

# Effectiveness of Guided Mental Imagery Training in the improvement of Reaction Time and Reduction of Competitive State Anxiety in Karate Athletes

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## Abstract

**Background:** Pre-match anxiety and its effect on the psychological states and motor skills of athletes is one of the heated topics raised in sports psychology. It is recognized as a major factor affecting athletes' performance, especially at championship levels.

**Objectives:** The study aimed to investigate the effectiveness of guided mental imagery training in the improvement of reaction time and reduction of competitive state anxiety in karate athletes.

**Materials and Methods:** This quasi-experimental study was of pretest-posttest control group design. The statistical population of the study consisted of all karate athletes in Tehran in 2019. The participants were selected via the convenient sampling method and assigned to the guided mental imagery group (n=15) and control group (n=15) using a simple randomization method. In this study, data were obtained using the Competitive State Anxiety Inventory (1990) and a reaction time meter. Data were analyzed in SPSS software (version 22) using repeated measures of analysis of variance.

**Results:** Based on the results, guided mental imagery training exerted positive effects on the improvement of reaction time ( $P<0.001$ ) and reduction of competitive state anxiety ( $P<0.001$ ) in karate athletes.

**Conclusion:** It can be concluded that guided mental imagery training effectively improves reaction time and reduces competitive state anxiety in karate athletes. This training can be used to resolve the psychological problems presented to karate athletes.

**Keywords:** Reaction time, Anxiety disorders, Imagery, Athletes

## Introduction

Anxiety is a negative emotional state associated with anger and discomfort (1). Anxiety in sport reflects athletes' feelings which may be unreal, leading to failed performance. Preliminary studies of anxiety were based on the assumption that competitive anxiety was higher among young participants in individual sports, in comparison to those engaged in team sports and non-collisional sports (2). Anxiety reaction provoked in specific competitive situations is called competitive state anxiety (3). It is a type of anxiety triggering in competitive sports situations (4).

One of the variables affecting athletes' performance is athletes' reaction time (5). Decision-making is recognized as one of the most important factors in skillful implementation. This decision should be made quickly and with great reliability in special circumstances. Reaction time is a significant indicator of decision speed and efficiency and it is defined as the time interval between presentation of stimulus and appearance of appropriate voluntary response in a subject (6). It is used to study sensory and mental

currents and a vital means of understanding how information processing (stimulus identification, response selection, and response planning) occurs within the human intelligence apparatus. Therefore, any factor that prolongs one of the processing stages of information increases the reaction time (7).

Reaction time is affected by some factors, such as age, gender, number of response triggers, stimulus-response adjustment, nutrition, physical activity, exercise, physical fitness, and fatigue (8). Gender differences can be ascribed to the fact that men and women have different neural organizing patterns for processing information and various strategies in the problem-solving process (9). Nevertheless, this was only significant in men and women in terms of performance based on the reaction time index in studies where tasks were simple and did not require high-level information processing (10).

The importance of the reaction time index lies in the fact that it is a major part of many sports and is widely used to measure performance (11). In many fast skills, the athletes' success depends on the speed at which

he/she can identify the environmental conditions or movement of the opponent, decide what to do, and start moving properly. It implies that reaction time is an indicator of information processing speed and can play a major role in most sports since it can help us find out how quickly people respond to stimuli. Moreover, it can be used to select sports teams that require action speed (12).

One of the main goals of coaches and psychologists is the regulation and control of athletes' anxiety. Different intervention methods are used to reduce anxiety, including the cognitive-behavioral approach and mental imagery (13). The majority of people regard mental practice or mental review as synonymous with watching skill performances—an illustration of a sporting skill's performance from the perspective of the performer himself. From within, one finds himself performing a skill. Suppose a person closes his/her eyes for a moment and imagines that the ball is in his/her hand, and he/she is ready to throw a free kick. In this case, internal mental imagery is performed when the angle of view is from within the body while looking at the ball. Nevertheless, if the same person is throwing the ball repeatedly at the basket, he can only see his/her hands dropping the ball and leading it to the basket. Mental imagery is experienced by most people and is considered commonplace since it sees the surroundings simultaneous with a movement (14,15).

