

# IMMEDIATE EFFECT OF MENTAL SIMULATION ON SELF-CONFIDENCE AND PERFORMANCE WHEN PERFORMING STANDING SALTO BACKWARDS IN GYMNASTS

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## **Abstract**

*The aim of this study was to examine the combined effect of mental imagery as well as visualization on performance, self-confidence, and self-report during the performance of the standing salto backward. Eighteen gymnasts (age 22.11 ± 1.71 years) voluntarily participated in this study. Once the warm-up was completed, subjects performed a standing salto backward tucked on the force-plate to determine the baseline performance before each experimental session. Subsequently, subjects were given specific intervention instructions and were asked to perform the standing salto backward tucked to the best of their ability. Participants were asked to engage in two mental strategies namely mental imagery and visualization for 1 min just before performing (Standing salto backward tucked). The results of the present study show that the combined mental simulation (MI and V), generate a potential improvement in performance during the execution of the standing salto backward as well as self-confidence and self-evaluation.*

**Keywords:** *gymnastics, standing salto backward tucked, mental stimulation, mental imagery, visualization, self-confidence, self-evaluation.*

## **INTRODUCTION**

Sport psychology activity is the scientific study of people and their behavior to improve athletic performance (Weinberg & Gould, 1997). The determining factors of athlete's come from the environment. However, "the sporting actors in the world" attach little importance to thoughts, personality, and perceptions. So, it is interesting to have knowledge in psychology; it allows coaches and athletes to take a step back, analyze real-life situations, understand any dysfunctions and remedy them, and find

psychological methods intended to develop mental qualities (Bui-Xuan, 2000).

Thus, to promote the virtues of sports psychology among coaches and athletes, many dedicated professionals have reflected on the contributions that practitioners can bring to the sporting world. Hence, the notion of mental preparation is now considered to be a determining factor in athletic performance. This phenomenon is more prominent in individual sports (e.g., tennis, judo or fencing, etc.) that have shown an interest in this new discipline.

Featured in the work of Feltz and Landers (2007) and Orlick and Partington (1988), mental training, alongside physical, technical, and tactical training, contributes immensely to improving performance in various disciplines. Fournier (1998) also indicates that mental preparation is a preparation for competition by learning mental and organizational skills to optimize the athlete's personal performance.

As a physical activity, gymnastics is a reproduction of an activity; it is also a production of created or codified gestural forms. It engages a complex expressive body motor that is habitual and controlled to produce a sequence in a particular environment that is judged and appreciated. This rich body language creates situations of acrobatic mastery of gymnastics. However, it is also possible that the features of the movement (duration, complexity, nature of the constraints of the task) may lead the athlete to form clear mental images, which is why we associate the mental timing parameter with mental imagery during learning of a gymnastic sequence in order to appreciate the evolution of performance (Denis & Boucher, 1991; Féry, 63 2003; Hardy & Callow, 1999; White & Hardy, 1998).

Indeed, mental preparation focuses on the learning techniques and strategies allowing the athlete to progress and better manage his performance mentally, emotionally, and physically (Tod, 2005). Moreover, mental simulation consists of internally repeating the movement before performing. Theorists assume it improves motor skills and motor learning (Feltz & Landers, 1983; Deschaumes-Molinario et al., 1991).

Strategies used by athletes typically include imagery, attention, and preparatory excitement. These strategies are designed to increase physical and mental activation, concentration, and self-confidence (Brody, Hatfield, Spalding, Frazer, & Caherty, 2000). Many sports psychologists have been interested in the mental preparation

employed by the athlete immediately before sports performance (Geiger et al., 1999; Weinberg, Jackson, & Seaboune, 1985). Athletes believe that these strategies will lead to better performance and will allow them to lift heavier loads (Tod et al., 2003).

However, qualitative research perceives imagery as a strategy that helps athletes better overcome negative symptoms and facilitates better athletic performance (Hanton, Mellalieu, & Hall, 2004). For example, elite gymnasts, according to Hanton et al., 2004, described how imagery allowed them to maintain a positive attitude and to interpret the anxiety-triggering factors in a positive way.

Thus, mental imagery is used by athletes to regulate anxiety, reduce poorly adapted behaviors, reduce negative thoughts, and increase concentration (Richardson, 1967a, 1967b; Feltz & Landers, 1983; Suinn, 1993; Mumford & Hall, 1985).

