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Research Article



The Effect of Seven Mental Training Sessions on Developing Roundoff and Back Handspring Skills on Men's Artistic Gymnastics

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Abstract

Background: Beginner gymnasts face challenges when performing roundoff and back handspring skills, particularly in connecting the final stage of the roundoff with the initial stage of the back handspring. These difficulties arise when there is a lack of clarity in the mental image of the performance sequence, leading to inconsistent execution and, ultimately, failure.

Objectives: This study investigates the effect of seven mental training sessions on beginner gymnasts learning the roundoff and back handspring skills.

Methods: Sixty-two beginner gymnasts, aged 21 - 22 years, participated in the study. They were randomly assigned to two groups: Control and experimental. The mental training sessions were provided to the experimental group during the instructional sessions, with each session lasting 14 minutes and 30 seconds. The sessions consisted of three parts: Relaxation exercises, controllable control exercises, and mental imagery exercises for performance. These sessions were conducted over a period of seven weeks. The roundoff and back handspring skills were assessed using the Kinematic Coherence Scale for body parts.

Results: The Kinematic Coherence Scale demonstrated a significant difference and greater improvement in the experimental group compared to the control group.

Conclusions: We concluded that the seven mental training sessions improved the kinematic coherence of the experimental group in performing the roundoff and back handspring skills, enabling them to connect the two skills with a higher degree of movement coherence.

Keywords: Back Handspring, Men's Artistic Gymnastics, Mental Training, Roundoff

1. Background

Mental training is defined as a dynamic cognitive process that allows individuals to mentally simulate or rehearse movements (1, 2). It can be practiced in various forms, including auditory, visual, olfactory, gustatory, tactile, and kinesthetic (3). Several experimental studies have shown that practicing mental imagery can affect neural control mechanisms and is associated with actual motor performance, stimulating the brain cortex and enhancing motor skills (4-7). This provides evidence of a common encoding between cognitive perception and actual motor performance (8-10). In the past, mental training practices were limited to sports training. Athletes tended to include mental training in their programs only when they suffered physical injuries or needed to control the psychological stress associated with competitions (11, 12). However, mental training has now become a powerful tool for enhancing the learning of new movements. Practicing mental training helps correct errors in the motor pathway of body parts and eliminate them. There is a similarity in time frames between the mental visualization of a movement and its actual performance, meaning it is possible to activate motor performance through proper mental simulation (13-16).

The roundoff and handspring skills are part of the beginner gymnastics curriculum at the College of Physical Education at Anbar University. The roundoff is a technique for converting horizontal body speed into vertical speed and is usually the first skill taught before

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Brieflands

learning the back handspring as a related movement. Despite beginners possessing physical qualities that qualify them for gymnastics, many face obstacles when performing roundoff and handspring skills together. As a result, they are unable to connect the final stage of the roundoff with the first stage of the back handspring.

Beginner gymnasts, especially when learning the roundoff and back handspring skills, often experience internal feelings of losing coordination in the timing of body movements during the connection of these two skills. Others report negative self-talk, telling them they will fail when trying to push off the ground with their legs to achieve sufficient height in the air, which is necessary for completing the rotation around their longitudinal axis. They fear they will not be able to land correctly on both arms and may fall on one arm, their head, or their neck. These skills are important in gymnastics as they enable gymnasts to perform more complex and difficult stunts. The roundoff is particularly useful for converting horizontal speed into vertical speed, which provides the height needed to execute another skill, such as the back handspring. Success in these skills boosts the gymnast's confidence and improves performance, as they are considered fundamental for any aspiring gymnast.

This is a negative indicator of a lack of motor coordination and warns of overall failure in motor synchronization. We used slow-motion filming technology to analyze the performance of several beginners and found significant errors during the stages of performing the roundoff, especially at the end of the final stage and the beginning of the first stage of the back handspring (Figure 1).

We conducted interviews with several beginners, and their responses emphasized the difficulty in understanding the motor performance sequence the body should follow, particularly when trying to connect the first movement to the second. Some also expressed fear of falling on the back of their head when attempting these skills, which is classified as negative self-talk, leading to a loss of self-confidence. We also interviewed the gymnastics teacher, who confirmed the use of optimal teaching methods during the educational sessions, including verbal, visual, and sometimes manual feedback. However, we realized that the gymnastics training sessions did not include specific sessions dedicated to mental training.

