

# The Effect of Visualization, Relaxation, and Self-efficacy on the Performance of Men Speed World Record Athletes Category

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**Abstract Background:** The speed world record (WR) performance is an achievement made by athletes in the competitive rock-climbing category, where the athlete must complete the climbing route on a standard artificial climbing wall with a height of 15 m in the shortest possible time. **Purpose:** This study aims to determine: (1) the effect of visualization and relaxation training on athlete's performance; (2) the effect of self-efficacy on athlete's performance, and (3) the interaction between exercise (visualization, relaxation) and self-efficacy on the performance of rock-climbing athletes in the speed world record category. **Design/methodology/approach:** This research is experimental research with a true experimental design modified with a factorial design (2x2). The population in this study was all junior and youth WR speed rock climbing athletes, aged between 15-20 years in Yogyakarta and Central Java. A sample of 20 men athletes was taken with the Slovin Formula and ordinal pairing technique. The data were collected using the General Self-efficacy Scale (GSE) to measure self-efficacy and motion climb to measure the performance of rock-climbing athletes with WR speed. A Two-Way ANOVA test was used with the following analysis prerequisites: normality test and homogeneity test. The **results** of this study showed that: (1) Visualization is better than relaxation; (2) Athletes who have high self-efficacy have better performance than athletes who have low self-efficacy; and (3) There is a significant interaction ( $p < 0.05$ ) between exercise

(visualization and relaxation) and self-efficacy (high and low) on the performance of rock climbing athletes in the WR speed category. **Conclusion:** The highest performance is obtained with visualization exercises with high self-efficacy; followed by relaxation with high self-efficacy; and visualization exercises with low self-efficacy.

**Keywords** Performance, Speed World Record, Rock Climbing, Visualization, Relaxation, Self-efficacy

## 1. Introduction

Climbing is a sport that has been popular around the world, namely, as a competitive and recreational sport [1]–[4]. The popularity of rock climbing is going together with many researchers from various countries who have also developed the sport of rock climbing [5]. The popularity of rock climbing has led to increasingly professional competitions.

The World Cup competition is organized regularly by the International Federation of Sport Climbing (IFSC) (IFSC, 2019). The climbing competition that has taken place regularly, of course, demands high climbing performance. This has boosted the performance of researchers, academics, and rock climbing practitioners to

increase climbing professionalism and success in each climbing category through various studies on improving climbing performance.

Rock climbing-based research has become much more prevalent over the past three decades as a growing global sport. A major trigger that has caught the author's attention is the shift from competitive and recreational sports to the potential inclusion of rock climbing in the calendar of the Tokyo 2020 Olympic Games [6]. Also, the International Rock Climbing Research Association (IRCRA) was created as an institution that brings together coaches and researchers to disseminate their climbing knowledge and collaborate to develop climbing in each discipline or category [7].

Three categories of climbing sports are contested, namely bouldering, lead, and speed (speed climbing: world speed record) [8]. In short, bouldering refers to climbing with a climbing wall height of up to six meters, usually achieved by climbing a predetermined route without using any safety other than a mattress, with a climbing time of 4 minutes.

The speed category (speed world record) takes place on climbing walls as high as 15m walls with a standard point along the climbing route (IFSC, 2019). The speed category is part of a competitive climbing sport, requiring competitors to complete the climbing route as quickly as possible on a standard 15m high artificial climbing wall. In its development, the speed category does not use the insurer, but the automatic insurer (IFSC, 2019).

Also, several studies on the sport of rock climbing have been carried out to improve climbing performance, for example, analyzed study related to anthropometry [9]–[11]. In addition, several studies related to biomechanics [12]–[17], *physiological* [6], [18]–[21], and *psychological* [18], [22]–[25].

Indonesia is one of the countries which has the potential for performing rock climbing sports shaded by the Indonesian Climbing Federation (FPTI) and has never been absent from organizing or participating in competitions at regional, national, and international levels. Indonesian climbing has also been successful in an Asian and even global level. Of course, these achievements must be well maintained, in particular by carrying out a continuous development program (FPTI, 2019).

