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Efectos de un programa de visualizatión mental en el rendimiento de atletas de Boccia federados y no federados

Effects of an imagery programme on the performance of federated and non-federated Boccia athletes

Efeitos de um programa de imagery no desempenho de atletas federados e não federados de Boccia

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RESUMEN

El objetivo de este estudio fue analizar los efectos y las relaciones a través de la implementación de un programa de entrenamiento de *imagery* (IM) para participantes federados y no federados de Boccia. Veintiún atletas de Boccia participaron en este estudio. Al comienzo del estudio, y después de un período de entrenamiento de IM de 8 semanas, se evaluó la capacidad de IM de los atletas (MIQ - 3) y su desempeño en las tareas de Boccia (distancia al objetivo y distancia a la pelota de color). El análisis de datos se llevó a cabo mediante inferencias basadas en magnitudes no clínicas. Los resultados sugieren que, desde antes hasta después de la prueba, los atletas federados y no federados tuvieron una puntuación de IM más alta y exhibieron un rendimiento mejorado. Los niveles de rendimiento parecen haber sido influenciado por el nivel de experiencia de los participantes, y los atletas no federados revelaron una mayor magnitud de mejora que los atletas federados. Se observó una correlación no significativa entre MI y rendimiento. Aunque la inconsistencia de la relación entre IM y rendimiento, los resultados sugieren que el entrenamiento de IM mejora el desarrollo de la capacidad de IM y también las acciones motoras en los atletas de Boccia.
Palabras clave: entrenamiento mental, pericia, boccia, visualización mental, rendimento.

ABSTRACT

The aim of this study was to analyse the effects and the relations through the implementation of an imagery (IM) training programme for federated and non-federated Boccia participants. Twenty-one Boccia athletes participated in this study. At the beginning of the study, and after a period of an 8-week IM training, the athletes' IM ability (MIQ – 3) and their performance in Boccia tasks (distance to target and distance to coloured ball) were assessed. Data analysis was carried out using non-clinical magnitude-based inferences. The results suggests that, from pre to post

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test, federated and non-federated athletes had a higher IM score and exhibited an improved performance. The performance levels seem to have been influenced by the participants' level of expertise, with the non-federated athletes revealing higher magnitude of improvement than federated athlete's. A non-significant correlation was observed between IM and performance. Although the inconsistency of the relationship between IM and performance, the results suggests that IM training enhances the development of IM ability and also motor actions in Boccia athletes.
Keywords: mental training, expertise, boccia, imagery ability, performance.

RESUMO (1500 palavras) (mesma ordem como títulos)

O objetivo deste estudo foi analisar os efeitos e as relações através da implementação de um programa de treino de *Imagery* (IM) para participantes federados e não federados de Boccia em atletas federados e não federados de boccia. Vinte e um atletas de Boccia participaram neste estudo. No início do estudo, e após um período de um treinamento IM de 8 semanas, a habilidade IM dos atletas (MIQ - 3) e seu desempenho em tarefas de boccia (distância até o alvo e distância até a bola colorida) foram avaliados. A análise dos dados foi realizada por meio de inferências não clínicas baseadas em magnitude. Os resultados sugerem que, do pré ao pós-teste, atletas federados e não federados obtiveram maior *score* de IM e melhor desempenho. Os níveis de desempenho parecem ter sido influenciados pelo nível de experiência dos participantes, com os atletas não federados revelando maior magnitude de melhoria do que os atletas federados. Uma correlação não significativa foi observada entre IM e desempenho. Apesar da inconsistência da relação entre IM e desempenho, os resultados sugerem que o treino de IM aumenta o desenvolvimento da habilidade de IM e também das ações motoras em atletas de boccia.
Palavras chave: treino mental, pericia, boccia, capacidade de *imagery*, desempenho.

INTRODUCTION

Imagery (IM) is one of the most popular psychological techniques used by athletes and coaches to improve performance at competition level (Cumming & Williams, 2013). It has been shown that the use of IM also allows the development of learning and training of motor skills, mental preparation for competitions, development and redefinition of mental abilities and even the development of coping strategies that help athletes to deal with several issues (injuries, strenuous training or distractions in the training process) (Morris, Spittle, & Watt, 2005; Vealey, 2007; White & Hardy, 1995). IM has been also increasingly used as an intervention strategy to work with disabled people helping them to improve the rehabilitation of motor tasks (Cumming & Williams, 2012; Martini, Carter, Yoxon, Cumming, & Ste-Marie, 2016; Hernández-Mendo, 2002).