Research on the means to be implemented to improve sports performance report two main uses of mental images based on goals, different methods and means. Indeed, mental images are used, on one hand, in the learning of motor skills, and on the other hand, in the mental preparation of athletes. (Rushall & Lippman, 1998).

In addition, one of the most effective mental preparation techniques in the field of sport is visualization. "Visualization, like mental imagery, is a technique that implements the resources of the mind, imagination, and intuition to increase one's well-being". (Murphy & Jowdy, 1992). In this sense, imagery is scientifically defined as a cognitive practice that consists of evoking the characteristics of an object, event or process absent from our current perceptual field.

It is the ability to think in pictures that can be learned. It will allow the gymnast to acquire new technical elements, to correct and strengthen them, and to prepare for

and manage competitions by recalling symbolic images (Warner & McNeill, 2013).

Visualization is therefore a powerful tool for improving performance, recovering faster, optimizing athlete's time, and at the same time increase his concentration and motivation. Whether in the sporting, technical, medical, or musical field, visualization is a powerful and useful tool (Warner & McNeill, 1988).

Elements that will influence the effectiveness of such a practice are precision, correct visualization of movement, frequency of practice, and association with real movement (Warner & McNeill, 1988). The gains are therefore greater if we combine sessions of precise and detailed visualization with well-conducted workouts. The association of visualization with training therefore provides more gains than training alone (Lebon, 2010).

Many gymnasts struggle with performing up to their potential in competition. Research indicates that psychological factors such as concentration, confidence, motivation, and anxiety have a significant impact on performance in sports and may lead to athletic performance deterioration (Morrow, Jackson, Disch, & Mood, 2000). In some cases, these factors can be critical to success in sports, particularly at the highest levels. Mental training is important in artistic gymnastics, since gymnasts face ever increasing difficulty demands required by the international Code of Points from an early age. To meet these requirements, gymnasts should be willing to put in a high level of physical effort as well high level of mental concentration to perform the technical elements of this sport (Nassib et al., 2014).

Gymnastics is a complete sport; it develops musculature, coordination, self-control, concentration, and mental skills. There is a direct link between gymnastics and cognitive function. A recent study (Jemni, 2011) proved that gymnastic

exercise requires agility training, circuit training, coordination, and other intense physical skills that can dramatically impact cognitive markers. These include reasoning skills, verbal communication, spatial ability, and inductive reasoning. All these mechanisms are specific to cerebral activities that determine a person's overall cognitive health. They also impact a person's attention, learning, and memory skills (Caine, Russell, & Lim, 2013).

However, in gymnastics, very few studies have examined the effect of mental practice on performance and no research has been conducted on execution of acrobatic elements.

Thus, the purpose of this study was to assess the combined effect of mental imagery and visualization on performance, self-confidence and self-evaluation while performing the standing salto backward tucked. More precisely, to determine if there was a positive transfer from visual modality (visualization) to proprioceptive modality (imaging) that would increase the precision of the technical element.

## METHODS

Eighteen male gymnasts (age  $22.11 \pm 1.71$  years; height  $1.73 \pm 0.06$  m; mass  $68.65 \pm 5.65$  kg; experience  $10.2 \pm 1.7$  years) volunteered to participate in this study. They were all undergraduate students pursuing licence degrees in Exercise Science and Physical Education at the University of Manouba, Tunis (Tunisia). Their average experience in gymnastics was  $10.2 \pm 1.7$  years and the average of their weekly training was between 6-8 hours. Before the experiment, none of the subjects had ever specifically performed mental stimulation with the aim of improving motor performance. The participants were divided into two counterbalanced and randomized groups as follows:

- Mental imagery group (MI)
- Visualisation group (V)

They received detailed instructions to perform specific mental skill strategies with precision and efficiency. The principles of anonymity and volunteering have been guaranteed to subjects before the start of the experiment. They were informed of the sole use of data for scientific research purposes.

The experimental protocol of the current study was approved by the Ethical Committee of the ISSEP Ksar Saïd of the research unit "Analysis and evaluation of factors determining the sports performance". All participants read and signed informed consent forms in accordance with research ethics. To ensure good reproducibility of test results and reduce the effects of learning, athletes were asked to avoid high-intensity physical training for 24 hours before testing. This was to prevent residual fatigue from interfering with the test performance.