Climbing requires special physical aspects and mental skills to improve climbing performance [15]. This means that if you can synergize both physically and mentally, it will improve your climbing performance. The link between physical and psychological through mental visualization exercises can significantly improve climbing performance, that is, it can make climbers more focused and increase training capacity [25]. Therefore, the aspects of physical training and mental training cannot be separated, they must both be trained to achieve the best climbing performance. In addition, aspects of physical training and physical capacity are not sufficient for success in athletic success.

Mental training is necessary in addition to the physical training aspect to achieve consistent performance [9].

Psychophysiological orientation is considered a way of studying actions during exercise to examine physiological processes in the brain and their effects on physical activity. Thus, physical and psychological aspects influence each other fundamentally, ie psychological conditions also affect climbing performance [26]. This reinforces the view that mental training will not be effective without practicing what is trained during mental training [27], [28].

The mental aspects of climbing, especially the speed category, require a more dominant psychological aspect than the lead and bouldering categories. The speed category climbing route has been standardized worldwide, so that each official speed category climbing route for valid matches is the same in terms of point layout, width and climbing length. Compared to other sports, for example athletics with race numbers, the risk of making mistakes is always high during performance.

Unlike the sport of speed WR climbing, tolerance for course errors when climbing can be considered non-existent. Climbers really need to take the climbing route perfectly without mistakes. Therefore, the need for psychological aspects is very important in the speed category of climbing sport, for example, confidence, self-efficacy, risk-taking and the ability to overcome fear of falling while climbing are very important for conditioning. One of the most effective mental exercises for improving climbing performance is a visualization exercise called dissociated visualization.

The disassociated visualization exercise is a form of visualization exercise that can be performed by speed WR climbing athletes, by visualizing the climbing that has been done before. Disassociated visualization is the best visualization model to improve previously poor climbing performance could be better [20]. Because by doing Disassociated Visualization, climbers can replay what was done on the climb that is the cause of the failure in completing the climbing course, without making any significant disappointments or feelings of discontent [20].

Besides, disassociated visualization is useful for improving techniques in the speed category of climbing sport. With programmed dissociated visualization exercises, the climber can correct time-consuming movements, so that effective movements can be obtained to shorten the climb time, i.e. shorter climb times.

Apart from frequent speed training to improve climbing performance, psychological training is also necessary, namely relaxation training. Relaxation training is necessary, as the stress level will increase both before and during the climb where the target speed to stop the climbing time is as short as possible. To avoid possible stress, relaxation training in anticipation of stress is necessary for speed training.

In this case, considering the need for climbing in the WR speed category, progressive relaxation is a solution to

improve the performance of the athlete. Indeed, progressive relaxation can reduce internal anxiety which generally worsens performance during competition [29]. In rock climbing, the gradual relaxation process can help sharpen awareness of the level of tension in various parts of the climber's body, reduce tension in the body, and relieve tension before climbing performance declines [30].

Therefore, to achieve the perfect movement and achieve the best performance, dissociated visualization and progressive relaxation exercises are needed to involve all five senses. This is an effective psychological training strategy to improve the speed performance of climbing athletes in the speed category. Coupled with training in stressful and competitive situations as a means of anticipating the psychological aspects of competition.

Because of the various issues described above, the authors have been motivated to examine the effect of visualization and relaxation exercises based on confidence level on climbing performance in the world speed record category. This research is related to the psychology of sport and exercise, namely a scientific study of man and his attitudes in exercise and sport and practical applications based on professional principles and guidelines, which can help athletes and bring benefits to sports performance [27], [28], [31]. Thus, the object of this study is visualization and relaxation exercises based on the level of confidence in the performance of climbing athletes in the world speed record category.