Another feature of illustration is the inactivity of the person who has no feelings about performing his/her movements and only observes his/her movements. The related studies have demonstrated that skilled people use more internal imagery to practice illustration; nonetheless, beginners use more external imagery (16). Furthermore, more neuromuscular activity is induced in internal imagery (17). Taheri, Ghanbari, and Sharifzadeh (18) found that mental imagery training reduces competitive anxiety. Posner (19) concluded that guided mental imagery training exerted positive effects on the social anxiety of addicts leaving.

## Objectives

The majority of studies have focused on the use of physical methods of anxiety control. Less psychological interventions have focused on the reduction of the cognitive dimension of competitive state anxiety. In light of the aforementioned issues, the present study aimed to investigate the effectiveness of guided mental imagery training on the improvement of reaction time and reduction of competitive state anxiety in karate athletes.

## Methods

This quasi-experimental study was of pretest-posttest control group design. The statistical population of the study consisted of all karate

athletes in Tehran in 2019. The participants were selected via the convenient sampling method and assigned to the guided mental imagery group (n=15) and control group (n=15) using a simple randomization method in which each participant was assigned a number. The required sample size was calculated at 30 cases in total based on effect size= 0.40,  $\alpha=0.95$ , test power (1- $\beta$  err prob)=0.80, and 10% loss for each group. The inclusion criteria were as follows: attendance in one of the karate sports teams, acceptance of the time frame of the amoshi program, and commitment to attending the meetings. Each subject who was absent in the meetings without prior notice was excluded from the experimental group (participation in all sessions was necessary for the subjects). Considering ethical considerations, all subjects received written information related to the research and participated upon their request, and they were assured that all information would be treated as confidential and would only be used for research purposes. Furthermore, the questionnaires were completed anonymously to observe participants' privacy.

**Competitive State Anxiety Inventory:** This 27-item questionnaire was designed by Martens, Willie, and Burton in 1990 (20). The items are rated on a four-point Likert scale ranging from 1 to 4 (1=not at all to 4= very high). This questionnaire encompasses three subscales: the cognitive component of state anxiety, the physical component of state anxiety, and self-confidence. The scores in each subscale range between 4 and 36, with higher scores representing a higher level of anxiety. The Cronbach alpha coefficient of this questionnaire was obtained at 0.90. The correlation coefficient of this questionnaire was significant with Spielberger's trait-state anxiety questionnaire ( $r=0.63$ ;  $P<0.001$ ). In another study conducted by Farahani et al. (21), Cronbach's alpha coefficient was calculated at 0.85. The reliability of this questionnaire in the present study was reported as 0.81 by Cronbach's alpha coefficient.

**Reaction Time Meter:** The reaction time meter was registered for the first time in the name of Sharif Applied Physics Research Center, in the Office of Registration of Documents and Industrial Ownership (39428 12/03/2007). The device used in the present study was manufactured by Sina Ravan Tajhiz Institute (the first designer and manufacturer of laboratory equipment for psychology in Iran). Mental imagery treatment was performed in eight 90-minute sessions based on the Kosli training package. The validity of this protocol has been confirmed by its developer and has a high face and content validity (22).

All data were collected, coded, and analyzed by SPSS software (version 22). Firstly, the normality of

data distribution was determined by the Shapiro-Wilk test; thereafter, mean and standard deviation were used to describe demographic information. Finally, the role of training of guided mental imagery was investigated using multivariate analysis of covariance (MANCOVA).

## Results

The mean age scores of subjects in two groups of guided mental imagery and control were reported as  $36.4 \pm 7.63$  and  $38.6 \pm 8.71$ . Mean scores of research variables in pre-test and post-test are presented in Table 1.

