ROLE OF THE MENTAL REPRESENTATION IN ENHANCING MOTOR LEARNING AND PERFORMING GYMNASTIC ELEMENT

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Original article

Abstract

The aim of the present study was to analyze the effect of three intervention modalities ((a) external visual imagery modality, (b) verbal feedback modality and (c) visualization modality) on the Roll backward to handstand. 42 females' students (age 20.6 ± 1.3 years) voluntarily took part in this study. Subjects were assigned into three groups according to three learning modalities: mental imagery modality, verbal feedback modality and visualization modality. During the two testing sessions (before and after training sessions), the participant was marked according to the FIG Code of Points. The results thus reveal a significant effect on the training, therefore on the learning of the backward roll followed by a handstand by the method of mental imagery. Thus, the mental imagery seems to be a tool for transmission of knowing and training by excellence making it possible to the students to progress while getting rid of the lack of motivation, organization, implication and work. Moreover, the results gathered following the gymnastic practice also show an improvement of the performance of the first group that had to undergo training by verbal feedback. This supports the idea that the training by the method of verbal feedback improves the technical performance of a gymnastic element. However, the method of training by visualization of a model appears to be the less developed by the participants in comparison with the mental imagery and the verbal Feedback.

Keywords: *sensory feed back, motor learning, female, acrobatic.*

INTRODUCTION

A handstand, as a key exercise of the contemporary gymnastics, was a static acrobatic exercise where the body was maintained in the equilibrium position with the hands pressed into the floor (Tipton, 2011). Handstand exercise was performed in many sports activities for both men and women such as: sports aerobics, fitness, sports acrobatics, and sports gymnastics. Moreover, it was an integral part of various key positions in break dancing (freeze and kick); it was a starting position in high diving, a position in synchronized swimming (with a head submerged in water and the legs stretched out of it), an integral part of martial arts such as caper or Eastern skills such as yoga. The specificity and the

significantimportance of a handstand were found particularly in sports gymnastics. In fact, many gymnastics' experts have still been discussing and writing about the handstand exercise because it was a basic acrobatic skill which appears in various forms and with different purposes on all the apparatus of the gymnastics all-around (Arkaev & Suchilin, 2009). Accordingly, the quality and success of a performer depended mainly on his technical performance. Similarly, his poor performance was certainly going to have a significant impact on all other exercises whose technique was associated with it. The variations of handstand form play as well an important role as an initial and final position of some of the gymnastics elements mainly in artistic gymnastics. However, back swing connections during gymnastics acrobatic series considerably influence technical performance and difficulties and would allow best performance and lower the risk of falls. In artistic gymnastics, the fundamental movements are decisive to successfully and safely perform acrobatic elements. In this respect, the choice of the technical preparatory Roll backward to handstand elements provide a base for more advanced motor skills and is crucial for optimal performance (Gallahue & Ozmun, 2005). So, this fundamental movement was chosen according to the following criteria: (1) it is teaching topics in Exercise Science and physical education curriculum; (2) according to the participant's abilities and pre-knowledge students can learn the same and similar artistic gymnastics skills (Delaš Kalinski, 2009); (3) these skills represent basic skills in artistic gymnastics. Examining and developing the mental aspects of the handstand could help gymnasts develop more self-confidence and consistency (Calmels et al., 2017) It was also assumed that the mental representations were in fact hierarchically organized memory structures comprised of cognitive units specified as Basic Action Concepts (Schack & Mechsner, 2006) and that the arrangement and clustering of these BACs (Basic Action Concepts) controls and guides skill execution. Despite the fact that handstand is one of the most important basic exercises of the sports gymnastics, (Bolković & Kristan, 2002; Čuk et al., 2009; Živčić Marković K., et al., 2015; Novak et al., 2008;) only little attention was paid to mental practice as far as the training condition of this exercise was concerned. These mental skills were more particularly the practice of the mental imagery and the training by visualization of a model (Schmidt, 1993; Chalghaf et al., 2013). Accordingly, "Imagery, in the context of sport, may be considered as the creation and re-creation of an experience generated from memorial information, involving quasi-sensorial, quasi-perceptual, and quasi-affective characteristics, that was under the volitional control of the imager, and which may occur in the absence of the real stimulus antecedents normally associated with the actual experience" (Morris et al., 2005, p19). Part of this process is the detection of errors, which was the result of an actual-target-comparison, the comparison between real and expected performances of the learner because the concept of how the expected performance of the learner should be like, may be clearer. However, little was known to date on imagery use in gymnastics, with only few studies focusing on imagery use in this particular sport. Given the versatility and importance of imagery in general sports (Morris et al., 2005) and in gymnastics in particular (Fournier et al., 2005), this study focuses on imagery practice and on Roll backward to handstand, as a different form of handstand that was the result of a multitude of motor actions that require balance, stability and sheathing the body for later transfer of learning other technical elements. Thus, the aim of the present study was to analyze the effect of three different intervention modalities