We found several experimental studies on the impact of mental training interventions for learning new movements or improving performance. For example, Post et al. used mental training interventions over three weeks on four 1000-yard swimmers, with results showing significant improvement in the performance time of three swimmers. Similarly, Al-Tiya and Mushref applied four mental training interventions over two weeks on beginners learning the forward roll diving movement in gymnastics, and the results showed a significant improvement in performance compared to the control group. Additionally. Abdul Latif et al. used eight mental training interventions over eight weeks on junior judo players, and the results indicated significant improvements in psychological skills such as relaxation, attention focus, neuromuscular reaction time, and correct response. Finally, Metwally used twelve mental training interventions on weightlifters under the age of 15. showing significant improvements in mental and psychological skills and motor performance in weightlifting (17-20).

Despite these studies, we did not find any research specifically focused on mental training for learning the gymnastics skills under study. Therefore, we designed mental training sessions, and we hypothesize that seven mental training sessions can help beginners create mental images of the entire performance sequence and improve their motor coordination across different body parts.

Training beginners to connect these two movements allows them to perform them as a single, highly coordinated movement. This not only enables them to execute more advanced gymnastics routines but also helps them become proficient gymnasts, providing opportunities to participate in sports competitions and achieve satisfactory results.

2. Objectives

The purpose of this study is to investigate the effect of seven mental training sessions on learning the roundoff and back handspring skills of young gymnasts.

3. Methods

3.1. Participants and Research Design

The study included 62 beginner learners from the second year at the College of Physical Education and Sports Sciences, University of Anbar, Iraq. The second-year class consists of 118 male beginners, representing 53.488% of the study population. We obtained approval to conduct the study from the Scientific Research Ethics Committee within the educational institution, and all participants were informed of their right to participate or decline before data collection. All participants agreed



Figure 1. Descriptive analysis models for a sample of beginners in gymnastics

to take part in the study under the condition of anonymity.

The basic experimental design of the study involved evaluating two groups of beginners: The intervention group without mental training and the mental training group, to assess the effects of the mental training intervention. The study sample was selected randomly. A list of sequential numbers, including the names of second-year students, was prepared, and the first 32 even numbers were drawn to represent the control group, which did not receive the mental training sessions. Using the same procedure, the last 30 even numbers were drawn to represent the experimental group, which received seven mental training sessions. The data for all 62 participants in the study were as follows: (age = 21 years, SD = 0.778), (height = 173 cm, SD = 0.455), (weight = 71 kg, SD = 0.662) (Table 1).

3.1.1. Identifying and Measuring Research Variables

We reviewed several experimental studies to identify the study variables and methods for measuring them. We found that the performance of roundoff and handspring skills consists of six stages, which became the study variables (Figure 2). We designed a scale to evaluate the motor coordination of body parts according to the stages of performance, including the preparatory phase, the main performance phase, and the concluding phase. The Kinematic Coherence Scale was presented to experts and specialists in motor learning and gymnastics for independent review, and we obtained approval to use it. Thus, it became an appropriate measurement tool for assessing roundoff and handspring movements in beginners.

The scale includes six sections corresponding to the stages of performance: (a) lifting the lead foot and contacting the ground; (b) passing with hands on the ground with a quarter turn; (c) losing hand contact with the ground and contacting both feet; (d) passing with both feet on the ground and preparing for the back handspring; (e) foot losing contact with the ground and performing the back handspring; (f) contacting both feet on the ground and maintaining balance. Each stage of performance was scored with a maximum of 5 points. The evaluation was carried out by three gymnastics experts.

The performance attempts of both the control and experimental groups for the roundoff and handspring movements were recorded during the pre-test and post-

Variables	Mean ± SD	Median	Skewness
Age (y)	21.164 ± 0.631	21	0.778
Hight (cm)	173.028 ± 0.184	173	0.455
Weight (kg)	71.084 ± 0.381	71	0.662

^a Skewness is acceptable at (±1).