**Table 1. Mean and standard deviation for scores of research variables in pre-test and post-test**

Variable		Group	Pre-test		Post-test	
			Mean	SD	Mean	SD
Competitive state anxiety	State-cognitive anxiety	Intervention	26.13	3.95	22.66	3.79
		Control	25.06	3.08	25.86	2.99
	Physical state anxiety	Intervention	15.40	1.63	13	1.55
		Control	14.66	2.05	14.53	2.13
	Self-confidence	Intervention	17.66	2.71	20.06	2.43
		Control	15.80	2.33	15.73	2.37
Reaction time		Intervention	428.77	49.85	382.14	42.87
		Control	412.15	45.81	406.40	43.67

The MANCOVA was used to investigate differences in three groups regarding competitive state anxiety scores. The evaluation of data characteristics demonstrated that the statistical assumption of consistency of variance-covariance matrices for

research components (Box's  $M=28.60$ ;  $P<0.05$ ) was established. Therefore, the Lambda Wilkes index was used to evaluate the significance of the multivariate effect.

**Table 2. Results of multivariate covariance analysis on the mean after-test of competitive state anxiety scores in experimental and control groups with pre-test control**

Tests	Value	Df hypothesis	Df error	F	P	Eta
Pillai's effect	0.80	3	22	21.88	0.001	0.80
Wilks Lambda	0.19	3	22	21.88	0.001	0.80
Hotelling effect	4.16	3	22	21.88	0.001	0.80
Roy's Largest root	4.16	3	22	21.88	0.001	0.80

As displayed in Table 2, Wilks Lambda index pointed to the significant effect of group on the linear composition of dependent variables ( $F=2.80$ ;  $P<0.0001$ ). In other words, there is a statistically

significant difference between the two groups of guided mental imagery and control in one of the components of competitive state anxiety.

**Table 3. Covariance analysis results of competitive state anxiety scores and reaction time in experimental and control groups**

Variables	SS	df	MS	F	P	Eta
State-cognitive anxiety	9.74	1	9.74	31.93	0.001	0.57
Physical state anxiety	7.25	1	7.25	49.24	0.001	0.67
Self-confidence	4.18	1	4.18	13.05	0.001	0.35
Reaction time	52.00	1	52.00	49.28	0.001	0.64

As illustrated in Table 3, the analysis of covariance statistics on each dependent variable was performed separately to determine the significant source of multivariate effect. Table 4 shows that the group significantly affects state-cognitive anxiety score ( $F=31.93$ ;  $\eta^2=0.57$ ), physical state anxiety ( $F=49.24$ ;  $\eta^2=0.67$ ) and self-confidence ( $F=13.05$ ;  $\eta^2=0.35$ ). This finding signifies that guided mental imagery has

led to decreased state-of-cognitive anxiety and physical state anxiety, as well as increased self-esteem of athletes. Furthermore, there was a significant difference between the experimental and control groups in terms of reaction time ( $F=49.28$ ;  $P<0.001$ ). The results pointed out that the mean scores of reaction time of the guided mental imagery group were lower at the end of the training group

(meaning improvement), compared to those obtained in the control group ( $P < 0.01$ ).

#### 4. Discussion

The present study aimed to determine the effectiveness of guided mental imagery training on the improvement of reaction time and reduction of competitive state anxiety in karate athletes. The results indicated that guided mental imagery training had positive effects on the improvement of reaction time and mitigation of competitive state anxiety in karate athletes. These findings were in line with those reported by Taheri et al. (18) on the effectiveness of mental imagery training on the reduction of competitive anxiety and the results obtained by Posner (19) on the effectiveness of guided mental imagery training on social anxiety of addicts leaving. Furthermore, the results of the current study were in agreement with the findings of the studies performed by Tsitsi et al. (23) on the effectiveness of guided imagery techniques in the mitigation of anxiety and improvement of the mood of parents of hospitalized children with malignancies. Moreover, the obtained results were in accordance with those reported by Charalambous et al. (24) regarding the effectiveness of guided imagery as anxiety-reducing interventions in breast and prostate cancer patients undergoing chemotherapy.