#### *Pre-experimental procedure*

Before the experiment, all participants completed the *Sport Imagery Questionnaire* which assesses the vividness of images (visual, kinesthetic, auditory imagery) generated to be able to subsequently incorporate the imaging condition into our experimental protocol.

Additionally, they completed the *Vividness of Visual Imagery Questionnaire* (VVIQ) that assesses the ability of subjects to see imagery with their eyes open and closed. The questionnaire VVIQ2 on the vividness of imagery and "Sport Imagery Questionnaire Hall and Martin (1997)" were explained item by item by a specialist. Once all the items in the questionnaires were explained, subjects were asked to answer the questions by choosing the response they felt that best corresponded to their situation. Participants who read and received standardized instructions for completing the questionnaire were informed that their responses were confidential. Throughout the process, standardized instructions were given to subjects and verbal

encouragement was provided to help them perform to the best of their ability.

The experiment consisted of two phases, followed by a final debrief. The first phase was a familiarization phase, and the second phase included experimental sessions. During the familiarization period, metric measurements of gymnasts (weight and height), the duration of gymnastics practice per week and per day were collected. Then, the questionnaires were filled in in the presence of the researcher to overcome any difficulties encountered. No information on the purpose of the study was provided to participants until the end of the sessions. No psychological intervention was applied during this period. The participants were also asked to avoid physical effort during the experimentation period to prevent injuries and fatigue.

Before the experiment, the gymnasts were given the same breakfast, consisting of juice, a cake, and a bottle of water; this was maintained throughout the experimental period to guarantee the same test conditions and neutralize the nutritional effects on performance. The different experimental sessions were carried out at the same time of the day for each subject (11a.m.-1p.m) and under standard environmental conditions ( $23 \pm 1$  ° C and  $41 \pm 2\%$  relative humidity) to avoid diurnal variations.

The participants attended 2 experimental sessions, 24 hours apart, to perform the standing salto backward tucked. The participants engaged in Visualization (V) during the 1st session and in Mental Imagery (IM) during the 2<sup>nd</sup> session. The interventions were counterbalanced and randomized to avoid any learning effect.

The combination of these strategies aims to produce a positive transfer of visual modality

(Visualization) which provides visual information about the movement being performed to the proprioceptive modality (Imaging) which consists of mentally

simulating action to increase the precision of gestures.

Upon arrival, the subjects began a standardized general warm-up of 5 minutes of moderate intensity running. This was followed by movement exercises and specific muscular actions. The warm-up exercises were inspired by the specific warm-up used in acrobatics in artistic gymnastics (Robe, 2006). Once the warm-up was completed, the subjects performed a standing salto backwards tucked on the force-plate to determine the baseline performance before each experimental session. Then, the subjects received specific instructions and were asked to perform again the standing salto backward tucked the best they could. At the end of the experiment, the participants completed the Self-Confidence Scale.

*Post-experiment interview:*

To check whether the subjects performed the experimental conditions in accordance with the instructions, subjects were asked to describe the cognitive strategies used.

**Measures**

*Performance*

The standing salto backwards tucked is a backward rotation passing in front of the center of gravity around an axis. During the standing salto backwards tucked, one should regroup, grab the legs, and finish in standing position.

*Movement analysis:*

- Dynamic and complete leg pulse.
- Launched-blocking of the arms.
- Grouped knees-chest-heels-buttocks.
- Grouping.

To analyze the movement of the standing salto backwards tucked, two AAE high-definition video cameras PNJ Cam 120 Hz were used to record in 2D each test of all subjects. These recordings were later used in the analysis of each of these trials. These high-definition devices record executions so that they can be analyzed later. The participants were scored

according to the criteria described in the FIG Code of Points (2017).

The standing salto backwards tucked performances were recorded using a force-plate equipped with piezoelectric sensors and connected to a computer equipped with the "Quattro Jump" software which provides, from the personal information of each subject, quantified data and graphics. All sessions took part in the same room and with the same researchers.

To avoid unmeasurable work, horizontal and lateral displacements were minimized during the tests. The participants performed standing salto backwards tucked from the standing position. For pre-test measurements, the standing salto backward tucked results were determined. The subjects involved in this study were instructed to react as fast and jump as high as they could to immediately execute the standing salto backward tucked. Two trials were performed with 1-minute active rest between the attempts.