(a) external visual imagery modality, (b) verbal feedback modality and (c) visualization modality on Roll backward to handstand in order to determine the most appropriate way for enhancing motor learning on gymnastics' actual execution. Concerning the hypothesis, it was expected that the external visual imagery is the most effective method in improving the technical performance of a gymnastic learning situation.

METHODS

Participants were 42 female students (age 20.6 ± 1.3 years) voluntarily took part in this study. They were sport science's students pursuing degrees in Exercise Science and Physical Education at the University of Manouba, ISSEP Ksar Said Tunis (Tunisia) and they don't have some previous experience in performing this skill. All the subjects have undertaken the same training program with the same gymnastics teacher and under the same work conditions (the same day during the morning in a well-equipped gymnasium) and with no previous experience of Roll backward to handstand. The subjects were randomly assigned in three equal groups to different conditions. The choice of the population of the present research seems paramount to the installation of the studies so that the relations between these variables can be analyzed. None of the participants had received formal cognitive imagery treatments whether specific or general before. It was made clear to them that participation was entirely voluntary and anonymous and that their answers would remain strictly confidential and the data will only be of use to scientific research.

The present study was conducted in three phases. During the first phase: participants completed Vividness of Visual Imagery Questionnaire in the purpose of determining those with clearness and richness of the mental images generated. Then they will be incorporated into the imagery condition during the experimental sessions. As a result, three experimental groups have been formed and were engaged in the following three experiments modalities as follow: (a) external visual imagery modality (group good visualizes), (b) verbal feedback modality and (c) visualization modality (groups poor visualizes). Pre-intervention base line measure of Roll backward to handstand (pre-test) of participants was carried out during this phase aimed at provided evidence that the improvements of sprint performance after experimental conditions were caused by the condition themselves. During the two testing sessions (before and after training sessions), the participant was marked according to a point code (FIG, 2003).

During the second phase: researchers used the same class level and taught six training gymnastics lessons according to the three learning modalities. Before the experiment, none of subjects had ever specifically performed mental preparation with the aim of improving motor performance.

During the third phase: participants performed Post-intervention measure of Roll backward to handstand (post-test) under the same experimental conditions as the pre-test. Participants were debriefed about the goal of the study once all experimental sessions were finished. Moreover, subjects received their own performance results of each test performed during the study. Experimental protocol was performed in accordance with the Declaration of Helsinki for human experimentation and was approved by the ethical committee. Out of respect for the research ethics, informed consent forms were read and signed by the participants. This study took place in February of the 2015-2016 academic years.

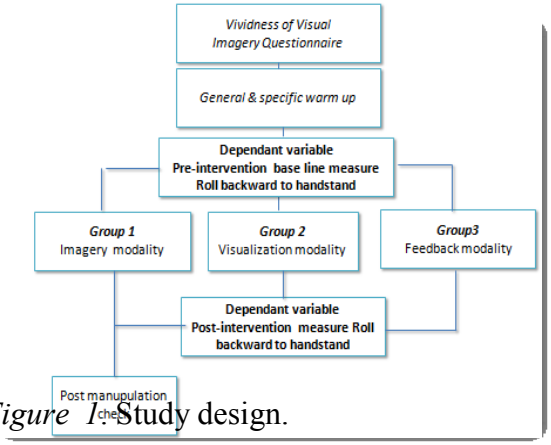

Figure 1. Study design.

Measures

- Gymnastics performance

During test and post-test participants executed Roll backward to handstand and their performance was recorded by a digital video camera. Video analysis was established with a Sony video camera (DCR PC 105E, 50 Hz) in order to analyze final value of the deduction. Recorded performances of the participants were watched and evaluated once again by three Judges mainly for the final value and technical of the deduction. Qualitative data for each participant were collected by using a scorecard for execution faults (FIG, 2003). All tests were applied at the same day and by the same evaluators. There were University professors and national judges (N=3) with more than 20 years of experience of work in various Tunis sports clubs and Faculty of Physical Education and Sport. The evaluation of each participant was based on regulation in Code of Points to mastery in technical skills (Brüggemann, 1994). The judges rated the participants' performance independently and through video analysis. The judges did not know which participant was assigned to which experimental condition. Any deviation from the correct position is considered as mistakes and the judges made deduction according to the FIG Code of Points (2013-2016).