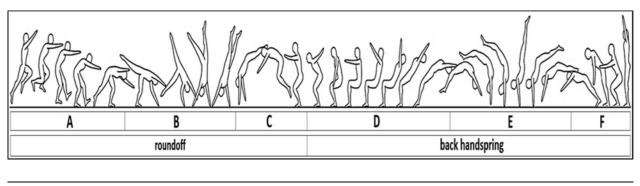


Figure 2. Stages of performing roundoff and back handspring

test phases using video, stored on a DVD, and sent to four gymnastics judges from different Iraqi universities for independent evaluation of kinematic coherence. It is worth mentioning that we excluded judges from the institution to which the study participants belong. The average score was then calculated to determine the results.

3.2. Intervention

3.2.1. Mental Training Sessions

After reviewing several previous studies (21-24), and consulting a sports psychology expert to determine the session content and the number of intervention doses, we designed seven mental training sessions for beginner gymnasts. These sessions aim to train beginner gymnasts in mental skills and aid in learning the correct motor pathways for body movements. Prior to each mental training session, the purpose and content were explained by a sports psychology expert, who supervised the implementation of all sessions.

Each mental training session was presented once during each educational lesson, following the physical warm-up, during which beginner gymnasts performed physical movements related to gymnastics, such as running, jumping, and flexibility exercises. After the physical warm-up, the experimental group immediately began the mental training session before moving on to physical practice. The mental training interventions spanned seven weeks, with all participants adhering to the mental training protocol throughout the study. It is worth noting that the control group proceeded directly to the physical practice of the roundoff and handspring movements after completing the 36-minute physical warm-up, which included verbal, manual, and sometimes visual feedback using still images of the movement components. Meanwhile, the experimental group engaged in 14 minutes and 30 seconds of mental training after the physical warm-up, followed by 21 minutes and 30 seconds of physical practice.

The mental training session consists of three parts: The first part lasts for 4 minutes and focuses on relaxation exercises, serving as an introduction to mental skills training. Breathing techniques are practiced either while sitting or standing, with the goal of reducing tension and promoting mental well-being. These exercises are guided by the following instructions: "We have completed the physical warm-up and overcome the fear of getting injured. Now, we will perform deep breathing. Stand up straight and inhale through your nose, filling the lower part of your lungs, then the middle part, and finally the upper part. Hold your breath for a few seconds, then exhale slowly, relaxing your abdominal and chest muscles. Take another deep breath, filling the lower part of your lungs, then the middle part, and finally the upper part. Hold your breath for a few seconds, then exhale slowly. Now, resume normal breathing. You can use deep breathing whenever you need to calm yourself."

The second part also lasts for 4 minutes and is dedicated to "controlling the controllables." Its purpose is to help participants manage their physical and emotional energy, focus more effectively on the task and goal, and address negative self-talk. Several control elements were introduced and performed as follows:

- Attitude: Success in performance does not come from a single attempt but rather from persistence in striving to achieve success. Imagine yourself as your favorite gymnast, someone who can successfully perform gymnastics movements, including the roundoff and the back handspring. Visualize how they perform these skills seamlessly, connecting them effortlessly. You too can execute them together with practice and determination.

- Effort: Performing skills can indeed be challenging, but if you give up on this task, you are also giving up on the very things that can set you apart from others. With effort and determination, you can achieve success and reach your full potential. Stay committed, and your hard work will distinguish you from the rest.

- Focus: There are many external factors that can distract you from achieving a successful performance. However, right now, you can focus solely on the sequence of motor performance for these skills. Direct your attention to each stage of the performance and concentrate on how each part of your body moves during each stage.

- Preparation: Many of you may feel eager to skip the first stages of performing skills to stand out from your peers. But do you know that this isn't what matters most? What truly matters is that each of you has the desire and commitment to be ready to deliver your best performance. Focus on mastering the fundamentals, and the results will follow.

The third part: The third part lasts for 6 minutes and 30 seconds and is dedicated to watching a video clip demonstrating the motor performance of the skills. The video is shown both in regular speed and slow motion, allowing learners to observe the correct sequence of movements. This segment is designed to help them visualize how to activate their muscles and use their body parts effectively when performing the actual skills.