In general, IM can be defined as the mental creation or recreation of an experience from information stored in the memory, without physical movement (Fletcher, 2005; Vealey & Greenleaf, 2001). Recently, it has been pointed that more than a mental creation, IM ensures neural activation, allowing the development of neural generation or regeneration of common neural networks in the brain, which sustain performance (Williams, Cumming, & Edwards, 2011). This involves, downstream, sensory, and perception characteristics, enhancing functional perception afferences equivalent to the lived sport experience (Amorim, Travassos & Duarte-Mendes, 2017; Cumming & Williams, 2012; Holmes & Calmels, 2008; Mendes, Marinho, Petrica, Silveira, Monteiro, & Cid, 2016). Such common neural activation enhances motor development and competitive learning (Williams et al., 2011). To ensure that the IM training consist on the repeated act of IM of movements without making them, the main purpose of the IM training is the improvement of the capability to combine different images and emotions associated with the movement itself relative to the task (Morris et al., 2005; Napolitano, 2017; Schack, Essig, Frank, & Koster, 2014).

The IM training programmes have been used with different methods in several research areas (education, medicine, music and sport). The *Physical, Environment, Task, Timing, Learning, Emotion, Perspective* (PETTLEP) model has been widely used in different IM training programs, within the sports context, with the objective of maximize the potential for overlap in neural activation between real and imaged behaviours.. According to the PETTLEP model, function and type of task should be taken into consideration (Holmes & Collins, 2001). The use of this model in previous studies allowed the amplification of the equivalence of IM representation, with clear implications on the performance of motor actions (Cooley, Williams, Burns, & Cumming, 2013; Cumming & Williams, 2012; Schuster et al., 2011; Smith, Wright, Allsopp, & Westhead., 2007; Wakefield, Smith, Moran, & Holmes, 2013;).

In 2013, Cumming and Williams presented *the Revised applied model of deliberate imagery use* (figure 1), with the goal to include the individual´ characteristics and the personal meaning in the analysis, and in order to reveal the difference between "what" is visualised and "why" it is visualised. The authors argued that "*an intervention combining both models will enable individual to perform functionally equivalent imagery that is personally meaningful to their goal achievement*" (Cumming & Williams, 2013, p. 226). Such adaptations to PETTLEP not only allow the use of the revised model to improve IM in sport context, but also in other areas (e. g.: dancers, athletes in general, rehabilitation patients).

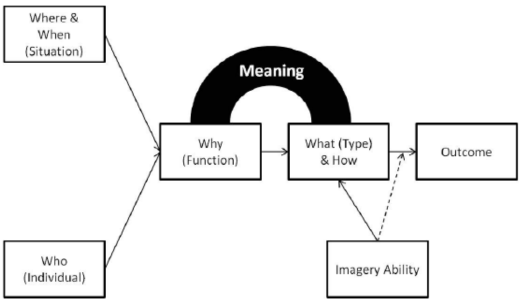

Figure 1. Revised model of deliberate imagery use (adapted from Cummings & Williams, 2013, p. 72)

Schuster et al. (2011) performed a systematic review about the best practices in the IM training, and the best results were observed when IM training was associated to the physical practice of the intended motor action. However, several factors should be considered when designing IM training programmes to ensure optimal results including the athletes' level of expertise, the tasks to carry out, as well as the athletes' IM capacity (Cooley et al., 2013; Cumming & Eaves, 2018). Nevertheless, Cumming and Eaves (2018) highlight the fact that more studies are necessary to fully understand the effect of the improvement of IM in the development of athletes' performance. The identification of the relationship between IM and performance depends on the analysed population, their skill level, the task and the methods used to assess their performance. Therefore, further studies should be carried out on different populations and different sports to identify the impact of IM in each group.

