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Can we benefit from motor imagery practice when we have difficulty imagining ourselves?

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ABSTRACT

The objective of this study was to test whether the ability to imagery (i.e., ease or difficulty in creating clear and vivid mental images in one's mind) could influence the speed of service learning in beginner tennis players when they were given motor imagery (MI) practice combined with real practice during their training sessions. The results of this experiment show an improvement in the speed and percentage of success (measured with a tablet equipped with Swingvision software) and in the quality of serves (assessed by expert tennis coaches) of the participants who carried out IM practice before serving. Furthermore, the results show that although players who had difficulty imagining serving performed worse than players who could easily perform MI, after 10 sessions their performance was similar after 20 sessions of practice. Since serving is a complex motor skill, we recommend that coaches use MI, in addition to actual practice, even if players have difficulty generating and using mental images: this will mean increasing the amount of practice.

Key words: Serve, beginner, motor imagery, tennis.

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INTRODUCTION

Tennis is a racquet sport that involves the performance of various complex motor skills, such as hitting forehands, backhands, smashes, volleys, or serves, the learning of which requires a large amount of practice and repetition (Akpinar, Devrilmez, & Kirazci, 2012) and the performance and acquisition of which can be facilitated by the use of motor imagery (MI) as a complement to actual practice (Robin & Dominique, 2022). MI is a conscious process during which the mental representation of a motor action, such as performing a tennis serve, is reactivated in the brain in the absence of actual motor execution (Robin & Blandin, 2021). This mental representation, which can be defined as the internalized model of a motor action and its consequences in the environment (Jeannerod, 1999), is constructed based on sensory information from the environment and the player's body (Dana & Gozalzadeh, 2017). Although it appears that most individuals can create mental images, there are inter-individual differences in MI that are captured under the umbrella term 'imagery ability', which refers to the difficulty or ease of generating and using mental images during imagery practice (Hall, 2001). Research conducted in the laboratory with beginners (Goss et al., 1986) or on the tennis court with expert players (Robin et al., 2007) has shown that participants categorised as "good imagers", using the Movement Imagery Questionnaire (Hall & Pongrac, 1983), had better motor performance than "poor imagers" after IM practice. The results of these studies highlight the need to assess players' imagery skills when considering the use of MI, particularly for tennis progression (Cumming & Ramsey, 2009). Robin and Dominique (2022) have recently shown that MI is a mental technique that is increasingly used by coaches, as a

complement to actual practice, to improve the learning and performance of tennis players, regardless of their level of practice. While some studies have shown beneficial effects

of MI combined with real practice on service performance in beginner players (e.g., Atienza et al., 1998; Dana & Gozalzadeh, 2017), other studies have shown much more mixed effects (Féry & Morizot, 2000; Noel, 1980) which could be explained by an insufficient amount of practice and the failure to consider the participants' imagery capacity.

The aim of this experiment, conducted under ecological conditions, was to test in young beginner tennis players whether the ease or difficulty of doing MI could influence their performance after 20 sessions of practice with or without motor imagery combined with real service execution. We first hypothesized that players who would benefit from motor imagery practice, in addition to real practice, would achieve better serve performance than players who would only perform real serves. Second, we hypothesized that poor imagery participants would need more practice than good imagery players to benefit from the positive effects of motor imagery practice combined with real serve practice.

METHOD

Thirty young beginner tennis players (M = 11.5 years, SD = 1.8 years) volunteered to participate in this experiment which was conducted at the Amicale Tennis Club in Gosier (Guadeloupe, France). The participants (26 boys and 4 girls) were divided into 3 experimental groups: control (N = 10), good imagers (N = 10) and poor imagers (N = 10) according to their scores on the movement imagery questionnaire (MIQ-3f, Robin et al., 2020). This questionnaire differentiates between internal visual imaging, external visual imaging, and proprioceptive imaging abilities. It is composed of 12 items (4 per type of imagery), involving the physical realisation of arm, leg and whole-body movements and then the motor imagery of these same movements. The estimation of the internal visual, external visual and proprioceptive imagery capacities of each item performed and then mentally simulated is done by means of 7-point Likert scales (ranging from 1 "very difficult to imagine or feel" to 7 "very easy to imagine or feel"). A written consent form, outlining the terms of participation in the study, was signed by the parents or guardians of each player. Ethical approval to conduct this research was obtained from the ethics committee of the ACTES laboratory (UPRES EA 3596) of the University of the West Indies (Pointe-à-Pitre, France).