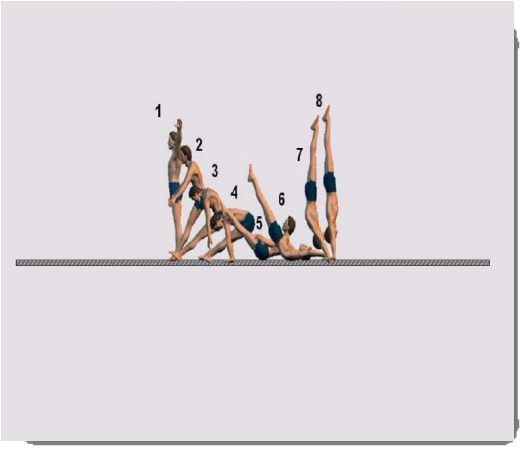

Figure 2. Stages of roll backward to handstand performance (FIG 2003).

- Evaluation Process

A scorecard was established for assessing Roll backward to handstand technique before and after /the training sessions. The five technical criteria studied were chosen according to the Table of General Faults and Penalties the FIG Code of Points (2013-2016). The level of the performance was videotaped (at the beginning and at the end of the program) and evaluated according to standard procedure on a five-point Lakers scale. Evaluation was based on the FIG Code of Points (2013-2016), but adjusted in order to be suitable for the PE curriculum, as follow:

Table 1

Evaluation criteria for judging student' performance during Roll backward to handstand (Execution faults and penalties).

	Deviation from straight direction	Body Posture fault	Reach handstand prior to landing	Perfect standing position	Dynamism/coordination for each variable based
Very good 1pts					
Good 0.8 pts					
Medium 0.5 pts					
Weak 0 pts					

Score /5

Process of evaluating Roll backward to handstand element was simple and according to code of point' regulation **(**COP). Performance was evaluated following the expectations of perfect performance. All deviations from this expectation are deducted.

Table 2
Deviation faults and penalties.

Fault	Deduction (pts)	Description
Perfect	No deduction	No deviation
Small	0.10	Deviation less 15o
Medium	0.30	Deviation less 30o
Large	0.50	Deviation less 45o
Very large	1.00	Fall at landing/no recognition

Total error score was calculated and deductions for errors in execution are added together and then deducted from 5.00 points to determine the Execution- Score (FIG Code of Points 2013 – 2016). A 5-Liker point was used in all three intervention methods. Very strong performances received a 5 point score as maximum cumulative score for best execution whereas unsuccessful performances received a 0 point score when participant did not perform element or else in the case of no recognition of movement.

- The mental imagery condition

Participants rehearsed Roll backward to handstand mentally in an external perspective during the gymnastics lessons and after each actual execution. During actual condition, participants were put in real-life situation and asked to perform exercise as they would at a situation test during 30 seconds (s) (Calmels & Fournier, 2001).

Thus, instructions were precise on the technical realization of gymnastic element. To generate, then to control mental work, a script of imagery was given to participants which was based on a previous research (Hammoudi-Nassib et al., 2014;Hammoudi -Nassib et al., 2017): "You have 30 s during which I would like that you visualize yourselves carrying out Roll backward to handstand as perfect as possible. Please, close your eyes and imagine that you established a new perfect performance". At my signal concentrate, then when you are ready, start to imagine the sequence without moving.

Interview post experimentation

To check if the students have realized experimental conditions in accordance with instructions given, they were questioned about their imagery perspective and nature and vivacity of image associated (Gould, 1980; Cumming, 2007).

- Visualization of a model

During the second modality, participants were seated at a table in the room adjacent to the gymnasium and were viewing exercise twice during 30 s, one at real time and one in a slow motion than in actual execution. Teachers had frequently recourse to immediate videotaped actual execution. So, video sequences of Roll backward to handstand which they should perform were presented to participants during gymnastics lessons and after each actual execution. Participants visualized performance achieved previously with a comment with reference to expectations of a perfect performance and deviations from this expectation.

