



HAL
open science

Tennis Service Performance in Beginners: The Effect of Instructional Self-Talk Combined With Motor Imagery

Nicolas Robin, Robbin Carien, Laurent Dominique

► **To cite this version:**

Nicolas Robin, Robbin Carien, Laurent Dominique. Tennis Service Performance in Beginners: The Effect of Instructional Self-Talk Combined With Motor Imagery. *Journal of Motor Learning and Development*, 2021, pp.1-12. 10.1123/jmld.2021-0044 . hal-03544064

HAL Id: hal-03544064

<https://hal.science/hal-03544064>

Submitted on 26 Jan 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

1 **Abstract**

2 The aim of this study was to investigate the effect of motor imagery (MI) combined with
3 instructional self-talk on service performance in young novice tennis players. The participants
4 were assigned to one of three groups: Control, MI or MI+self-talk. They performed a pre-test
5 (10 services), participated in 5 days of intervention sessions, and finally performed a post-test
6 similar to the pre-test. During the intervention sessions, the participants performed 20
7 services. The Control group was not given any instructions other than verbal instructions on
8 the steps of the serve. Before each service, the MI group was instructed to imagine
9 performing a successful service towards the "correct" service box. The MI+self-talk group
10 had to repeat the instructions during MI, before serving. The results of this original study
11 revealed that only the participants in the MI and MI+self-talk groups increased their service
12 percentage of success and technical quality scores from pre- to post-test. In addition, at post-
13 test, the participants of the MI+self-talk group had higher serve speeds and technical quality
14 scores than the participants of the Control and MI groups. The beneficial effect of using MI
15 and/or self-talk during short tennis interventions and the practical applications are discussed.

16 *Key words:* Tennis service, motor imagery, self-talk, performance, novice.

17

18

19

20

21

22

23

24

Tennis Service Performance in Beginners: The Effect of Instructional Self-talk Combined with Motor Imagery

According to Cece et al. (2020), the beneficial effects of using mental training techniques as strategies to improve motor learning and performance are widely acknowledged by coaches, mental trainers and players, especially in racket sports. Among these techniques, motor imagery (MI) seems to be the most frequently used technique, especially by tennis players regardless of their level of expertise (Dominique et al., in press; Mamassis, 2005). MI can be defined as a conscious process that requires mentally simulating an action without executing it (Robin et al., 2007). Numerous studies have shown that using MI in addition to physical training promotes motor learning and performance in sport (Schuster et al., 2011; Simonsmeier et al., 2020) and more specifically in tennis (Cherappurath & Elayaraja, 2017; Dana & Gozalzadeh, 2017; Fekih et al., 2020; Hegazy et al., 2015; Turan et al., 2019). For example, Guillot et al. (2013) showed that young tennis players had higher service performance (i.e., accuracy, speed and percentage of success) after MI interventions than in a control condition. In addition, other studies have shown the beneficial effects of using a combination of mental techniques, such as MI and self-talk, in tennis mental training programs to improve players' performances (Coelho et al., 2007; Dohme et al., 2020; Gabr, 2010; Morais & Rui Gomes, 2019).

Self-talk mainly refers to covert verbalizations that athletes address to themselves (Latinjak et al., 2019). Several studies support its effectiveness in sports (for a review, see Hardy, 2006). According to Theodorakis et al. (2000), self-talk can fulfil at least two functions: Motivational (i.e., discourse on self-confidence, increasing effort, optimizing the energy deployed or promoting a positive mood) and cognitive (e.g., verbalizations with an attentional focus directed towards technique and movements to perform). Van Raalte et al. (2016) pointed out that it is important to distinguish between spontaneous or uncontrolled