## 2. Materials and Methods

This research is an experimental study with a true modified design with a factorial design (2x2), by including control variable [32]–[34]. The study population were all juniors and youth WR speed rock climbing athletes, aged between 15-20 years from Yogyakarta and Central Java. The research sampling were 20 speed climbing athletes taken by slovin formula [35]. Data collection using the General Self-efficacy Scale (GSE) to assess self-efficacy and motion climbing, the speed performance of rock-climbing athletes was evaluated with WR speed. Data were analyzed using Two-way ANOVA after normality test and homogeneity test. Therefore for the purposes of analyzing data, the difference between the pretest and posttest performance of WR speed athletes obtained was converted into a standard score, namely the T-Score. With a higher T-Score, and a short time the better is the performance according to the athlete speed. The good performance was related to the short time made during the exercise.

### Procedure

During the research athletes were classified according to the high self-efficacy and low self-efficacy. The subjects have been given pre-test associated with

visualization and progressive relaxation training. The training took 8 weeks with three times per week (60 minutes for each meeting). After the training duration the researcher made a posttest to assess if there is any significant improvement about the performance before and after.

Nevertheless, a questionnaire has been addressed to the subjects to assess the high and low self-efficacy and, after getting the result, The content validity, external validity, and reliability analysis questionnaire were conducted. However the instrument used was validated by seven experts: 2 psychology expert lecturers, 2 sports and psychology expert lecturers, and 3 rock climbing national coaches, product moment correlation, and reliability with Cronbach Alpha. Microsoft excel and SPSS 25 software were used to obtain the previous result.

Below is Experimental Research Design of Factorial 2 x 2.

	Self-Efficacy (B)	
		High Self-efficacy (B <sub>1</sub> )
		Low Self-efficacy (B <sub>2</sub> )
Manipulative Variable (A)		
Dissassociated Visualization Exercise	A <sub>1</sub> B <sub>1</sub>	A <sub>1</sub> B <sub>2</sub>
Progressive Relaxation Exercise	A <sub>2</sub> B <sub>1</sub>	A <sub>2</sub> B <sub>2</sub>

Figure 1. Experimental Research Design of Factorial 2 x 2

### Legends:

- A<sub>1</sub>: Dissassociated visualization
- A<sub>2</sub>: Progressive relaxation
- B<sub>1</sub>: High Self-efficacy
- B<sub>2</sub>: Low Self-efficacy
- A<sub>1</sub>B<sub>1</sub>: The group of high self-efficacy athletes trained with Dissassociated visualization exercises
- A<sub>1</sub>B<sub>2</sub>: The group of low self-efficacy athletes trained with disassociated visualization exercises.
- A<sub>2</sub>B<sub>1</sub>: Athlete's group with high self-efficacy, and trained with progressive relaxation training.
- A<sub>2</sub>B<sub>2</sub>: Group of athletes with low self-efficacy trained with progressive relaxation training.

## 3. Result

The results of this study showed that: There is a significant difference (0.003 < 0.05) between visualization and relaxation training on athletes' performance; visualization is better than relaxation; thus, it is proved that p is less than the specified significance level, namely 5% (p < 0.05); then the F-statistic was significant from the mean (Post-test, T-Score); Visualization exercise was higher than relaxation exercise (52.61 > 47.39). As seen

from average performance (post-test); exercise with visualization (7.86 ") was faster than exercise with relaxation (8.83 "). This proves that visualization training is better than relaxation training in improving the performance of climbing athletes in the world record speed category.

There is a significant ( $p < 0.5$ ) effect of self-efficacy on rock climbing performance in the WR speed category; athletes who have high self-efficacy have better performance than athletes who have low self-efficacy; There is a significant difference in the performance (post-test) of climbing athletes in the world speed record in terms of self-efficacy, which is indicated by the F-count between B of 128.138 with a p-value of 0.000; proven  $p < 0.05$  by the average t score; high self-efficacy, an average of 58.57 was obtained; whereas at a low self-efficacy, an average of 41.43 has been obtained.