Adapted Sport and the Mental Visualisation Training

Despite the fact that IM is one of the most studied subjects in sport psychology, research in adapted sport and athletes with intellectual disabilities is scarce (Amorim et al., 2017; Amorim, Duarte-Mendes & Travassos, 2018; Anacleto, Dias, Ribeiro, Corte-Real & Fonseca, 2012; Duarte-Mendes, Marinho, Monteiro, Cid, Paulo, Serrano & Petrica, 2019; Vanlandewijck & Thompson, 2016), and usually carried out outside the competitive contexts (Martin, 2016). However, IM training is clearly effective and particularly useful in disabled athletes when used as a way of practising motor actions (Hanrahan, 2015) or even to reduce spasticity in athletes with cerebral palsy (Martin, 2013).

For example, Boccia is an adapted precision ball sport done mainly by individuals with cerebral palsy and/or limited coordination and locomotor impairment (Boccia International Sports Federation, 2013). According to Bodas, Lázaro and Fernandes (2007), this sport presents a scale of cognitive effort and skill that changes according to participants' physical abilities. Thus, psychological work could be used as a strategy to ensure optimal focus of attention and concentration levels, before and between throws to make muscle coordination and control easier (Monteiro et al., 2020). According to that, in sports like Boccia, that involves closed motor tasks and requires the optimization of timings and reduction of error, IM training constitutes an excellent strategy to improve performance (Amorim et al., 2017; Hall, 2001; Mendes, Marinho, & Petrica, 2015). Previously, in goalball, it was shown that high-level athletes used IM with functions like non-disabled athletes, predominantly in internal perspective (Eddy & Mellalieu, 2003). Interestingly, Anacleto et al. (2012) revealed an effect of expertise on the use of IM. Boccia high-level athletes used IM more frequently and with greater clarity, especially within the internal perspective, than lower-level athletes. However, to the best of our knowledge, to date there are no studies analysing the effect of IM training in Boccia athletes with different levels of expertise, and its relationship with improvements in performance of Boccia tasks.

Therefore, the aim of this study was to analyse the effects and the relations through the implementation of an IM training programme for federated and non-federated Boccia participants. Improvements on IM ability and in the performance of Boccia tasks have been expected, as well as in the correlation between IM training results and performance of Boccia tasks for federated and non-federated participants. Likewise, federated participants are expected to get higher score in MIQ-3 and in the pre and post-test performance, than non-federate participants. A significant negative correlation between IM ability and performance of Boccia tasks is also expected.

METHOD

Participants

Twenty-one individuals [mean (M) ± standard deviation (SD)= 35.8±11.19 of age] were randomly selected as Boccia athletes in Portugal, provided their signed informed consent prior to study entry procedures and engaged in the IM training programme. At the beginning of the study, participants were stratified by their modality expertise into federated (*n*= 12) and non-federated athletes (*n*= 9). Each group then underwent into the IM training and consequent assessment of their Boccia performance. All federated and non-federated participants had at least two years of regular practice in Boccia, with a minimum of 1 training session per week.

Instrument

To assess IM ability, the Portuguese version of MIQ-3 (Mendes et al., 2016) was used. The MIQ-3 is a 12 items questionnaire grouped in three subscales to assess the kinaesthetic, internal and external visual modalities. Due to the specificity of the study population as well as the nature of motor actions performed in Boccia sport, the Kinaesthetic modality was excluded from the study thus, it was not assesse, and the researcher carried out the movements of the questionnaire.

Firstly, the definitions of the internal ("*when you see yourself making the movement. It's as if you were actually inside you, doing and watching the action through your eyes*" (Mendes et al., 2016)) and of the external visual perspective ("*when you see yourself making a movement as if you were watching a DVD*" (Mendes et al., 2016)) were provided before the completion of the questionnaire. Afterwards, four basic movements (knee lift, jumping, moving the arm, and bending from the waist) were mentally recreated for each modality and, clarity during the imagery of those movements was measured by a Likert scale with seven measuring points ranging from "very hard to see" (visual modality) to "very easy to see". The Alpha (α) Cronbach´s revealed an excellent internal consistency in the two subscales (internal visual imagery α = .93; external visual imagery α = .92). Consistent with previous studies (Williams et al., 2012), the MIQ-3 tool presented good psychometric qualities to assess imagery skills (α ≥ .9). The score of each imagery ability was obtained by the arithmetic average of the recorded scores in each of their items. Each modality ranged from 1 to 7 marks.