The effects of guided mental imagery training on the reduction of competitive state anxiety in karate athletes can be justified on the ground that the utilization of mental skills is one of the important advantages used by karate athletes for performing sports skills. Apart from rigorous exercises Karate athletes do for the improvement of their technical and physical conditions, they always strive to control their minds as much as possible and achieve the best level of performance. In this regard, using multiple mental skills is one of the necessities for achieving these goals, one of the most important of which is state-competitive anxiety. Some methods, such as illustration to modulate state-competitive anxiety, have been always used by karate athletes (25). Mental imagery reduces state-competitive anxiety and increases the self-confidence and performance of karate athletes. The mental imagery and visualization of pleasant images and moments cause a distraction from the distressing situation and reduce focus on stressors. Athletes do not use imagery techniques for the reduction of anxiety, rather they use them to benefit from mental exercises to improve exercise skills or boost sedation spirit. Mental imagery is of great importance since it distracts karate athletes from the cause of anxiety, elevates their mood, and reduces their competitive state anxiety. Consequently, they can dominate their visual skills and put themselves in pleasant situations and imagination (26). Distraction from distressing situations and avoiding spontaneous worrying

thoughts can call for less competitive state distress reactions. Therefore, they are effective in the reduction of the level of competitive state anxiety.

Furthermore, the improvement of reaction time in karate athletes by guided mental imagery training can be attributed to the fact that guided imagery training is a flexible intervention that is based on creativity, rather than intelligence. Although not all karate athletes may have a high degree of intelligence, they are all creative. Therefore, this method is effective and applicable for all karate athletes of all ages (27). Guided imagery training helps karate athletes to communicate with their internal cognitive, emotional, and physical resources, improving their reaction time (28). The guided illustration can also be used to learn and practice skills, and visualization of various solutions and outcomes is more effective for problem-solving. This method also increases creativity and imagination and affects physiological processes (29). Guided mental imagery highlights the power of thinking, assuring karate athletes of their capability to control horrific events. Therefore, it can play a major role in the improvement of reaction time in karate athletes. Guided mental imagery of similar neural structures exists between the physical performance centers and their mental performance in the brain. In mental practice, perceived movements follow physical rules of motor control, except that the final motor output is not created during mental training. In addition, symbolic review mental imagery training is a physical activity without any clear muscle movement. The illustration can be used for learning skills and techniques (cognitive specific) or strategy and tactics (general cognitive), as well as managing motivation and emotions (motivational) (30). In the last decade, several studies have indicated the usefulness of mental practice in early learning, implementation, and hardness in the mindfulness stage. This effectiveness has been confirmed in the improvement of athletic performance in both beginners and experienced ones.

Like any other research, the present study has some limitations whose expression can stimulate the research findings and suggestions and help subsequent researchers take effective measures to counter the threat of internal and external validity of research projects. Among the notable limitations of the present study, we can refer to external conditions since the statistical population of the study was a specific group of society (i.e., karate athletes in Tehran). Therefore, the generalization of the results should be made cautiously. Moreover, the data collection in this study was based on self-reporting scales which may have affected the responses. In addition, the present study was conducted based on a quasi-experimental design. Therefore, this design does not provide the benefits of actual experimental designs. It is suggested that in future studies, the



researchers benefit from a specialist as a therapist and treatment training to reduce the likelihood of bias in the research. Moreover, it is suggested that interviews be used in future studies instead of self-reporting tools.

## Conclusion

As evidenced by the results of the present study, it can be concluded that guided mental imagery training has positive effects on the improvement of reaction time and reduction of competitive state anxiety in karate athletes.