Two attempts were recorded for each subject: the 1<sup>st</sup> performance before any psychological intervention (base performances), and the 2<sup>nd</sup> performance after the engagement in the mental preparation technique specific to each group. In addition, a scorecard was designed to evaluate standing salto backwards tucked (Table 2), with a maximum score of 2 points [very good (2 pts); good (1.5 pts); medium (1 pts); low (0.5 pts) for each variable]. Three national judges assessed all students during the experiment.

Salto Rear Scoring System (Table 1).

- Small fault 0.25 pts (deflection / flexion angle less than 15°).
- Average fault 0.5 pts (deflection / flexion angle greater than or equal to 15° and less than 30°).
- Gross fault 1 pts (deflection / flexion angle greater than or equal to 30° and less than 45°).
- 2 pts fall (from the apparatus or on the apparatus).

- 16 pts technical and 4 pts held, i.e., a score out of 20 pts.

### ***Mental strategies***

#### ***Mental imagery (MI)***

Each gymnast imagines performing the standing salto backwards for a minute while trying to improve performance. The instructions given to the subjects in this group were based on the personal information data obtained from the questionnaire. The gymnasts were asked to close their eyes or keep them open. Then, they were asked to watch their movement or feel their body in space or listen to the noise related to the movement in their head.

The correct execution of this condition was checked by the researcher in a post-experiment interview to ensure the subjects performed the experimental condition according to the instructions. Subjects were asked to describe the nature of imagery after the intervention (Gould, Weinberg, & Jackson, 1980; Cumming, Olphin, & Law, 2007).

To generate and then control the mental work, an imagery script was given to participants (Tod et al., 2003; Whelan, Epkins, & Meyers, 1990):

"You have 1 minute during which I would like you to visualize yourself carrying out sprints as fast as possible. Please close your eyes and imagine achieving a new personal record".

#### ***Visualization (V)***

Once the baseline performance was determined, the subjects were requested to visualize individually a video presenting their basic performance (standing salto backward tucked) for 1 minute. The video had been projected so that the movement was well known to the subject. During this strategy, an external modality was used. There was a frontal take of the movement made by the participant, followed by another in profile, in real time, and then in slow motion. The video did not contain any sound effects and/or written

instructions to ensure that attention was paid to the movement only.

The experimenter had to remove any disturbing elements from the environment by giving the subject the following instruction before starting the video:

" In front of you, you have a one-minute video that you need to watch carefully for maximum performance". No verbal instructions were given to subjects during the viewing.

#### ***Sport Imagery Questionnaire: (SIQ)***

Before carrying out the study, the vividness of the participants' images was assessed to determine the sharpness and richness of the mental images generated to be able to subsequently incorporate the Imaging into our experimental protocol. To do this, we used the Sport Imagery Hall Questionnaire (Hall & Martin, 1997). SIQ is widely used in psychology and applied to sports; its validity and reliability was demonstrated by Kamel-Rateb (2007). This questionnaire was used as a measure of the ability of visual, auditory, and kinesthetic imagery. As part of this study, the calculation of the internal coherence coefficients (Cronbach's alpha) = 0.88 with the interval of 95% confidence: [0.79-0.94] allowed the control of the psychometric qualities of the tool used (Munroe-Chandler, & Hall, 2016).

This questionnaire measures the abilities of athletes to experience different senses, emotions, and perspectives during imaging. The SIQ refers to four common experiences in the sport: practicing alone, practicing with others, watching a teammate, and performing in a competition. After doing the imagery for a minute, including each of these experiences separately, the subject must then estimate the vividness and sharpness of the mental images on a five-point Likert scale ranging from 1 point "no image present" to 5 points "Image perfectly sharp, as precise and lively as a real perception".

In the present study, the SIQ was used to measure the individual imaging capacity based on the measures most used and most recommended by many authors (Hardy, Jones, & Gould, 1996). However, only the visual modality of mental imagery was considered in this research.

Participants were invited to complete a questionnaire in a quiet location and in standardized conditions. The literature points out that, thanks to its ease of administration and rapidity of analysis, in addition to its good validity and reliability (Childers, Houston, & Heckler, 1985; Rateb, 2007), this is a "good example" of measuring individual's mental imagery capacity.