There is a significant interaction ( $p < 0.05$ ) between exercise (visualization and relaxation) and self-efficacy (high and low) on the performance of rock climbing

athletes in the WR speed category. The highest performance is obtained with visualization exercises with high self-efficacy; followed by relaxation with high self-efficacy; and visualization exercises with low self-efficacy.

This indicates that the F count between AB (two-way interaction) is 9.782 with a p-value of 0.0006 which is lower than the cut-off of 0.05. Visual interaction can be described as follows.

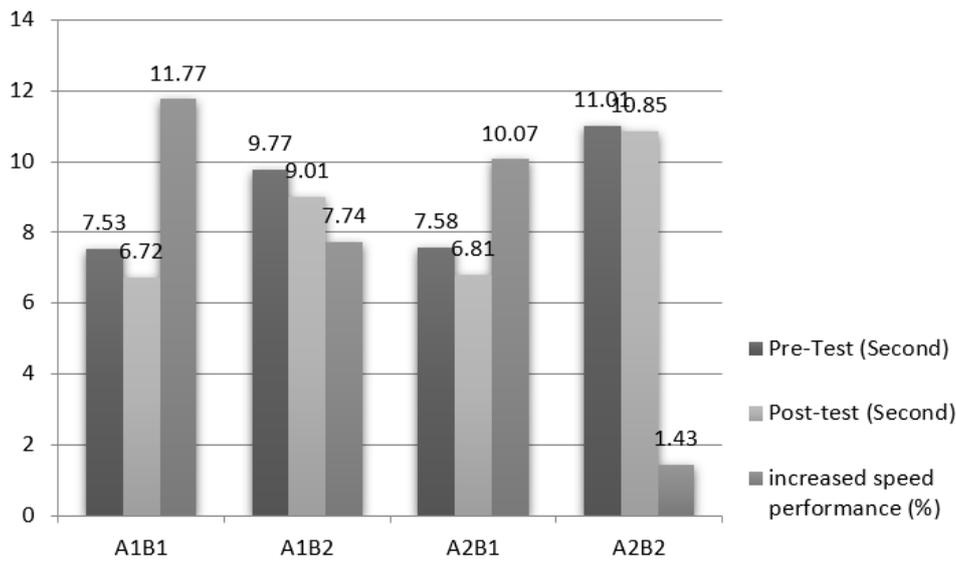
1. Bar Chart Comparison of Pre-Test, Post-Test Results, and Improvement (%) of the Performance of athlete's Speed World Record Athletes.

A1B1=The treatment group of disassociated Visualization Exercise with high Self Efficacy

A1B=The treatment group of Disassociated Visualization Exercise with low Self Efficacy

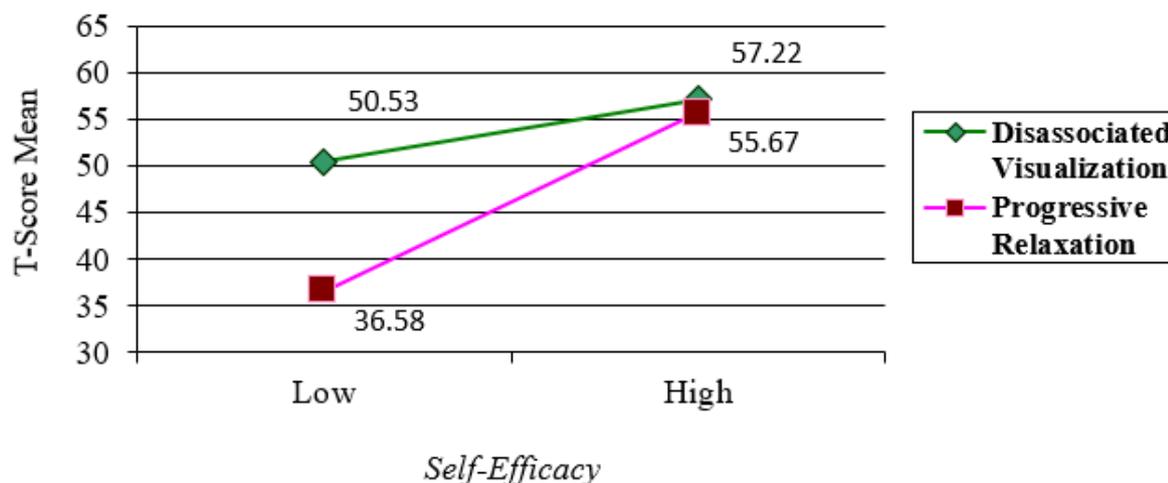
A2B1=The treatment group of Progressive Relaxation exercise with high Self Efficacy