The total duration of one session was 14 minutes and 30 seconds, and the cumulative time for the seven

sessions was 101 minutes and 30 seconds, out of the total 540 minutes allocated for the seven lessons.

3.2.2. Data Analysis

We used SPSS (version 20) to process the results. The Explore function was used to extract homogeneity values. We applied paired samples statistics to analyze the pre- and post-measurements within each group. Then, the independent samples test was used to compare the post-test results between the groups. Additionally, Cohen's d was used to calculate the effect size.

In the results tables, the letters (A, B, C, D, E, F) will represent the following stages: (a) lifting the lead foot and contacting the ground; (b) passing with hands on the ground with a quarter turn; (c) losing hand contact with the ground and contacting both feet; (d) passing with both feet on the ground and preparing for a back handspring; (e) foot losing contact with the ground and performing a back handspring; (f) contacting both feet on the ground and maintaining balance.

4. Results

Tables 2 and 3 compare the pre- and postmeasurement results for indicators of motor coordination of body parts.

Our study showed that the arithmetic mean for the evaluation of motor coordination by gymnastics experts in the pre-test for both the control and experimental groups gradually decreased, reaching a very low score in the fourth and fifth stages of performance. The experts gave the control group scores of (D: 0.601, E: 0.507) for these stages, while the experimental group received scores of (D: 0.451, E: 0.507). This confirms the validity of the research participants' claims that they found it difficult to comprehend the sequence of motor performance during these stages, especially in connecting the roundoff skill with the back handspring. It also highlights the participants' difficulty in visualizing the correct performance, leading to feelings of confusion, fear, and hesitation in executing the skills.

According to Tables 2, and 3, and as shown in Figure 3, the statistical analysis results for the mean, standard deviation, T-values, and P-values when comparing the pre- and post-test results for both the control and experimental groups are as follows.

For the control group, which used verbal, manual, and sometimes visual feedback through the educational booklet, the post-test showed improvement in the performance stages of the roundoff and handspring movements as follows: (A: 3.102, SD = 0.711, P = 0.010), (B:

Variables	Measurement Unit	Pre-measurement	Post-measurement	Range	Average Deviation	t-test	Sig
Roundoff							
А	5 scores	2.521 ± 0.724	3.102 ± 0.711	0.281	0.722	2.178	0.010
В	5 scores	1.322 ± 0.246	2.721 ± 0.354	0.299	0.689	2.430	0.00
С	5 scores	1.348 ± 0.391	3.217 ± 0.787	0.269	0.524	2.861	0.00
Back handspring							
D	5 scores	0.601 ± 0.112	2.872 ± 0.234	0.171	0.429	2.220	0.00
E	5 scores	0.527 ± 0.881	3.201 ± 0.721	0.301	0.611	2.761	0.00
F	5 scores	1.527 ± 0.335	3.921 ± 0.924	0.394	0.739	2.984	0.00

^a Values are expressed as mean ± SD.

Variables	Measurement unit	Pre- measurement	Post-measurement	Range	Average Deviation	t-test	Sig
Roundoff							
А	5 scores	2.901 ± 0.328	4.628 ± 0.734	0.228	0.523	2.451	0.000
В	5 scores	1.315 ± 0.647	4.151 ± 0.477	0.236	0.557	2.383	0.000
С	5 scores	1.440 ± 0.347	4.381 ± 0.624	0.191	0.486	2.195	0.004
Back handspring							
D	5 scores	0.451 ± 0.834	4.208 ± 0.912	0.108	0.214	2.842	0.000
E	5 scores	0.507 ± 0.398	3.807 ± 0.124	0.200	0.517	2.173	0.02
F	5 scores	1.347 ± 0.664	4.981 ± 0.358	0.184	0.432	2.389	0.00

 a Values are expressed as mean \pm SD.

 $^{\rm b}$ Statistically significant under the error level \leq (0.05) at the degree of freedom (30 -1 = 29).