1 self-talk, which concerns statements related to the activities that come to mind spontaneously
2 and effortlessly and concern past or future outcomes, and strategic or goal-directed self-talk,
3 which is a deliberate strategy that players employ to regulate emotions by means of its
4 motivational function (Fritsch et al., 2020) or to enhance performance by means of its
5 cognitive function (Boudreault et al., 2016). Indeed, cognitive self-talk, also called
6 instructional self-talk (Latinjak et al., 2011), can promote performance by focusing athletes'
7 attention on technique (e.g., toss, backswing, contact and follow-through for a service) or the
8 motor actions that need to be performed (e.g., "getting back on the court"). In a water polo
9 task requiring precision, Hatzigeorgiadis et al. (2004) showed that instructional self-talk had a
10 higher impact on performance than motivational self-talk or a control condition. More
11 specifically in tennis, Landin and Hebert (1999) found among experienced players that
12 instructional self-talk increased movement patterns or accuracy and helped gain and maintain
13 concentration when they performed volley shots. Similarly, Cutton and Landin (2007) showed
14 the beneficial effects of using self-talk on learning the forehand tennis groundstroke during
15 beginning tennis classes. Indeed, directing players to the critical parts of a motor skill can be
16 facilitated by instructional self-talk (Hardy et al., 2001), especially in beginners (Magill,
17 2004), and can facilitate motor learning and performance improvement (Boudreault et al.,
18 2016).

19 Previous studies have supported instructional self-talk as an effective tool for skill
20 acquisition and performance improvement in novice tennis players making volley shots
21 (Cutton & Landin, 2007) or skilled players performing services (Malouff et al., 2008). The
22 latter authors and others have also reported that MI interventions have beneficial effects on
23 tennis movement accuracy and performance (e.g., Cherappurath et al., 2020; Guillot et al.,
24 2013) and that a combination of MI and self-talk can enhance motor performance in a
25 precision task (Cumming et al., 2006). This has therefore been recommended during pre-

1 motor execution in tennis (Morais et al., 2019). Given these findings, the aim of this original
2 study was to evaluate the effects of a combination of instructional self-talk and MI on service
3 performance in beginners. In novice players who are not familiar with MI, especially in
4 tennis, self-talk related to the steps in performing a service might facilitate the creation or use
5 of a mental representation of the movement requested during imagery (Schack et al., 2014).
6 Moreover, Fitts and Posner (1967) noted that during early learning stages (i.e., the cognitive
7 stage), novices tend to “talk” themselves through movements, and instructional self-talk could
8 provide appropriate content for this inner dialogue (Hardy et al., 2009) during both real and
9 imagined movements. Based on the results of the above-mentioned research, we hypothesized
10 that using MI in addition to physical practice would result in higher performances than
11 physical practice alone (i.e., control condition) in novice tennis players. We also hypothesized
12 that the use of instructional self-talk combined with MI would increase performances even
13 more than the MI intervention and a control condition.

14 **Methods**

15 **Participants**

16 Thirty-eight novice tennis players ($M_{age} = 9.59$, $SD = 3.24$) volunteered to participate
17 in this study that was conducted according to the guidelines of the Declaration of Helsinki.
18 All the participants had no more than 1 year of tennis practice. The current study was
19 consistent with the ethical principles specified in the APA standards and was approved by the
20 local ethics committee of the University. The participants who volunteered to participate in
21 the study, as well as their parents, were given details about what their involvement would
22 consist of and were assured about their right to withdraw. They were also provided with a
23 consent form describing the study aim and procedure and gave their written consent. Standard
24 verbal and written instructions regarding the content of the protocol were then provided.

1 Instructions emphasized the confidentiality of the results. The participants were randomly
2 assigned to one of three groups: Control, ($N = 13$), MI ($N = 12$) and MI+self-talk ($N = 13$).

3 **Study Design**

4 The study used a pre-post experimental design and was carried out during a 5-day
5 daily tennis course. All the participants performed a pre-test, then four sessions of practice,
6 and then a post-test. The pre-test and the first practice session were performed on day 1, the
7 second to fourth practice sessions from day 2 to day 4, and the post-test on day 5.

8 **Material**

9 The experimental task was carried out on a tennis court meeting the international
10 standards. Each experimental session was held at the same time of day (9 am) for all
11 conditions to avoid circadian effects.

12 **Outcome, Measure and Task**

13 **Service test.** During the pre- and post-tests, all the participants performed 10 services
14 as accurately as possible using intermediate service balls. Performance was evaluated in terms
15 of percentage of success (i.e., bounce of the ball in the service box), serve speed (recorded by
16 means of a Cordless MPH Radar Gun, Type R1000), and technical quality (mean scores on 6
17 items: Starting position, ball throw, arm-racket movement backwards, arm-racket movement
18 forward, point of contact and end of movement, noted with a scale ranging from 0: poor to 7:
19 excellent) for each service. These evaluations were made afterward by two qualified expert
20 tennis coaches via videos (for a similar procedure, see Atienza et al., 1994). The performances
21 of the participants were filmed with two Canon HD, Legria HF G25 cameras during the pre-
22 and post-tests. The two cameras were placed, respectively, to the right and to the left in the
23 extension of the baseline, 4 meters from the doubles sideline.