- Retroactive verbal feedback

Effective instruction may be crucial to the pursuit of optimal sporting performance (Hodges & Franks, 2002; Schmidt et al., 2004). So, in the present study, the role of the physical education teacher is to give information about Roll backward to handstand' execution in the form of verbal and visual feedback as a key tool in improving and learning motor skills. Accordingly, teacher provides instructors' feedback in positive form about errors, corrections and encouragements with presentation of shapes and sketches to facilitate performance of task and to enhances attention and provides additional information that may not be available through visual observation (i.e., impulse to handstand, body position during the

movement…).

- Vividness of Visual Imagery Questionnaire (VVIQ)

Before Imagery condition, the VVIQ (Marks, 1973) translated and adapted in French by Denis, 1979 was used to monitor the participants' statements describing various scenes, which they must visualize mentally. Participants' vividness of the image was evaluated in order to determine the richness of the mental images generated to be able to incorporate thereafter. The vividness of the image is rated along a 5-point scale. The questionnaire has been widely used as a measure of individual differences in vividness of visual imagery. The large body of evidence confirms that the VVIQ is a valid and reliable psychometric measure of visual image vividness. VVIQ assesses vividness of visual imagery using 16 items in four groups of 4 items in which the participant is invited to consider the image formed in thinking about specific scenes and situations. So that higher scores reflect higher vividness. Participants form a series of images of a friend or relatives face, the rising sun, a shop, and a country scene. Ratings of image vividness were made on a five-point scale, ranging from 1, perfectly clear and vivid as normal vision, to 5, No image at all, you only "know" you are thinking of the object. Participants answered questionnaires in groups, with the presence of a tutor who acted as the experimenter. They were asked to seat themselves as far apart as possible in the room. Responses were made in silence, and participants were told not to put their names anywhere in the booklet.

Participants answered questionnaires in the order in which they appeared in the booklet. An individual score from 0 to 64 was calculated, which made it possible to classify participants in "good visualizes" and "poor visualizes". In the version of Marks, 1973, there were two levels of scores derived in a population of students; "good visualizes" (average = 3.25) and "poor visualizes" (average = 1.64), i.e. participants in good capacity of visualization (vividness) and participants in low capacity.

Qualitative and quantitative data were collected within average from observation grids composed by criteria of success of the technical element and which were translated in the form of marks based on the codes of marking. Inter-rater reliability of Roll backward to handstand' scores were analyzed using intra-class correlation coefficient (ICC), with a value of 0.7–0.8 being questionable and 0.9 indicating high reliability (Vincent, 2005), and standard error of measurements (SEM) calculated by dividing the standard deviation of the difference between scores by √2 (Hopkins 2000). All the values are expressed in the form of average ± standard deviation. For the quantitatively data analysis, the score allotted to each participant was compared before and after training for each method, to do so, the analysis of multiple variance ANOVA was used. Effect size was calculated for all ANOVAs with the use of a partial eta squared (η^2) <0.01 = small, 0.01-0.06 = medium, and > 0.06 = large).

This statistical analysis was used to study correlation between various variables of our study namely: effect of training for each method of training on performance, comparison of inters group performance and groups/training interaction. Percentage of delta was also calculated: Δ%= (T1-T0) /T0×100; T0 is equal to the average initial performance of T1 and the average of the representation. Software Statistics version 3 was used for all of the statistical analyses. The threshold of significance was fixed at $p<0.05$.

RESULTS

The interclass coefficient of correlation (ICCs) ranged between 0.94 and 0.98 indicating very high inter-rater reliability. ICCs were also very high in each of the

session (Table 3).

Table 3
Inter-rater reliability of the scores.

Session	ICC3.1 (95% CI)	SEM
Pre-	0.98 [0.96-0.99]	0.06
Session 1	0.97 [0.96-0.98]	0.04
Session 2	0.94 [0.88-0.97]	0.08
Session 3	0.94 [0.88-0.96]	0.06
Session 4	0.98 [0.97-0.99]	0.01
Session 5	0.97 [0.95-0.98]	0.05
Session 6	0.95 [0.91-0.97]	0.05
Post	0.97 [0.95-0.98]	0.03

Effect of the Three Learning Modalities on the Development of Roll backward to handstand: Video recording of Roll backward to handstand of the three groups according to their learning modalities was analyzed on the basis of the five criteria of success of the task previously indicated.

External visual imagery modality

Analysis of the results obtained indicates that the external visual imagery improve Roll backward to handstand execution. Improvement in score means attributed to performers was 4.6 ±0.7 compared with test values 3±1. This explains why external visual imagery learning is an effective method for improving performance (Figure 3).