2.721, SD = 0.354, P = 0.000), (C: 3.217, SD = 0.787, P = 0.000), (D: 2.872, SD = 0.234, P = 0.000), (E: 3.201, SD = 0.721, P = 0.007), (F: 3.921, SD = 0.924, P = 0.000).

For the experimental group, which underwent seven mental training sessions, we observed improvement in the post-test for the performance stages of the roundoff and handspring movements as follows: (A: 4.628, SD = 0.734, P = 0.000), (B: 4.151, SD = 0.477, P = 0.000), (C: 4.381, SD = 0.624, P = 0.004), (D: 4.208, SD = 0.919, P = 0.000), (E: 3.807, SD = 0.124, P = 0.027), (F: 4.981, SD = 0.358, P = 0.000).

According to Table 4, which presents the statistical analysis results for the mean, standard deviation, T-values, P-values, and effect size to compare the post-test results between the control and experimental groups, we found improvements in all stages of the roundoff and handspring performance, favoring the experimental group that participated in the seven mental training sessions.

- In performance stage (A), the mean and standard deviation for the control group were (3.102, SD = 0.711) compared to the experimental group (4.628, SD = 0.734).

The comparison showed a statistically significant T-value with a high effect size of (0.143), favoring the experimental group with the higher mean.

- In performance stage (B), the mean and standard deviation for the control group were (2.721, SD = 0.354) compared to the experimental group (4.151, SD = 0.477). The T-value was statistically significant with a high effect size of (0.149), again in favor of the experimental group.

- In performance stage (C), the mean and standard deviation for the control group were (3.217, SD = 0.787) compared to the experimental group (4.381, SD = 0.624). The comparison revealed a statistically significant T-value with a high effect size of (0.107) in favor of the experimental group.

- In performance stage (D), the mean and standard deviation for the control group were (2.217, SD = 0.234) compared to the experimental group (4.208, SD = 0.912). The T-value was statistically significant with a high effect size of (0.121), favoring the experimental group.

- In performance stage (E), the mean and standard deviation for the control group were (3.201, SD = 0.721) compared to the experimental group (3.807, SD = 0.124).

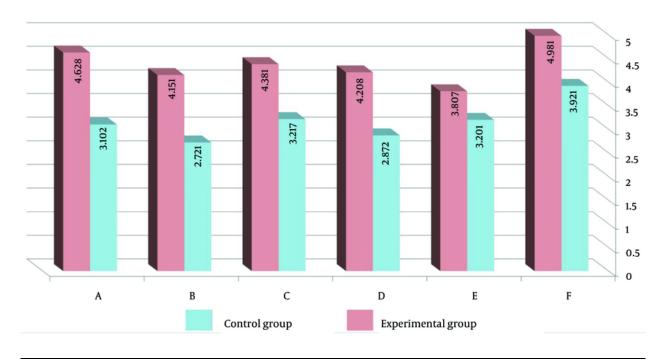


Figure 3. Comparison between the control and experimental groups results in the post measure.

/ariables	Measurement Unit	Control Group	Experimental Group	t-test	Sig	Effect Size
Roundoff						
А	5 scores	3.102 ± 0.711	4.628 ± 0.734	11.560	0.000	0.143
В	5 scores	2.721 ± 0.354	4.151 ± 0.477	18.157	0.001	0.149
С	5 scores	3.217 ± 0.787	4.381 ± 0.624	8.905	0.000	0.107
ack handspring						
D	5 scores	2.872 ± 0.234	4.208 ± 0.912	10.950	0.000	0.121
Е	5 scores	3.201 ± 0.721	3.807 ± 0.124	6.365	0.000	0.102
F	5 scores	3.921 ± 0.924	4.981 ± 0.358	4.701	0.000	0.137

^a Values are expressed as mean \pm SD.