#### *Self-confidence*

The self-efficacy questionnaire (SEQ) was used to assess the perceived trust of each participant (Mills, Munroe & Hall, 2000). The SEQ is made up of five items that ask the participant to write down the strength of their belief in their mental abilities based on a 100-point scale, with 10-unit intervals ranging from 0 (no confidence) to 100 (full confidence). Mental abilities measured by this questionnaire include concentration, control, and mental toughness. More precisely, the five items are: "I am confident of being able to work in difficult situations"; "I am confident I can stay focused for a long time in difficult situation"; "I am confident that I can be mentally strong throughout a competition"; "I am confident that I can maintain control in challenging situations"; and "I am confident in being able to appear confident in front of others". The SEQ presented internal consistencies with an alpha level of .86 (Munroe-Chandler, Hall & Fishburne, 2008).

#### *Self-evaluation*

Self-evaluation is a process by which a participant makes a judgment on the quality of his progress, his execution, or his achievements regarding predefined objectives (Legendre, 2005). Thus, at the end of the experimental session, a self-evaluation grid was administered to assess how the subjects perceived their performance. The performance of standing salto backward tucked was judged by the participants with an evaluation score of 1 to 20. This was to encourage participants to analyze what they achieved and how they were doing.

Data are reported as mean  $\pm$  standard deviation. Before using the parametric tests, normality of the distribution was verified by the Shapiro–Wilk W-test. Data was analyzed using repeated measure analysis of variance (ANOVA) to examine the difference between performance before and after using mental strategies (MI / V). When the effects were not significant, ANCOVA was used to compare the base performance with performance after mental strategies. When significant effects were present, a Bonferroni test was performed to determine the differences in pairs. The changes expressed in percentages were calculated  $[(IM\ V) / V * 100]$ . Significance was set at 0.05% ( $p \leq 0.05$ ). Calculations and statistical analyses were performed using the Statistical Package for the Social Sciences version 20.0 (SPSS Inc., Chicago, IL, USA).

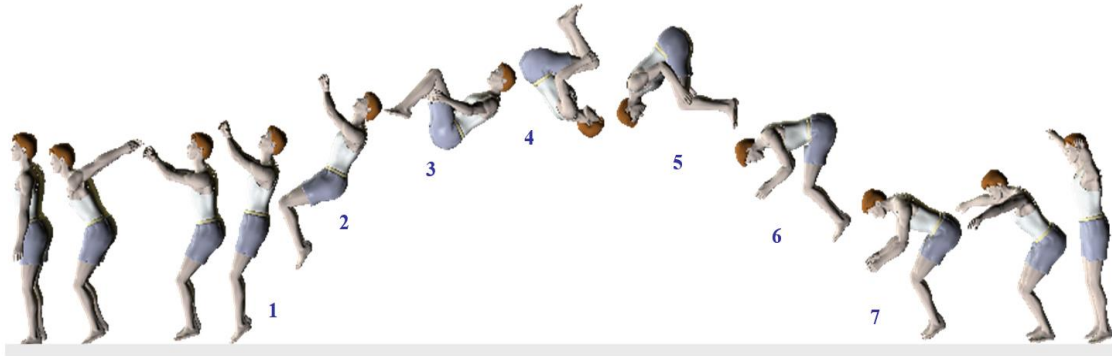


Figure 1. Standing Salto Backwards Tucked (Mkaouer, 2013).

Table 1  
*Execution Criteria of Assessment.*

Score	Take-off		Grouped		Off grouped		Landing	
	Take-off angle (°)	Trunk/Leg ang (°)	Trunk/Leg ang (°)	Thigh/Leg ang (°)	Vertical displacement (m)	Trunk/Leg ang (°)	Horizontal displacement (m)	Stability (step/fall)
Excellent (2 pts)	80 – 90°	185 – 190°	46 – 50°	76 – 90°	≥ 0.50 m	165 – 175°	On the spot	Stick 0 step
Small Error (1.5 pts)	70 – 79°	191 – 195°	41 – 45°	61 – 75°	0.41 – 0.49m	145 – 164°	0.10 – 0.2m	1 small step
Medium Error (1 pts)	60 – 69°	196 – 200°	36 – 40°	46 – 60°	0.31 – 0.40m	125 – 144°	0.21 – 0.30m	1 big step
Large Error (0.5 pts)	< 60°	201 – 205°	30 – 35°	30 – 45°	0.20 – 0.30m	100 – 124°	> 0.30m	Several steps

Table 2.  
*ANCOVA (repeated measures ANOVA with covariance with baseline performance).*

Variables	df	Mean square	F	Sig.	Partial eta squared	Power
With Mental Simulation	1	0.872	5.312	0.05	0.431	0.511
Without Mental Simulation	1	0.650	3.959	0.087	0.361	0.405
Training	1.737	50.186	12.556	0.001	0.611	0.976

Table 3  
*Changes in means expressed in %.*

	Mean	Std. Deviation	N	
IM_Perf_(N/20)	13.277	1.655	9	[(IM-V)/V*100] = 6.14 %
V_Perf_(N/20)	12.722	1.986	9	



Table 4. Correlation between self-confidence assessment results and self-assessment results, after training without mental strategies.