Experimental Procedure

In order to assess the IM training effects in the federated and non-federated Boccia athletes, it was carried out a pre and post-test non randomized experimental design that was mediated by an eight-week training period (16 sessions) by the same coach with experience of imagery intervention, separate into two different phases. During the first two-weeks, it was performed a workout to improve the relaxation capacity (Jacobson, 1938), as well as the familiarization with the IM tasks (Cumming & Williams, 2013). Afterwards, it followed a six-week IM training period based on the *Revised applied model of deliberate imagery use* described by Cumming and Williams (2013). During this six-week IM training, there was a progressive evolution in the proposed tasks to enhance IM learning process (Wakefield & Smith, 2012). Each session lasted approximately 30 minutes and occurred at the Boccia training site. During the sessions, the coach instructed participants for the IM tasks based on the PETTLEP model (Holmes & Collins, 2001) and on the *revised applied model of deliberate imagery use components* proposal (Table 1) (Cumming & Williams, 2013). In all training situations, the coach asked the participants to close their eyes, relax and feel the accomplishment of the task according to the intended perspective of imagery (internal or external visual). After the IM training session, Boccia athletes' performance was assessed in two specific Boccia tasks: *i*) white ball, in which the athlete had to put the ball on a spot defined by 3 points or as close as possible to it; *ii*) coloured ball, in which the athlete had to place the coloured ball as close as possible to the target ball.

Table 1. Revised model of deliberate imagery use components and examples (adapted from Cummings & Williams, 2013, p. 72)

Component		Example
Where	Location	At training session
When	Situation	Before performance routine
Who	Individual	Boccia athletes
Why	Function	Increase performance (cognitive specific)
What	Type/Content	Themselves performing the boccia routine to be performed in competition
How	Characteristics	Real time, 3PP
Meaning	Content should serve function	Imaging boccia routine improves performance
Imagery ability	Vividness & controllability of what and how	Vivid and in real time from 3PP
Outcome	End-product	Increased motor skills for performance

Data collection

All individuals were duly informed and gave their consent according to the Declaration of Helsinki (World Medical Association, 2013,). The data collection was uniformly implemented in terms of place and conditions to avoy contamination bias. The MIQ-3 Portuguese version questionnaire (Mendes et al., 2016) was implemented in a room with groups of up to five participants with all the appropriate conditions to guarante that all athletes could concentrate during the questionnaire. Data on the IM ability and performance of Boccia tasks were collected in their normal training site in two different moments: pre-test (M1) and post-test (M2). The performance was assessed using a measuring tape to assess the distance (cm) of the ball thrown at the target set in each task. Each athlete executed 3 throws at each moment, and the average score by all athletes was considered for statistical comparison purposes. Therefore, 27 throws by non-federate athletes and 36 throws by federate athletes were considered.

Statistical Analysis

Statistical treatment was carried out using the non-clinical magnitude-based inferences. Descriptive statistics including mean and standard deviation were performed for all variables under analysis. Due to the small sample size and the underpowered nature of our experimental design we adhere to the non-clinical magnitude-based inference method as suggested by Hopkins, , Marshall, Batterham, & Hanin (2009). The variation intervals to classify the magnitude of the effects (Cohen *d*) were as follows: 0-0.2, trivial; 0.21-0.6, small; 0.61-1.20, moderate; 1.21-2.0, big; > 2.0, very big (Hopkins et al., 2009). The correlation between the results of IM ability and the athletes' performance (distance to target and distance to coloured ball) was calculated in the pre and post-test. Due to the reduced sample size, the non-parametric Spearman´s correlation was used to test for IM training effect using the SPSS software (22.0 version; SPSS Inc., Chicago, IL).

RESULTS

Table 2 shows the means values and standard deviation of MIQ-3, obtained by federated and non-federated athletes in both assessment moments, pre-test (M1) and post-test (M2).

Table 2. Descriptive analysis of subscales of MIQ-3 (Federate, Non-Federate) and the values of the magnitude of effect between each moment for both groups.

	MIQ-3			
		M1	M2	
	N	*M* ±*sd*	*M* ±*sd*	Differences in means (*d*; ±90% CI)
Federate	12	4,32±0,92	5,70±1,16	1,3 (2,02±0,54)
Non-Federate	9	2,97±0,40	4,98±0,47	4,41 (5,79±2,94

Note: M1 = pre-test, M2 = post-test; M= Means; sd = standard deviation *d* = -effect size; CI = Interval coefficient

The results suggests that between the pre and the post-test there was a large increase in the MIQ-3 scores for federated athletes and a very large increase for non-federated athletes, showing improvement in IM ability. The non-federated athletes' larger increase in the IM ability is due to their lower initial IM ability compared to federated.

