individual's behavioral patterns in dealing with possible failure.

Measuring behavior in specific sports situations can be a better predictor of performance. Additionally, sports psychologists seek to create specialized tests that can more reliably and consistently measure stable and unstable personality traits in sports contexts. One of these tests is the mood states questionnaire.

Shamsipour Dehkordi and colleagues (2023) examined mood states and sports emotions among Iranian athletes. The results indicated that measuring emotions such as joy, anger, anxiety, and confidence can enhance the understanding of athletes' emotional experiences and contribute to improving their performance and well-being [35].

Farrokhi et al. (2013) examined the mood states questionnaire among athletes. The results indicated that this tool can be an effective means for measuring mood states in research related to motor behavior [24].

5. Limitations

Limitations of the present study include various factors such as participants' rest periods throughout the day, psychological factors like stress and anxiety during testing, genetic effects, and individual differences in response to training. Future research should examine the effects of other activities that might influence on performance and consider longer training durations and more frequent sessions per week. Additionally, future studies should explore the impact of gender on the current research variables and compare the results accordingly.

6. Conclusions

The present study demonstrated that success criteria in low-error training conditions significantly impact the learning of motor skills and mood states. The use of small goals in training not only enhances performance accuracy but also contributes to improved self-efficacy and reduced tension. These results clearly indicate that setting appropriate goals can accelerate the learning process and provide a more positive experience for learners. Ultimately, the findings of this study can assist educators and researchers in designing more effective educational programs and optimizing training conditions to enhance individuals' learning and motor performance. Overall, these insights underscore the importance of addressing the psychological aspects of motor skill learning and highlight that the proper selection of goals can lead to improved educational outcomes

Conflict of interest

The authors declared no conflicts of interest.

Authors' contributions

The author contributed to the original idea, study design.

Ethical considerations

The author has completely considered ethical issues, including informed consent, plagiarism, data fabrication, misconduct, and/or falsification, double publication and/or redundancy, submission, etc.

This study was approved by the Ethics Committee of Yazd University (Ethics Code: IR.YAZD.REC.1403.062). All participants have signed informed consent prior to enrolment in the study. This research was conducted ethically in accordance with the World Medical Association Declaration of Helsinki.

Data availability

The dataset generated and analyzed during the current study is available from the corresponding author on reasonable request.

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References

[1] Arsham S, Sarabandi M, Sanaei F. "The effect of social-comparative feedback and autonomy support on self-efficacy and children motor learning". *J Res Behav Sci*. 2018; 15(4): 443-51. https://doi.org/20.1001.1.17352029.1396.15.4.7.2. [in Persian]

[2] Abdollahipour R, Valtr L, Wulf G. "Optimizing bowling performance". *J Mot Learn Dev*. 2019; 8(2): 233-44. https://doi.org/10.1123/jmld.2019-0017.

[3] Guadagnoli M, Lindquist K. (2007). "Challenge point framework and efficient learning of golf". *International Journal of Sports Science & Coaching*. 2(1): 185-197. https://doi.org/10.1260/17479540778 9705505.

[4] Magill R, Anderson D. *Motor Learning and Control*. United States of America: McGraw - Hill Education. 2017.

[5] Wulf G, Lewthwaite R. "Optimizing performance through intrinsic motivation and attention for learning: The OPTIMAL theory of motor learning". *Psychon Bull Rev*. 2016; 23(5): 1382-414. https://doi.org/10.3758/s13423-015-0999-9.

[6] Palmer K, Chiviacowsky S, Wulf G. "Enhanced expectancies facilitate golf putting". *Psychol. Sport Exerc*. 2016; 22: 229-232. https://doi.org/10.1016/j.psychsport.2015.08.009.

[7] Chiviacowsky S, Wulf G, Lewthwaite R. "Self-controlled learning: the importance of protecting perceptions of competence". *Front. Psychol*. 2012; 3: 458. https://doi.org/10.3389/fpsyg.2012.00458.

[8] Conroy P, Lambon Ralph MA. "Errorless learning and rehabilitation of language and memory impairments". *Neuropsychological Rehabilitation*. 2012; 22(2): 137. https://doi.org/10.1080/09602011.2012.662064.

[9] Masters RS, Maxwell JP. "Implicit motor learning, reinvestment and movement disruption". *Skill Acquisition in Sport*. 2004: 231-252. Routledge. https://doi.org/10.4324/9780203646564.

[10] Capio CM, Poolton J, Sit C, Eguia K, Masters R. "Reduction of errors during practice facilitates fundamental movement skill learning in children with intellectual disabilities". *Journal of Intellectual Disability Research*. 2013; 57(4): 295-305. https://doi.org/10.1111/j.1365-2788.2012. 01535.x.

[11] Poolton JM, Masters RS, Maxwell JP. "Passing thoughts on the evolutionary stability of implicit motor behaviour: Performance retention under physiological fatigue". *Consciousness and Cognition*. 2007; 16(2): 456-68. https://doi.org/10.1016/j.concog.2006.06.008.

[12] Vaez Mosavi MK, Abed Eshghi M. "Validity and reliability of persian version of the Sport Emotion Questionnaire (SEQ) among athletes with different physical activity level". *Sport Psychology Studies*. 2023; 12(43), 31-52. https://doi.org/10.22089/spsyj.2020.7128.1757. [in Persian]

[13] Lane AM, Gregory P, Whyte P. Terry C, Nevill AM. "Mood, self-set goals and examination performance: the moderating effect of depressed mood". *Personality and Individual Differences*.

2005. 39: 143-53. https://doi.org/10.1016/j.paid.2004.12.015.