	<i>Performance without mental stimulation</i>	<i>Self-confident</i>
<i>Self-confident</i>	-0.709*	---
<i>Auto-evaluation</i>	0.452	0.889**

(\*) Significant at  $p \leq 0.05$ ; (\*\*) Significant at  $p \leq 0.001$ .

Table 5. Correlation between self-confidence assessment results and self-report results after visualization training.

	<i>Performance</i>	<i>Self-confident</i>
<i>Self-confident</i>	-0.759*	---
<i>Auto-evaluation</i>	0.118	0.680*

(\*) Significant at  $p \leq 0.05$

## RESULTS

### *Execution results*

This present study examined the combined effect of mental imagery, visualization of performance, self-confidence and self-evaluation on the standing salto backward tucked. More precisely, the study aimed to determine if there was a positive transfer from visual modality (Visualization) to proprioceptive modality (Imaging) on increasing the precision of the execution.

The results of ANCOVA (repeated measures ANOVA with covariance with baseline performance) are described in detail in Table 2.

In addition, the interaction between the imaging and the visualization simulation methods showed a significant result ( $F = 8.46$ ,  $p \leq 0.05$ ). A post hoc analysis (Bonferroni test) showed a significant difference at  $p < 0.05$ .

Regarding the simulation method, the analysis revealed that mental imagery as well as visualization had an important effect, with an improvement of 6% by switching from the imagery method to visualization (see Table 3).

### *Psychological results*

Correlation between self-confidence results and self-evaluation after training without mental strategies showed a negative correlation between the results of self-confidence performance (%) and performance without mental imagery (N / 20) (see Table 4). Moreover, our results show a positive and significant correlation between the results of self-evaluation (N / 20) and confidence (%) (see Table 4).

For training with visualization, results showed a negative and significant correlation between the results of self-confidence (%) and performance (cm). In addition, results showed a positive and significant correlation between the results of self-evaluation (N / 20) and self-confidence (%) (see Table 5).

## DISCUSSION

This study aimed to investigate the influence of mental strategies (IM and V) on performance (standing salto backward tucked) and on self-confidence in gymnasts. The present findings highlighted the importance of mental preparation

strategies and their potential effects on improving physical and psychological performance. A statistical analysis of the repeatable ANCOVA, which was carried out on the average of performances, found a significant effect of the simulation intervention ( $F = 5.31$ ;  $p < 0.05$ ), while the baseline performance (without mental stimulation) had no significant increase ( $F = 3.95$ ;  $p > 0.05$ ). Indeed, this improvement in performance (standing salto backward tucked) resulted in better execution with segmental coordination on the force platform. Mental strategies (MI and V) have an important role in improving performance. Specifically, a repeated measure ANOVA analysis was performed to determine whether there were any main effects or significant interactions on each of the performance dimensions, hence a significant effect noted on the performance ( $F = 12.55$ ;  $p < 0.001$ ).

The Richardson's (25) neuromuscular feedback theory demonstrated that a vivacious and focused image produced muscle activation comparable to that observed in actual motion. When mental simulation is sufficiently high it can generate proprioceptive feedback used to enhance the corresponding motor program. Brody et al. (2000) suggested that mental strategies might lead to changes in motor unit recruitment within the muscle. Specifically, it was hypothesized that there could be an increase in motor unit activation in the agonist muscle and a decrease in motor unit activation in the antagonist muscle. Self-directed cognitive strategies or psyching up do likely occur in the cerebral cortex. Therefore, psyching up may stimulate changes in the activity of the central nervous system (CNS), resulting in adjustments in motor unit recruitment, or synchronization, or muscle firing rate, or all. Similarly, changes in the CNS may modify the sympathetic nervous system activity, which may result in alterations in peripheral factors, like muscle contractility (Bray, Seed, Cluff, & Seed, 1994).