PROCEDURE

During the first session, and before the start of the experimental phases taking place on outdoor tennis courts, participants completed the French version of the movement imagery questionnaire (MIQ-3f). Players who obtained mean scores less than or equal to 2 on the MIQ-3f questionnaire were considered poor imagers and those with scores greater than 5 were categorized as good imagers.

The players then performed 20 tennis sessions in which, after a warm-up that was standardised, they had to perform 20 serves, changing the service box on each attempt. The players in the good and bad imagery groups were instructed, before each serve, to imagine in their minds themselves performing a successful serve (i.e., the ball reaching the correct service box). The players in the control group only made real serves.

During the first session, the players performed the pre-test, which consisted of 10 service balls with alternating service boxes aimed at each trial. The speed of the balls and the percentage of success were measured using a digital tablet (Apple iPad Pro 11 512G) equipped with a performance collection software developed specifically for tennis (Swingvision). In addition, the technical quality of the serves (based on the scores of 6 items: starting position, ball toss, backswing arm-racket movement, forwardswing arm-racket movement, point of contact and end of movement rated with a scale ranging from "0" poor to "7" excellent) was recorded and evaluated by two tennis coaches certified by the French Tennis Federation (for a similar procedure see Robin et al., 2021) After the first 10 practice sessions, all participants performed the intermediate test; then after the 20 practice sessions, all players performed the post-test (10 service balls by changing the service box at each trial) under identical conditions to those of the pre-test.

RESULTS

The results of the statistical analyses (repeated measures Anovas and post-hoc test), showed that all players improved their serving speed between the pre-test and post-test and that the players who benefited from imaging practice, whether they were good imagers (mean = 61 km/h) or poor imagers (mean = 62 km/h), served faster than the participants in the control group (mean = 55 km/h) after the 20 practice sessions as shown in Figure 1.

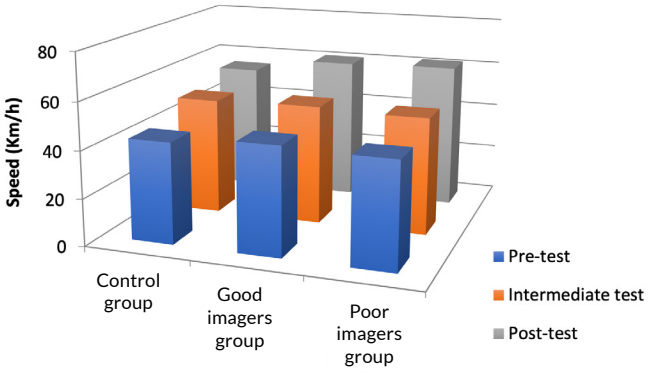

Figure 1. *Service speeds, in kilometres per hour (Km/h), achieved by players in the control, good imager and bad imager groups in the pre-test, intermediate test, and post-test.*

In terms of service success percentage, participants in the good imagery group (mean = 33%) performed better than players in the poor imagery group (mean = 24%) or the control group (mean = 21%) as early as the first 10 practice sessions (i.e., at the intermediate test). In addition, the MI players (mean = 39%) had better service success rates than the control group (mean = 30%) at the post-test (i.e., after 20 practice sessions; see Figure 2).

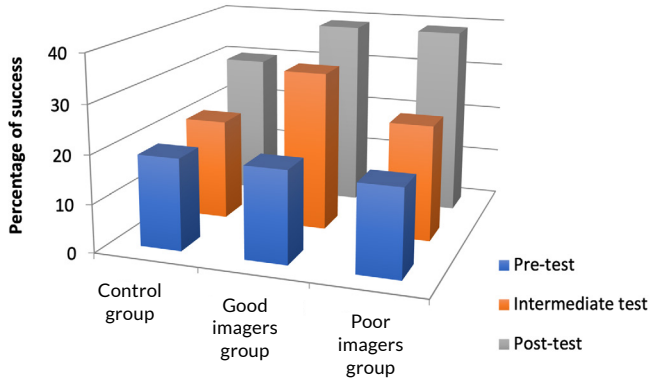

Figure 2. *Percentage of successful services performed by participants in the control, good imager and poor imager groups in the pre-test, intermediate test, and post-test. intermediate test, and post-test.*

Finally, the participants in the good imagery group (mean score = 2.7) obtained better technical scores than the players in the control group (mean score = 2.3) after 10 practice sessions (i.e., intermediate test). Furthermore, the players in the poor imager group improved their technical scores between the intermediate test (mean score = 2.4) and the post-test (mean score = 2.8), i.e., after 20 practice sessions.