[14] Bandura A. *Self – Efficiacy: The Exercise of Control*. Freeman. 1997.

[15] Moritz SE, Feltz DL, Fahrbach KR, Mack DE. "The relation of self-efficacy measures to sport performance: a meta-analytic review". *Res Q Exerc Sport*. 2000; 71(3): 280-94. https://doi.org/10.1080/02701367.2000.10608908. PMID: 10999265.

[16] Bandura A. *Social Foundations of Thought and Action; A Social Cognitive Theory*. Englewood, Ciffs, NJ- Hall. Inc. 1986.

[17] Parma GO, Bacelar MFB, Cabral DAR, Lohse KR, Hodges NJ, Miller MW. "That looks easy! Evidence against the benefits of an easier criterion of success for enhancing motor learning". *Psychology of Sport and Exercise*. 2023; 66: 102394. https://doi.org/10.1016/j.psychsport.2023.102394.

[18] Mousavi SM, Dehghanizade J, Iwatsuki T. "Neither too easy nor too difficult: Effects of different success criteria on motor skill acquisition in children". *Journal of Sport and Exercise Psychology*. 2022; 10. https://doi.org/10.1123/jsep.2022-0082. [in Persian]

[19] Bacelar MFB, Parma JO, Murrah WM, Miller MW. "Meta-analyzing enhanced expectancies on motor learning: Positive effects but methodological 128 concerns". *International Review of Sport and Exercise Psychology*. 2022. https://doi.org/10.1080/1750984X.2022.2042839.

[20] Taghiyan Fini F, Nezakat Alhosseini M, Safavi Homami Sh. "The effect of optimizing performance through enhanced expectancies, autonomy support, and external attentional focus on motor learning in children". *Motor Behavior*. 2023; 14(50): 17-38. https://doi.org/10.22089/mbj.2023.13834.2064. [in Persian]

[21] Goldberg DP, Williams P. *A Users's Guide to the General Health Questionnaire*. London, England: GL Assessment. 1988.

[22] Ramezanzade H, Doraneh Kord M. "The effect of attention focus in errorless and errorful practice conditions on performance and learning of dart throwing skill". *Journal of Sports Movement Growth and Learning*. 2018; 10(1): 121-138. https://doi.org/10.22059/jmlm.2018.229760.1228. [in Persian]

[23] Ong NT, Lohse KR, Hodges NJ. "Manipulating target size influences perceptions of success when learning a dart-throwing skill but does not impact retention". *Front. Psychol*. 2015: 6: 1378. https://doi.org/10.3389/fpsyg.2015.01378.

[24] Farrokhi A, Mutshariy A, Zeidabadi R. "Determining the factorial validity and reliability of the Persian version of the 32-item Bromez Mood Questionnaire". *Movement Behavior*. 2013; 13. [in Persian]

[25] Gernigon C, Fleurance P. "Effects of uncontrollability and faiure on the development of learned helpessness in perceptual – motor tasks". *Research Quarterly for Exercise and Sport*. 2000; 71(1): 44-54. https://doi.org/10.1080/02701367.2000.10608879.

[26] Mohammadzadeh H. *The Effect of Failure (Learned Helplessness) on the Performance and Learning of Motor Skills in Physical Education Students at Urmia University*. Doctoral Dissertation and Defended at the University of Tehran. 2003. [in Persian]

[27] Ghamari A, Mohamadi J, Mohamadi M. "The effect of errorless and errorfull practice on learning and transfer of dart throwing skill in adolescents with intellectual disabilities". *Behavioral Journal*. 2015; 7(21): 126-111. [in Persian]

[28] Schmidt RA, Lee TD. *Motor Learning and Performance: From Principles to Application*. Human Kinetics; 2013.

[29] Ong NT, Hawke J, Hodges NJ. "Target size manipulations affect error processing duration and success perceptions but not behavioural indices of learning". *Brain Sciences*. 2019; 9: 119. https://doi.org/10.3390/brainsci9050119.

[30] Ziv G, Lidor R. "Different task success criteria affect expectancies of success but do not improve golf putting performance. *Psychology of Sport and Exercise*. 2021; 54, 101887. https://doi.org/10.1016/j.psychsport.2021.101887.

[31] Ong NT, Hodges NJ. "Balancing our perceptions of the efficacy of success-based feedback manipulations on motor learning". *Journal of Motor Behavior*. 2018; 50: 614-630. https://doi.org/10.1080/00222895.2017.1383227.

[32] Jones F, Harris P, Waller H, Coggins A. (2005). "Adherence to exercise prescription scheme: the role of expections, self – efficacy, stage of change and psychological well – being". *British*

Journal of Health Psychology. 10(3): 359-378. https://doi.org/10.1348/135910704X24798.

[33] Coffee P, Rees T, Hasler A. "Bouneing back from failure: The interactive impact of perceived controllability and stability on self-efficacy beliefs and future task performance". *Journal of Sports Sciences*. 2009; 27(11): 1117-1124. https://doi.org/10.1080/02640410903030297.

[34] Mohammadzadeh H, Heydari M. (2012). The Relationship of Failure or Success with Self-Efficacy Expectations of Young Men in Shooting Task. *Journal of Sports and Motor Development and Learning*. 2012; 4(1): 5-18. https://doi.org/10.22059/jmlm.2012.25072.

[35] Shamsipour Dehkordi P, Vaez Mousavi MK, Aded Eshghi M. (2023). "Validity and reliability of persian version of the Sport Emotion Questionnaire (SEQ) among athletes with different physical activity level". *Sport Psychology Studies*. 12(43): 31-52. https://doi.org/10.22089/SPSYJ.2020.7128.1757. [in Persian]