## References

- Hagan Jr JE, Pollmann D, Schack T. Elite athletes' in-event competitive anxiety responses and psychological skills usage under differing conditions. *Frontiers in psychology*. 2017 Dec 22;8: 2280. <https://doi.org/10.3389/fpsyg.2017.02280>
- Mottaghi M, Atarodi A, Rohani Z. The relationship between coaches' and athletes' competitive anxiety, and their performance. *Iranian journal of psychiatry and behavioral sciences*. 2013;7(2):68.
- Fernandes MG, Nunes SA, Raposo JV, Fernandes HM. Efeitos da experiência nas dimensões de intensidade, direção e frequência da ansiedade e autoconfiança competitiva: Um estudo em atletas de desportos individuais e coletivos. *Motricidade*. 2014;10(2):81-9. [https://doi.org/10.6063/motricidade.10\(2\).2930](https://doi.org/10.6063/motricidade.10(2).2930)
- Fernandes MG, Nunes SA, Vasconcelos-Raposo J, Fernandes HM. Factors influencing competitive anxiety in Brazilian athletes. *Revista Brasileira de Cineantropometria & Desempenho Humano*. 2013 Dec;15(6):705-14. <https://doi.org/10.5007/1980-0037.2013v15n6p705>
- Helm F, Reiser M, Munzert J. Domain-specific and unspecific reaction times in experienced team handball goalkeepers and novices. *Frontiers in psychology*. 2016 Jun 21;7:882. <https://doi.org/10.3389/fpsyg.2016.00882>
- Van Biesen D, McCulloch K, Janssens L, Vanlandewijck YC. The relation between intelligence and reaction time in tasks with increasing cognitive load among athletes with intellectual impairment. *Intelligence*. 2017 Sep;64:45-51. <https://doi.org/10.1016/j.intell.2017.06.005>
- Badau D, Baydil B, Badau A. Differences among three measures of reaction time based on hand laterality in individual sports. *Sports*. 2018 Jun;6(2):45. <https://doi.org/10.3390/sports6020045>
- Wilkerson GB, Simpson KA, Clark RA. Assessment and training of visuomotor reaction time for football injury prevention. *Journal of sport rehabilitation*. 2017 Jan 1;26(1):26-34. <https://doi.org/10.1123/jsr.2015-0068>
- Akyüz M, Uzaldi BB, Akyüz Ö, Dogru Y. Comparison of Sprint Reaction and Visual Reaction Times of Athletes in Different Branches. *Journal of Education and Training Studies*. 2017 Jan;5(1):94-100. <https://doi.org/10.11114/jets.v5i1.1987>
- Zarrouk N, Hammouda O, Latiri I, Adala H, Bouhlel E, Rebai H, Dogui M. Ramadan fasting does not adversely affect neuromuscular performances and reaction times in trained karate athletes. *Journal of the International Society of Sports Nutrition*. 2016 Dec;13(1):1-10. <https://doi.org/10.1186/s12970-016-0130-2>
- Moscatelli F, Messina G, Valenzano A, Petito A, Triggiani AI, Messina A, Monda V, Viggiano A, De Luca V, Capranica L, Monda M. Differences in corticospinal system activity and reaction response between karate athletes and non-athletes. *Neurological sciences*. 2016 Dec;37(12):1947-53. <https://doi.org/10.1007/s10072-016-2693-8>
- Sant'Ana J, Franchini E, da Silva V, Diefenthaler F. Effect of fatigue on reaction time, response time, performance time, and kick impact in taekwondo roundhouse kick. *Sports biomechanics*. 2017 Apr 3;16(2):201-9. <https://doi.org/10.1080/14763141.2016.1217347>
- Buck DJ, Hutchinson JC, Winter CR, Thompson BA. The effects of mental imagery with video-modeling on self-efficacy and maximal front squat ability. *Sports*. 2016 Jun;4(2):23. <https://doi.org/10.3390/sports4020023>
- Slimani M, Tod D, Chaabene H, Miarka B, Chamari K. Effects of mental imagery on muscular strength in healthy and patient participants: A systematic review. *Journal of sports science & medicine*. 2016 Sep;15(3):434.
- Carrasco DG, Cantalapiedra JA. Effectiveness of motor imagery or mental practice in functional recovery after stroke: a systematic review. *Neurología (English Edition)*. 2016 Jan 1;31(1):43-52. <https://doi.org/10.1016/j.nrleng.2013.02.008>
- Curtin KD, Munroe-Chandler KJ, Loughhead TM. Athletes' imagery use from a team-level perspective and team cohesion. *International Journal of Sport and Exercise Psychology*. 2016 Oct 1;14(4):323-39. <https://doi.org/10.1080/1612197X.2015.1036096>
- Slimani M, Chamari K, Boudhiba D, Chéour F. Mediator and moderator variables of imagery use-motor learning and sport performance relationships: a narrative review. *Sport Sciences for Health*. 2016 Apr 1;12(1):1-9. <https://doi.org/10.1007/s11332-016-0265-1>
- Taheri, M., Ghanbari, N., Sharifzade, M., The effectiveness of mental imagery training on reducing competitive anxiety. *The Third National*