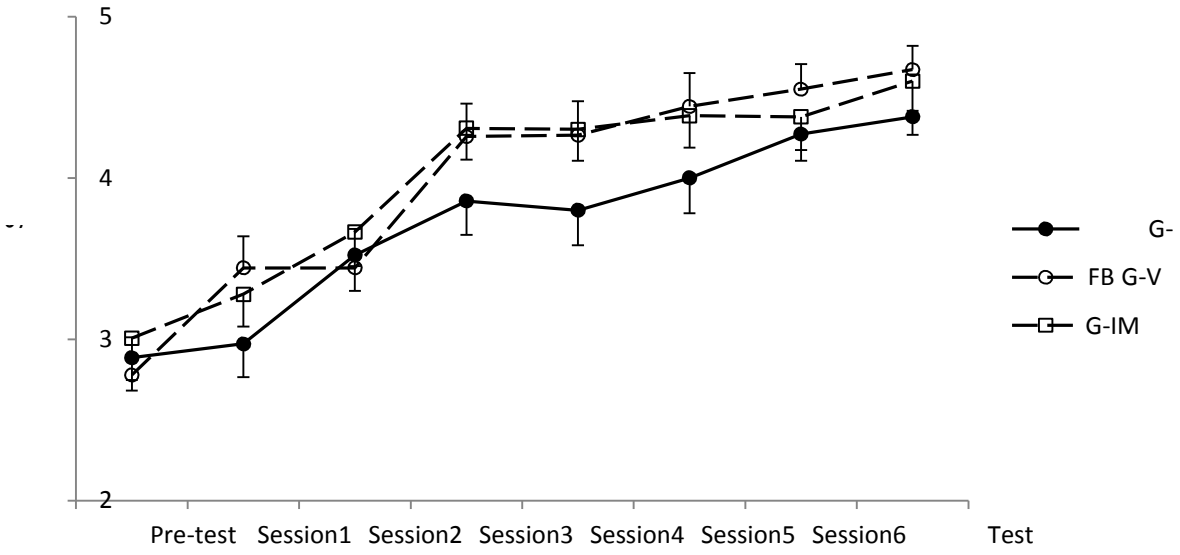

Figure 3. Evolution of the level of learning of the Back Roll to handstand according to learning modalities.

ANOVA analysis revealed that there is a significant effect of the training [F (7; 91) = 25.5; p <0.001; η^2= 0.662] .

Verbal feedback modality

Analysis of the variance (ANOVA) of Roll backward to handstand' performance also revealed that the verbal feedback (FB) either at the beginning or at the end of training revealed a significant effect in terms of performance, as well as in training p <0.001 [F (7.91) = 22.52; $\boldsymbol{\eta}^2$=0.601]. In addition, results indicate that the average performance rating was significantly better in comparison to the predictive scores of 2.9±0.8 to 4.4±0.4 (Figure 3).

Visualization modality

However, visualization modality

contributed to the improvement of scores' mean throughout the learning sessions from 2.8±0.9 to 4.7±0.5 (Figure 3), although Visualization has a significantly lower score compared to other modalities. Results presented in graphic 1 show a significant effect of the training leading to the improvement of technical execution of Roll backward to handstand throughout the cycle as well as the increase in performance obtained.

Technical corrections of gesture and more particularly of mental imagery in the progression of the learning of Roll backward to handstand which vary with each session have a significant effect which was demonstrated by the regression curve which confirms our interpretations. In addition, a progression in the learning of the technique of Roll backward to handstand with verbal feedback' modality was also observed. Moreover, learning through verbal feedback proved to useful in improving technical performance (Figure 3).

General Performance Analysis

ANOVA revealed a significant effect of learning modalities, [F (7; 91) = 22.52; p <0.001; η^2=0.601] for verbal feedback group; [F (7; 91) = 16.62; p <0.001; η^2=0.492] for visualization group; and [F (7; 91) = 25.50; p <0.001; η^2=0.591] for external visual imaging group, although difference between degree of contribution of each one. Although, participants' performance was recorded, their progress during Roll backward to handstand teaching was highlighted. Thus, to illustrate this improvement in performance, an intergroup comparison was used. As shown in Figure 3, with respect to the learning of Roll backward to handstand, ANOVA showed a non-significant group effect as well as a non-significant group interaction of training for F (2; 39) = 1.02; p = 0.37; η^2=0.042] and [F (14; 273) = 0.95; p = 0.51; η^2=0.031) respectively, while a significant effect of training (F (7; 273) = 59.04; p<0.001: η^2 = 0.05].