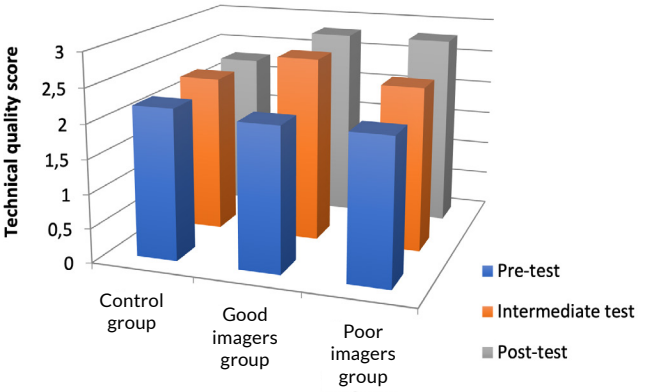

Figure 3. *Technical quality scores of the services performed by players in the control, good imager and bad imager groups in the pre-test, intermediate test, and post-test*

DISCUSSION

This experiment was carried out to measure the effects of motor imagery practice combined with real service practice in young beginner tennis players. On the other hand, the aim of this study was also to evaluate whether the ease or difficulty in creating clear and vivid mental images (i.e., imagery capacity) of a complex motor action, such as serving in tennis, could influence the speed of acquisition of beginner tennis players when they benefited from a combination of motor imagery practice (recall: MI) and real service rehearsals.

The results of this study show, first, that participants who benefited from MI practice in addition to real trials (i.e., players in the good imagery and poor imagery groups) performed better than players in the control group who only physically performed their serves during the 20 practice sessions. These results show the interest of using IM practice combined with the actual execution of motor actions in racquet sports (Cece et al., 2020) and more specifically in tennis (Robin & Dominique, 2022). Moreover, the results of this experiment also confirm the results of previous research studies that have shown a positive effect of MI on performance in novice (e.g., Atienza et al., 1998; Dana & Gozalzadeh, 2017), experienced (Cherappurath et al., 2020; Daw & Burton, 1994; Mamassis, 2005) and expert (Dominique et al., 2021; Robin et al., 2007) tennis players. As discussed by Hardy and Callow (1999), it is possible that practice in MI allowed players who benefited from this mental technique (i.e., the good imagery and bad imagery groups) prior to serving to visualise the overall movement of the serve as well as the different positions and steps required to perform this motor skill more easily. Furthermore, it is also possible that the players in the good imagery and bad imagery groups benefited from the motivational function of MI (Robin & Dominique, 2022): the combination of this mental practice and the physical practice of the serves being more motivating to perform than the simple real executions done by the players in the control group.

Secondly, the results of this experiment show that the players who had difficulties in generating and using mental images (i.e., the participants in the poor imagery group) needed a greater amount of practice than the players in the good imagery group to become as good as them. Indeed, while the latter obtained improvements in service performance within the first 10 practice sessions, it took twice as many practice sessions for the poor imagery group to become equivalent to the good imagery group. These results confirm work in the literature showing differences in acquisition speed for simple movements (Goss et al., 1986) or in performance in complex motor skills (e.g., return of serve in expert tennis players; Robin et al., 2007) as a function of participants' imaging ability. This modulation of acquisition speed between participants in the good imagery and poor imagery groups could be explained by the fact that a good IM capacity would facilitate the construction of the mental representation of the action to be performed (i.e., serve) and the encoding of information in long-term memory (Robin & Dominique, 2022) solicited during the mental simulation of the serves.

To facilitate the creation of mental representations of the actions to be imagined, particularly for beginners and/or those who have difficulty imagining the movements, Guillot et al. (2005) showed the interest of carrying out the MI in costume, on the court, with the racket in the hand. Other authors have shown the positive effects of using internal discourse, particularly on the steps involved in the execution of a service (Robin et al., 2021), or of watching videos before performing the MI (Atienza et al., 1998; de Sousa Fortes, 2019) for novice tennis players. It would be interesting to evaluate, in future research, whether these strategies would be beneficial, specifically for players with difficulties in performing MI (i.e., poor imagers), to facilitate the learning of complex motor skills such as the tennis serve.

CONCLUSION

The results of this field study confirm research that has shown that motor imagery, when used in conjunction with actual practice, can improve serving performance in beginning tennis players. Although participants categorised as poor imagers using an imagery questionnaire performed worse than players in the good imagery group after 10 practice sessions, their performance became equivalent after 20 practice sessions. We therefore recommend that coaches and trainers use MI, in addition to real practice, even if the players have difficulties in generating and using mental images on the field, by adapting the number of practice sessions according to the participants' imaging ability.

CONFLICT OF INTEREST AND FUNDING

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