Table 3 shows the means values and standard deviation for the performance variables in distance to white ball (DWB) and distance to coloured ball (DCB) obtained by federate and non-federated participants in both assessment moments, M1 and M2.

Table 3. Comparison of federate and Non federate groups in both moments M1 and M2 in the performance of Boccia tasks.

	Boccia Tasks	
	M1	M2

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	n	*M* ±*sd*	*M* ±*sd*	Differences in means (*d*; ±90% CI)
			DWB (cm)	
Federate	12	3,88±1,84	2,77±1,23	-1,0 (-1,43±-0,61)
Non-Federate	9	11,25±3,00	4,24±2,03	-2,7(-3,32±2,08)
			DCB (cm)	
Federate	12	2,33±1,26	0,92±1,03	-1,21 (-1,63±0,79)
Non-Federate	9	9,07±1,63	3,44±1,58	-3,5 (-4,16±-2,75)

Note: M1 = pre-test, M2 = post-test; M = Mean; sd = standard deviation *d* = Effect size; CI = Interval Coefficient; DWB = Distance to white ball; DCB = Distance to coloured ball.

The results suggests that there was a small decrease in the variable DWB between the pre-test and the post-test, and a moderate decrease in the variable DCB for federated participants. Regarding non federated participants, there was a large decrease in the variables DWB and DCB between the pre-test and the post-test. The largest decrease in the obtained distances among non-federate participants is mainly due to their lower initial IM ability compared to federated participants. Likewise, results show higher variability values among non-federated athletes than among federated athletes either in M1 or M2.

Table 4 shows the correlation values between DWB and DCB and the MIQ-3 scores in pre and post-test for federated athletes.

Table 4: Correlation between performance variables and MIQ-3 in pre and post –test for federate athletes

	DWB - M1	DWB - M2	DCB - M1	DCB - M2	MIQ3-M1	MIQ3-M2
DWB M1	1	,865**	,701*	,663*	-,122	-,032
DWB M2	,865**	1	,646*	,654*	-,279	-,126
DCB M1	,701*	,646*	1	,814**	-,086	-,087
DCB M2	,663*	,654*	,814**	1	-,302	-,282
MIQ3 M1	-,112	-,279	-,086	-,302	1	,921**
MIQ3 M2	-,032	-,126	-,087	-,282	,921**	1

Note: DWB = Distance to white ball; DCB = Distance to coloured ball; M1 = pre-test; M2 = post-test; *p<.05; **p<.01.

The results revealed a strong positive correlation between DWB and DCB variables between the pre and the post-test. Likewise, a strong positive correlation was observed between the values obtained in the pre and post-test in MIQ-3. However, no significant correlation values were observed between the assessed performance variables and the scores in MIQ-3 obtained by federated athletes as found in non-federated athletes (p<.05).

DISCUSSION

The aim of this study was to analyse and compare the implementation of an IM training programme for federated and non-federated Boccia participants.

Despite the increasing interest in IM benefits in performance and learning of motor ability, more studies were needed to verify the effect of IM development on the performance of athletes at different competitive levels (Cumming & Eaves, 2018), particularly in specific populations as in adapted sport (Hanrahan, 2015).

Generally, the results confirm the formulated hypotheses that, regardless of level and expertise, all Boccia athletes, after completing the IM training programme, improved their IM ability and their performance on specific Boccia tasks. The performance levels were influenced by the participants' level of expertise. In fact, the level of Boccia expertise influenced the IM ability as well as the magnitude of learning. This relation can be justified by the existence of a shared neural activity or functional equivalence, in which the practice of IM activates the same neural areas as it does during execution of the same movement. Therefore, this common neural activation enhances motor development and competitive learning (Williams et al., 2011).

In general, results showed that, from the pre to the post-test, the athletes increased their score in MIQ-3 (higher capacity of imagery) and improved their performance (a shorter distance to the target and to the coloured ball). These results are consistent with former studies, which showed that improvement in IM ability enhances the development of the intended motor action (Schuster et al., 2011). In addition, Smith, Wright and Cantwell (2008), in their study with golfers, showed that higher improvements in performance were registered for golfers that developed IM ability relative to those that developed technical and physical capabilities associated to golf actions.