DISCUSSION

The objective of this study is to determine the role of mental representation during the teaching / learning of Roll backward to handstand.

Potential effect of the imagery, which was clearly identifiable, along with the technical progress was well perceived by the students. Progress recorded by students was particularly improved thanks to an assiduous mental practice and with specific images to the practiced element. These results are aligned with those illustrated by Simonsmeier & Buecke (2016) was showed that imagery is frequently used in gymnastics, and imagery use is positively associated with performance. Also, simulation between mental training by the means of mental imagery and the training of the purely technical movements contribute to achieve the best performance, this result is affirmed by Moraru, Cristiana E. et al., (2015), who showed that the effects of the mental training contribute to the improvement of the technical execution in rhythmic gymnastics and consequently the best results in the competitions. This method is characterized by the fact that the pupil felt like actively implied in the visual performance. Battaglia et al., 2014, Fournier et al., 2005, Smith et al., 2007, confirm the positive effects of imagery procedures have proven to be an effective tool to improve performance in the field of gymnastics. Several conditions allowed an effective use of the mental imagery with high-level athletes.

From an external perspective, the imaging activity was characterized by the fact that the athlete felt actively involved in the visualized performance. Improving the performance of Roll backward to handstand is resulting in an improved motor performance of the same element by the method of external visual imagery. Similarly, technical execution has improved thanks to the improved motor performance since our study element is composed by the association of several

motor actions such as handstand passage. Learning through external visual imagery promoted the stability of the execution of Roll backward to handstand and subsequently improving the technical performance since Handstand is the most important skill in our sport and remaining tight is essential! Gymnasts of all levels perform the handstand several times throughout their workout. While performing many skills in gymnastics, the gymnast must actually pass through the handstand or vertical phase safely and efficiently. Without a good handstand a gymnast may have trouble building skills and therefore progressing through the sports many levels safely and efficiently. These results were confirmed by the work of Jacobson of the neuro-muscular theory (1932) which was one of the first theories explaining the effects of mental imagery on motor performance. Our results were confirmed by the research of Weinberg (1982) which states that visual external imagery should lead to a higher level of performance because it was accompanied by a greater level of muscle activity. In short, results confirm the beneficial effect of the integration of the visual external imagery into a programmer of training in physical education and more particularly in gymnastics compared to the other methods.

Verbal feedback modality

The use of the verbal Feedback method aimed either to improve the performance of the student or to advice around the criteria of success of a gymnastic movement or the errors to be avoided. This helps the student to know his errors and the means to implement to be correct, which allows him by following his training to improve the quality of his performance Giannousi et al. (2017) claim that using verbal cues is very effective, especially for very young children that attempt to learn a new kinetic pattern, especially when verbal cues are linked to practice

Moreover Mrayeh et al. (2015), insisted on the importance of Feedback during or after the completion of the physical task on the improvement of the physical training. As for Schmidt & Wrisberg (2008) reported that feedback is an important variable in the teaching/learning process that can be attributed to motivation in the performance of sports skills of students and athletes.

In short, main results support the idea that the training by the verbal feedback method improves the technical performance of a gymnastic element.

Visualization modality

The method of training by visualization of a model made it possible to associate a video with the element predetermined to provide the learner with the appropriate way to visualize on the laptop the element that he must produce. However, this method appeared to be less developed at the participants in comparison with the mental imagery and the verbal Feedback. Indeed, our results are in conformity with the previous research results, either that was in the sport of high level or in Sport and Physical Education. Merian & Baumberger (2007) state on the basis in the theory of the social training of Bandura that it is possible to learn by observation from a model Baudry et al. (2006) affirm that the video model helps the gymnast to develop a cognitive representation of the movement. This latter would act like an information source and the data that would result from this will be then coded and would make it possible to the observer to build "symbolic notations of the observed behaviors" Baudry et al. (2006, p.55). By viewing the sequences, the subject will analyze the different steps necessary to achieve the performance. It will handle and build, in a way, a way forward to achieve the goal.

Moreover, this learning technique by visualization of a model allows providing information on the student; this will serve later as a reference for the execution or the regulation of his physical actions. According to Magill (2011), the representations put in memory would be used as a guide for the execution of the

movement, but also as standard reference for the detection and the correction of the errors.