- Conference on Sports Science and Physical Education of Iran. (2016). 2 (3): 25-41.
19. Posner, M. I. Brief meditation training induces smoking reduction. *Proceedings of the National Academy of Sciences*. (2017).110(34), 13971-13975.  
<https://doi.org/10.1073/pnas.1311887110>
  20. Martens R, Vealey RS, Burton D. *Competitive anxiety in sport*. (1990).
  21. Farahani A, Torabi F, Aghaei G. Perceived motivational climate's relationship with competitive anxiety and self-determination among Iranian pro league handball players. *International Journal of Sport Studies*. 2013;3(8):822-7.
  22. Kosslyn SM. *Mental imagery. Visual cognition: An invitation to cognitive science*. 1995;2:267-96.  
<https://doi.org/10.7551/mitpress/3965.001.0001>
  23. Tsitsi T, Charalambous A, Papastavrou E, Raftopoulos V. Effectiveness of a relaxation intervention (progressive muscle relaxation and guided imagery techniques) to reduce anxiety and improve mood of parents of hospitalized children with malignancies: A randomized controlled trial in Republic of Cyprus and Greece. *European Journal of Oncology Nursing*. 2017 Feb1;26:9-18.  
<https://doi.org/10.1016/j.ejon.2016.10.007>
  24. Charalambous A, Giannakopoulou M, Bozas E, Paikousis L. A randomized controlled trial for the effectiveness of progressive muscle relaxation and guided imagery as anxiety reducing interventions in breast and prostate cancer patients undergoing chemotherapy. *Evidence-based complementary and alternative medicine: eCAM*. 2015;2015.  
<https://doi.org/10.1155/2015/270876>
  25. Lim G, Krohner RG, Metro DG, Rosario BL, Jeong JH, Sakai T. Low-fidelity haptic simulation versus mental imagery training for epidural anesthesia technical achievement in novice anesthesiology residents: a randomized comparative study. *Anesthesia and analgesia*.2016May;122(5):1516.  
<https://doi.org/10.1213/ANE.0000000000001260>
  26. Velikova S, Nordtug B. Self-guided positive imagery training: Effects beyond the Emotions–Aloreta study. *Frontiers in human neuroscience*. 2018 Jan 9;11:644.  
<https://doi.org/10.3389/fnhum.2017.00644>
  27. Aghababaei S, Yazdannik AR, Keshvari M. The impact of guided mental imagery on the sleep quality of the elderly after having heart attack. *Annals of Tropical Medicine and Public Health*. 2017 Sep 1;10(5):1328.  
[https://doi.org/10.4103/ATMPH.ATMPH\\_204\\_17](https://doi.org/10.4103/ATMPH.ATMPH_204_17)
  28. Blackwell SE, Westermann K, Woud ML, Cwik JC, Neher T, Graz C, Nyhuis PW, Margraf J. Computerized positive mental imagery training versus cognitive control training versus treatment as usual in inpatient mental health settings: study protocol for a randomized controlled feasibility trial. *Pilot and feasibility studies*. 2018 Dec;4(1):1-4. <https://doi.org/10.1186/s40814-018-0325-1>
  29. Sit HF, Hall BJ, Wang Y, Zhang Y, Ju Q, Gan Y. The effect of positive mental imagery training on Chinese University students with depression: A pilot study. *Current Psychology*. 2020 Jun 27:1-4.  
<https://doi.org/10.1007/s12144-020-00867-1>
  30. Murphy SE, O'Donoghue MC, Blackwell SE, Nobre AC, Browning M, Holmes EA. Increased rostral anterior cingulate activity following positive mental imagery training in healthy older adults. *Social Cognitive and Affective Neuroscience*. 2017 Dec;12(12):1950-8.  
<https://doi.org/10.1093/scan/nsx120>