According to Napolitano (2017), the main aim of IM training is to acquire and optimize motor skills. Our results seem to confirm that IM training enhances the IM ability and the ability to reach specific performance goals (Cumming & Williams, 2013). Therefore, although IM ability is directly related to the expected outcomes, it is important to emphasize that there is enough evidence suggesting that IM ability improves athletes' performance in a systematic way (Cooley et al., 2013).

Despite general improvement among observed athletes, the effect size between M1 and M2 was larger for non-federated athletes than for federated athletes. The non-federated athletes initially showed lower IM ability and performance levels which allowed a higher improvement in IM in M2. As suggested by Anacleto et al. (2012), higher level Boccia athletes use IM more frequently and more clearly than lower level athletes. Munroe-Chandler and Guerrero (2017) added that lower IM ability levels are the result of the lack of knowledge of space and kinaesthesia needed to perform motor tasks. Cox (2011) even refered that more experienced athletes have higher benefits with the use of IM than less experienced athletes, although the changes might not reflect the improvements in performance, as less experienced athletes. Notably, Collins and Carson (2017) showed that, when IM is used by experienced athletes, the effects on their performance seem to be more positively consistent. Therefore, these results reinforce the fact that the level of athletes' expertise should be considered when designing IM training programmes, particularly in terms of IM activities, training time, type of groups used for the intervention (Cooley et al., 2013), as well as the evaluation measures to perform the assessment of athletes' IM ability and performance (Cumming & Eaves, 2018). Cumming and Eaves (2018) even refer that further studies should also focus on contextual aspects which can influence IM or performance levels in the execution of this sort of interventions such as fatigue, the kind of competition, quantity and quality of sleep or even the coach's intervention style.

Contrarily to our hypotheses, the correlation between IM ability (MIQ-3 score) and performance of Boccia tasks (DWB and DCB) was not significant, either for federated or non-federated athletes. These results seem to suggest that despite the reported improvements, we cannot assure that there is a linear relationship between IM ability and performance of motor tasks (Lacourse, Orr, Cramer, & Cohen, 2005). Interestingly, as registered by Gabbard and Lee (2014), all the correlations between IM ability and performance (i.e. distance) were negative for the non-federated athletes group, despite no significance. These results suggest that as IM abilities improve, the performance levels also improve. However, despite these tendency, more research is needed to fully understand this potential relationship but also integrate the combination of different assessment tools to test

IM ability, as well as, athletes' performance ability (Cumming & Eaves, 2018). Remarkably, our results also suggests a strong positive correlation between pre and post-test on the IM abilities and performance of federated athletes potentially reinforcing the idea that there is a higher level of functional equivalence among expert athletes than among non-experts (Williams, Cumming, & Edwards, 2011).

The reduced sample size and the underpowered nature of our study design but also the inexistence of one control group to allow a direct comparison with the results from our experimental groups, and the fact that weren`t controlled some contextual aspects that may influence the intervention, are limitation factors that should be overcome in future studies. Nevertheless, despite doubts concerning the correlation levels between IM and performance, our results seem to reinforce the fact that IM training enhances the development of motor actions in disabled Boccia athletes (Hanrahan, 2015). In addition, our results also seem to consubstantiate the need for specific evaluation and adapted tools to assess and develop IM ability in Boccia athletes, particularly those related to performance evaluation. Therefore, more research is needed to optimise the applicability of the IM training in adapted sports, particularly related to the use of IM as an integrated component in the long-term development of motor skills performance and if exist (Collins & Carson, 2017), and if there are differences between genders (Rodrigues, Neiva, Marinho, Duart-Mendes, Teixeira, Cid & Monteiro, 2019).

CONCLUSION

The results suggests that, from pre to post test, federated and non-federated athletes had a higher IM score and exhibited an improved performance. The performance levels seem to have been influenced by the participants' level of expertise, with the non-federated athletes revealing higher magnitude of improvement than federated athlete's. A non-significant correlation was observed between IM and performance. Although the inconsistency of the relationship between IM and performance, the results suggests that IM training enhances the development of IM ability and also motor actions in Boccia athletes.

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