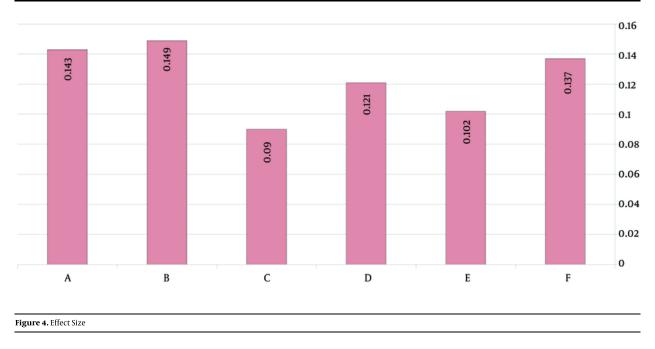
 $^{\rm b}$ Statistically significant under the error level \leq (0.05) at the degree of freedom.

The T-value was statistically significant with a high effect size of (0.102), in favor of the experimental group.

- Finally, in performance stage (F), the mean and standard deviation for the control group were (3.921, SD = 0.924) compared to the experimental group (4.981, SD = 0.358). The T-value was statistically significant with a high effect size of (0.137), favoring the experimental group with the higher mean. Figure 4 for the comparison results.

5. Discussion

We hypothesized that seven mental training sessions would improve the motor coordination of body parts during the stages of performing the gymnastics skills under study. The results showed that the experimental group, which participated in the mental training sessions, demonstrated significant improvement in whole-body motor coordination when performing the roundoff and back handspring compared to the control group. This indicates that the mental training had a very



large positive impact on learning these two skills over the course of the seven sessions. The experimental group members were able to overcome fear and anxiety, form a complete mental image of motor performance, and eliminate the sense of uncertainty during the performance. This helped the beginners link the motor sequence of the two skills, achieving motor synchronization between them, thereby fulfilling the study's objective.

These interpretations are supported by interviews conducted with the experimental group participants after the experiment. They evaluated the mental training interventions as highly beneficial in improving their mental imagery of performance and very effective in reducing fear and psychological hesitation during their attempts to perform the roundoff and handspring movements. They reported that the mental training, combined with physical practice, positively influenced their performance levels. This may be attributed to enhanced neural activation caused by mental training, which can induce structural changes in the brain associated with performance improvement. The sample size and the seven-session mental training period may have also contributed to these results.

These findings are consistent with the results of Hut et al., which indicated that psychological skills training for student athletes in track and field races significantly reduced sports anxiety, decreased negative self-talk, and improved satisfaction with sports performance (25). Our findings also align with Hasan et al., who found that the combination of motor modeling and mental training led to superior learning for beginners. The use of video presentations with different speeds of performance provided learners with an ideal mental vision and integrated mental training before practical application in the handball hall (26). Additionally, our results are in line with those of Pocock et al., who concluded that mental imagery interventions helped football players develop the courage to think, make alternative decisions that suited playing situations, and choose the most appropriate option, resulting in highly effective performance during games (27).

Accordingly, we recommend using the mental training technique developed in this study to assist other beginner gymnasts in learning and improving the performance of roundoff and handspring movements, as well as other gymnastics skills that require connecting two or more movements. We also recommend conducting similar studies on different age groups and extending the duration of mental training, along with exploring various techniques for delivering mental training sessions.

5.1. Conclusions

The use of seven mental training sessions led to significant improvements in learning the roundoff and back handspring skills and enhanced motor coordination in beginner gymnasts. Therefore, we recommend incorporating mental training sessions when teaching gymnastics skills to beginners and applying them to other sport movements with complex skill structures to help beginners better understand the stages of performance and improve their motor coordination.

Footnotes

Authors' Contribution: Hameed H. Khalaf: Data collection, statistical analysis, manuscript preparation, and fund collection; Manaf M. Hasan: Study design, data collection, statistical analysis, and manuscript preparation; Muhammad S. Ahmed: Data collection and fund collection.

Conflict of Interests Statement: The authors have no conflict of interest to declare.

Data Availability: The dataset presented in the study is available on request from the corresponding author during submission or after publication.

Ethical Approval: Ethical approval was obtained from the Scientific Research Ethics Committee of the College of Physical Education and Sports Sciences, the University of Anbar (No. 12401 on 22-6-2022).

Funding/Support: No funding was received for this study.

Informed Consent: All participants were informed of their right to participate or decline before data collection. All participants agreed to take part in the study under the condition of anonymity.

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