A2B=The treatment group of Progressive Relaxation exercise with low Self Efficacy



**Table 1.** The Conclusion Analysis Two-Way Anova of T-Score Performance Post- Test Data

Source		Sum of Squares	df	Experimental Method		Sig. (p)
				Mean Squares	F	
Main Effects	(Combined)	1604,782	2	802,391	70,020	0,000
	Between A	136,399	1	136,399	11,903	0,003
	Between B	1468,384	1	1468,384	128,138	0,000
2-Way Interactions	Inter AB	112,101	1	112,101	9,782	0,006
	Model	1716,884	3	572,295	49,941	0,000
	Residual	183,350	16	11,459	--	--
	Total	1900,234	19	100,012	--	--



**Figure 2.** Interaction of Exercise and Self-Efficacy on Performance (Post-Test) of Climbing Athletes in the Speed World Record category

The results of this study showed that: There is a significant difference ( $0.003 < 0.05$ ) between visualization and relaxation training on athletes' performance; visualization is better than relaxation; thus, it is proved that  $p$  is less than the specified significance level, namely 5% ( $p < 0.05$ ); then the  $F$ -number was significantly from the mean (Post-test T-Score); Visualization exercise was higher than relaxation exercise ( $52.61 > 47.39$ ). As seen from average performance (post-test); exercise with visualization (7.86 ") was faster than exercise with relaxation (8.83 ") This proves that visualization training is better than relaxation training in improving the performance of climbing athletes in the world record speed category.

#### 4. Discussion

The increasing popularity of rock climbing has prompted many researchers to investigate the performance of rock climbing. Sport climbing activities dealing with the height and placement of the right body limb [36], if the foot or handrail is placed in the wrong position, it will disperse the mental state [30]. Therefore, visualization aims to improve the movement of thinking earlier than making actual movements. Visualization is also known as imagery, mental rehearsal, meditation. Visualization is the process of creating a mental image of something you choose to do or feel the actual situation.

The form of visualization can be explained in imagining objects, bodies, substances, products, behaviors, actions or other activities that are not visible [37]. Athletes who visualize can relieve anxiety during the competition [27]. When athletes use visualization techniques, not only can they see performance being done, but they can feel the activity going on in their mind [25].

One study conducted and explained that the benefits of psychological aspects in the form of visualization exercises can improve athlete performance, in this case

the result showed that there was an increasing of rock climbing athletes performance in the hand of WR speed. Previous researches explained that the physical and mental combination can be improved through visualization exercises [25]. In addition, the presence of systematic visualization exercises increasing athlete's performance, self-efficacy, although this study did not re-test the athlete's self-efficacy after a visualization training program. Visualization exercises, if carried out frequently, can also enhance the athlete's self-efficacy and performance [38].

On the other hand, relaxation exercises help enhance climbing performance (Eklund & Tenenbaum, 2012). The results of this study contradict previous studies, namely that there used to be no significant effect on enhancing the performance of climbing athletes (Eklund & Tenenbaum, 2012). The study found significant changes after the introduction of progressive relaxation training, especially for athletes with high self-efficacy.

Therefore, this research finds out about additionally confirmed previous studies related to progressive relaxation, which can improve athletic performance. Indeed, relaxation can decrease internal anxiety which will generally worsen performance during a competition (Lagrange & Ortiz, 2006). Additionally, relaxation is also mentioned to decrease stress when unexpected occasions happen during competition [27]. Additionally, relaxation can reduce levels of somatic anxiety, even though it was not studied in this study [27], [29], [39], [40].