CONCLUSIONS

The present study aims at determining the potential effect of the mental imagery on teaching/learning of the gymnastic elements. Thus, visual external imagery seems the best strategy for transmission of knowledge and training as compared to visualization and feedback modalities. Thus, this research opens new prospects as for various scopes of used application. It would be particularly necessary to test other increasingly complex technical elements, apply this method according to the sex and to better standardize the conditions of mental work practice. Consequently, this work aims mainly to clear up, drive awareness and inform in some ways the teacher about these new methods and by hoping that such a reading gives desire to certain teachers to go further in their reflections, their trainings and their practices. Therefore, gymnastics is an individual sport with few external factors, and therefore both the mental and physical states of the gymnast are by far the most important factors influencing the success of a performance. Implementing sport psychological skills is thus an important tool for coaches as well as gymnasts to optimize the mental state of the athlete.

REFERENCES

Arkaev, L., & Suchilin, N. G. (2009). *How to create champions: the theory and methodology of training top-class gymnasts*. Maidenhead: Meyer and Sport (UK) Ltd.

Battaglia, C., D'Artibale, E., Fiorilli, G., Piazza, M., Tsopani, D., Giombini, A., & Calcagno,G. (2014). *Use of video observation and motor imagery on jumping performance in national rhythmic gymnastics athletes*. Human Movement Science, 38, 225-234.

Baudry, L., Leroy, D. & Chollet, D. (2006). *The effect of combined self- and expert modeling on the performance of the double leg circle on the pommel horse*. Journal of Sports Sciences, 24(10), 1055-1063.

Bolković, T. & Kristan, S. (2002). *Akrobatika. Ljubljana*: Fakulteta za šport, Univerza v Ljubljani.

Brüggemann, G.P. (1994). *Biomechanics of gymnastic techniques*. Sport Science Review, 3(2), 79–120.

Calmels, C., & Fournier, J. (2001). *Duration of physical and mental execution of gymnastic routines*. The Sport Psychologist, 15, 142-150.

Calmels, C., D'Arripe-Longueville, F., Fournier, J.F., & Soulard, A. (2017). *Competitive strategies among elite female gymnasts: an exploration of the relative influence of psychological skills training and natural learning experiences.* International Journal of Sport and Exercise Psychology.

Chalghaf, N., Cherif, A., Sbaa, S., & Azaiez, F. (2013). *The Impact of the Judo's Mental Imagery Learning on the Imaging Ability among High Institute Students*. Journal of Humanities and Social Science, 12, 83-87.

Čuk, I., Bolković, T., Bučar Pajek, M., & Turšić, B. (2009). *Športna gimnastika 1 za študente Fakultete za šport*. Ljubljana: Fakulteta za šport Univerze v Ljubljani.

Cumming, J.TO, & Law, M. (2007) .*Self-Reported Psychological States and Physiological Responses to Different Types of Motivational General Imagery*. Journal of Sport & Exercise Psychology, 29, 629-644.

Delaš Kalinski, S. (2009). *Learning dynamics of artistic gymnastics motor skills (dissertation*). Zagreb: Faculty of Kinesiology University of Zagreb,232.

Denis. (1989). *Image and cognition*. Paris, Presses Universitaires de France

FIG (2013-2016). *Code of points Women's Artistic Gymnastics*. International Gymnastics Federation, Lozan Switzerland.

Fleurance, P. & Kermarrec, G. (1998*). Effects of learning strategies on*

performance in a self-controlled motor task .Science et motricité, 35-36, 117-118

Fournier, J. F., Calmels, C., DurandBush, N. & Salmela, J. H. (2005). *Effects of a season-long PST program on gymnastic performance and on psychological skill development*. International Journal of Sport and Exercise Psychology, 3(1), 59-77.

Gallahue, DL., & Ozmun, JC. (2005). *Understanding Motor Development: Infants, Children, Adolescents, Adults*. 6th, ed. Iowa, Dubuque: McGraw-Hill.

Giannousi, M., Mountaki, F., & Kioumourtzoglou, E. (2017). *The effects of verbal and visual feedback on performance and learning freestyle swimming in novice swimmers*. Kinesiology, 49, 65-73.

Gould D, R.W, & Allen, J. (1980). *Mental Preparation Strategies, Cognitions, and Strength Performance*. J of sport psychology, 2, 329-339.