In studies of Feltz and Landers (1983), Orlick and Partington (1988), and Gow, Tuffey, Hardy, and Lochbaum (1993), it has been shown that mental training, along with physical, technical, and tactical training, contributes enormously to improving performance in various disciplines. A study of Thelwell and Maynard (2003) and Hanton, Wadey, and Connaughton (2005) indicated the importance of mental skills in the achievement of sports performance. MI and V improved the physical performance of subjects. Therefore, these results are aligned with those demonstrated by Jones, Hanton, and Swain (1994). They have proven that the development of effective coping strategies and preparation through mental imagery to eliminate parasitic thoughts are all elements favoring the emergence of neutral perceptions or favorable to performance. In addition, qualitative research shows that imaging is a better strategy helping athletes overcome negative symptoms and facilitates better performance (Hanton & Jones, 1999a, 1999b).

Regarding the simulation method, our analysis revealed a significant effect of mental imagery as well as visualization ( $p < 0.04$ ,  $p < 0.01$ ; respectively), and an improvement of 6% when switching from the imagery method to visualisation. Therefore, the immediate effect of the two strategies on standing salto backward tucked is better performance. This improvement is thanks to the combined effect of the two effective modalities (MI and V). At the same time, combining visualization and imagery with training results provides more gains than training alone (Lebon, 2009).

It should be noted that to develop power, movement must be done quickly or explosively, because this causes the nervous system to recruit the maximum number of muscle fibers in the minimum time (Brody *et al* 2000). Along with these physiological explanations that show that improved muscle power comes first from

the controls of the nervous system, research on the relationship of cognitive techniques with nerve controls and muscle changes has been developed.

According to this research, cognitive techniques can stimulate changes in the activity of the central nervous system (CNS), resulting in adjustments in the activation of motor units, synchronization and / or rate of involvement of these units (Bray et al., 1994; Brody *et al* 2000). Likewise, these studies support that those changes in the CNS may alter the activity of the sympathetic nervous system which affects muscle contractility.

Although these results suggest that cognitive techniques affect the cerebral, nervous and mycological structures at the origin of the control of muscle power, we note the multitude of phenomena acting on this quality. It is therefore likely that improving lower extremity muscle power through cognitive techniques strategies would require more sessions than those spent during the present study, given the complexity of developing this quality.

Concerning improving psychological performance, these self-managed strategies used by gymnasts could ensure the best improvement in athletes' self-confidence. Indeed, statistical analysis of correlations between performance and self-confidence indicated that after using mental strategies, there were more positive and significant correlations between self-evaluation, self-confidence score, and the standing salto backward tucked in comparison to the performance without mental training strategies.

## CONCLUSION

The aim of the current study was to investigate the ability of gymnasts to engage in (visual and spatial) mental imagery and visualization, and the effects of this ability on enhancing athletes' performance of standing salto backward tucked . The study contributed to the exploration of mental imagery, supplying

an added support for psychological effects of mental imagery and for its practicality in motor and sport sciences. Initially, it was found that the combined effect of the two strategies (MI and V) improved performance in comparison to the baseline performance. Second, self-confidence and self-evaluation are statistically proven to be better after using these strategies. Apart from the reduced number of sessions in the present study, the improvement is strongly present and the effects of imaging and visualization on performance and on self-confidence are observed following the combined effect of two strategies. The initial hypothesis that mental preparation strategies have potential effects on improving physical and psychological performance, as claimed in previous studies, is thus confirmed.

The hypothesis suggesting that these strategies could ensure an improvement in self-confidence of athletes based on the results of previous research is validated. In addition, the present research highlights the role played by mental strategies in mobilizing cognitive, mental (self-confidence) and physical (performance) resources. In addition to the pursuit of better physical performance, the mental state is a pillar of success and optimization of performance. Mental strategies can improve slightly the initial potential of psychological performance (self-confidence). This fact seems to us of major importance for the preparation of athletes in difficult situations that threaten their confidence and their ability to succeed. Among mental techniques, we distinguish IM and V for their potential to improve self-confidence.

This research is useful to physical, mental, and athletic trainers, and provides them with information on how to optimize performance. Although the findings do not provide definitive conclusions, they bring more interest to the subject of MI and V in sports preparation. Future research should include a greater variety of gymnastic

elements analyzed, especially more complex ones.

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