Disassociated visualization exercises have a greater effect on enhancing the performance of WR speed climbing athletes. Indeed, this visualization workout can enhance the athlete's capability to improve the movement of climbing techniques.

Compared to relaxation exercises, in this study, progressive relaxation exercises were used and considered to be the most effective relaxation exercise for enhancing

performance, as they have a direct influence on physical work. In rock climbing, progressive relaxation exercise can help sharpen the awareness of the body part, which is very necessary for climbers to gain a fast response to speed climbing in the WR speed category.

Research shows that self-confidence affects an athlete's performance. Those who have high self-confidence will perform better, especially in the sport of rock climbing [38]. This is due to the fact athletes who have high self-efficacy agree within themselves and do their performance if there is something in their route [41].

This is consistent with the dimensions of self-confidence in the form of greatness, strength, generality [38], [41]. Athletes who do whatever to obtain a purpose are based on these three dimensions (Jones et al., 2002).

Self-efficacy has a significant effect on improving the performance of WR speed climbing athletes with a significant value of less than 5% ( $p < 0.05$ ). The increased performance of world record speed climbing athletes with high self-efficacy is on average 10.42% higher than that of athletes with low self-efficacy with an average increase of 4.59%. self-efficacy was influenced by its dimensions [38], [42]. This study is also consistent with previous studies related to self-efficacy with high-risk exercise [43]. Additionally, previous research has examined the relationship between self-efficacy and habit in indoor and outdoor climbing athletes. This study shows that confident athletes are used to participating in climbing activities which moderate to very difficult trails on both indoor and outdoor venues [44]. The specific area of measuring the specific self-efficacy of speed WR climbing athletes also confirms the validation and reliability of the GSE instrument [45], [46]. This study proved that there is a significant interaction ( $p < 0.05$ ) between exercise (dissociated visualization and progressive relaxation) and self-efficacy (high and low) on the performance of climbing athletes in the speed WR category. This result was proven by two-way interactions between exercise and self-efficacy on the performance of climbing athletes in the speed world record category which is significant in achieving a  $p$  (sig) value of less than 5% ( $p < 0.05$ ). It turns out that the results also show that visualization and relaxation exercises are best given to athletes who have high self-efficacy. The group of athletes who were trained using visualization exercises with high and low self-efficacy would experience a more significant effect compared to the group of athletes who were trained using progressive relaxation training with both high and low self-efficacy.

The results showed that the performance of the climbing alter in the speed world record category was highest in the group of dissociated visualization exercises with high self-efficacy; followed by a progressive relaxation group with high self-efficacy; then the dissociated visualization exercise group with low

self-efficacy; and finally in the group of progressive relaxation with low self-efficacy. In this study, self-efficacy was proven to determine the performance of climbing athletes with the speed world record. This is related to the dimensions described above, namely that if athletes meet the criteria of these dimensions, they will further accelerate their improved performance, especially in combination with mental training, and will not leave routine training in other aspects. Based on the results of the data analysis and the research findings, it shows that the interactions in each paired group have quite varied interactions.

## 5. Conclusions

The conclusions that can be drawn in this study can be described in several points as follows: There is a significant difference ( $p < 0.05$ ) between dissociated visualization and progressive relaxation exercises on climbing performance in the category of world speed records. Dissociated visualization exercises are better for improving the performance of climbing athletes in the speed world record category compared to progressive relaxation training. There is a significant effect ( $p < 0.5$ ) of self-efficacy on climbing performance in the world record speed category. Athletes who have high self-efficacy perform better than athletes who have low self-efficacy. There is a significant interaction ( $p < 0.05$ ) between exercise (dissociated visualization and progressive relaxation) and self-efficacy (high and low) on the performance of climbing athletes in the world speed record category.

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