Hammoudi-Nassib, S., Nassib, S., Chtara, M., Briki, W., Chaouachi, A., Tod, D., & Chamari, K. (2017). *Effects of psyching-up on sprint performance*. Journal of Strength and Conditioning Research, 31(8), 2066–2074.

Hammoudi-Nassib, S., Nassib, S., Chtara, M., Nassib, S., Briki, W., Hammoudi-Riahi, S., Tod, D., & Chamari, K. (2014). *The time interval moderates the relationship between psyching-up and actual sprint performance*. Journal of Strength and Conditioning Research, 28 (11), 3245–3254.

Hodges, NJ., Franks, IM. (2002). *Modeling coaching practice: the role of instruction and demonstration*. J Sports Sci, 20(10), 793-811.

Hopkins, WG. (2000). *Measures of Reliability in Sports Medicine and Science.* Sports Med, 30(1), 1-15.

International Gymnastics Federation (2003). *Age group development program*. *FIG* Lausanne,Switzerland.

Jacobson, E. (1932). *Electrophysiology of mental activities*. American journal of psychology, 44, 677- 694.

Le Scanff, C. (1995*). Imaging andLearning , in Bertch J. & Le Scanff C. (Eds), Motor Learning and Learning Conditions*. Paris, Presse Universitaires de France, p204.

Magill, R. A. (2011). *Motor learning and control: concepts and applications. Marks, D. F. (1973). Visual imagery in the recall of pictures.* British Journal of Psychology, 64, 17-24.

Merian, T. & Baumberger, B. (2007). *Video feedback in school physical education*. De Boeck supérieur, revue-staps, 107-120.

Moraru, C. E., Radu, L. E., Grosu, E. F. & Puni, A. R. (2015*). Influence of mental training on the execution technique in rhythmic gymnastics*. Global Journal of Humanities & Social Sciences, 01, 176-181.

Morris, T., Spittle, M., & Watt, A. P. (Eds.). (2005). *Technical Aids to Imagery. In Imagery in Sport*. Champaign, IL: Human Kinetics, 237-266.

Mrayeh, M., Bouzid, M. S., & Hawani, A. (2015). *Analysis of the Impact of the Active Feedback on the Quality of Motor Learning in Athletics: Case of the Teaching of the Long Jump.* Creative Education, 6, 982-997.

Novak, D. & al. (2008). *Gimnastična abeceda*. [ABC of gymnastics] Ljubljana: Fakulteta za šport Univerze v Ljubljani.

Schack, T. & Mechsner, F. (2006). *Representation of motor skills in human longterm memory*. Neurosci. Lett. 391, 77–81. doi: 10.1016/j.neulet.2005.10.009.

Schmidt, R. A. & Wrisberg, C. A. (2008). *Motor learning and performance: A situation-based learning approch* .Champaign, IL: Human Kinetics.

Schmidt, R. A. (1993). *Motor learning and performance* . Paris:Vigot, 32.

Schmidt, R. A., Richard, A., Wrisberg, C. A., & Craig, A. (2004). *Motor Learning and Performance*. Cinétique humaine. Published by Human Kinetics Publishers.

Simonsmeier, B. A. & Buecker, S. (2017*). Interrelations of imagery use, imagery ability, and performance in young athletes*. Journal of Applied Sport Psychology, 29, 32–43.

Simonsmeier, B. A. & Buecker, S. M. (2016). *Interrelations of imagery use,*

imagery ability, and performance in young gymnasts. Journal of Applied Sport Psychology,32-43. Advance online.

Smith, D., Wright, C., Allsopp, A. & Westhead, H. (2007*). It's all in the Mind: PETTLEP-Based imagery and sports performance*. Journal of Applied Sport Psychology, 19, 80-92.

Tipton, J. (2011). *Types of Handstands* /on-line/. Retrieved on 15th October 2011 from http://www. ehow.com/facts_5279611_typeshandstands. Html.

Vincent, W. (2005). *Statistics in Kinesiology*. Champaign, IL: Human Kinetics.

Watt, A. P., Spittle, M. & Moris, T. (2002). *Evidence related to the evaluation of measures of sport imagery*. Journal of science and medicine in sport, 5(4) 29.

Weinberg, R .S. (1982). *The relationship between mental preparation strategies and motor performance*. A review and critique, ouest, 33, 195.

Živčić Marković, K., Krističević, T., & Aleksić-Veljković, A. (2015*). A suggested model of handstand teaching method*. Physical Culture, 69(2), 138-149.

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