24 **Mental task.** Participants in the Control group performed a mental task: Countdown,
25 which corresponded approximately to the length of time (about 10 seconds) that the

1 participants from the other groups spent on MI (for a similar procedure, see Robin et al.,
2 2019), before each actual service. The instructions were “Position yourself to serve behind the
3 baseline. Close your eyes. You are going to count down from 10 to 0 at the rate of one
4 number per second.”

5 **Motor imagery task.** The MI was performed on the tennis court. Participants in the
6 MI and MI+self-talk groups were instructed to imagine performing a service using an external
7 visual modality (i.e., seeing themselves in the third person, as if they were being filmed with a
8 camera) and seeing the service box they wanted to reach (for a similar procedure, see Guillot
9 et al., 2013) before they actually served. An MI script was read to the participants at the
10 beginning of each intervention session to ensure that they received similar instructions:
11 “Position yourself to serve behind the baseline. Close your eyes. You are going to visually
12 imagine yourself, as if you were being filmed with a camera, performing a successful service
13 toward the correct service box by visualizing each of the steps of the movement.” As indices
14 of imagery quality, the participants self-reported the level of perceived vividness on a Likert
15 scale ranging from 1 (“Unclear and inaccurate mental representation”) to 6 (“Perfectly clear
16 and vivid mental representation”) (for a similar procedure, see Dominique et al., in press).

17 **Self-talk and imagery.** Participants of the MI+self-talk group had to perform MI
18 combined with instructional self-talk using a script based on the steps of a serve (i.e., starting
19 position, ball throw, arm-racket movement backwards, arm-racket movement forward, point
20 of contact and end of movement) before performing a service and not during actual service.
21 The instructions were: “Position yourself to serve behind the baseline. Close your eyes. You
22 are going to visually imagine yourself, as if you were being filmed with a camera, performing
23 a successful service toward the correct service box by visualizing each of the steps of the
24 movement. You must combine the mental images with self-talk concerning your starting

1 position, the ball throwing, the arm-racket backwards then forward movements, the contact of
2 the ball in the centre of your racket, and the end of your movement.”

3 **Procedure**

4 Before the start of the study, the experimenters met with the tennis players to
5 determine their knowledge about MI. They were questioned about the frequency and nature of
6 their imagery use in order to exclude the participants who were totally unfamiliar with MI
7 (see Guillot et al., 2013, for a similar procedure). The participants self-reported using visual
8 imagery more easily and frequently than the other MI modalities.

9 **Pre-test phase.** During the pre-test held on day 1, participants performed a
10 standardized 20-minute warm-up and then performed 10 services by alternating the service
11 box after each trial.

12 **Intervention phase.** After the pre-test and on the four following days, the participants
13 performed serves in the four sessions composing the intervention phase. Each session started
14 with a standardized 20-minute warm-up. Then the participants had to serve 20 times by
15 alternating the service box after each trial. The participants of the Control group were not
16 given any instructions other than verbal instructions on the steps of the serve. Those of the MI
17 group were instructed to use MI (i.e., to imagine, from a third person perspective, performing
18 a successful service towards the "correct" service box) before each real service execution.
19 Finally, the participants in the MI+self-talk group had to repeat the instructions during MI,
20 before each service. The duration of each session was approximately 30 minutes for all
21 groups.

22 **Post-test phase.** On day 5, the participants performed a post-test that was identical to
23 the pre-test. The duration of these two phases was approximately 25 minutes.

24 **Data Analysis**

1 First, the MI quality scores across the experimental groups who performed MI were
2 examined. The percentage of success, speed of successful services, and technical quality
3 scores regarding the service balls served as dependent variables and indicators of performance
4 during the pre- and post-tests. For the technical quality scores, a third expert (i.e., last author)
5 was consulted when disagreements arose in order to obtain a single score. Normality was
6 checked (Kolmogorov-Smirnov test) and the dependent variables were submitted to 3 Group
7 (Control vs. MI vs. MI+self-talk) x 2 Phase (pre-test vs. post-test) ANOVAs with repeated
8 measures on the second factor. Effect sizes (η_p^2) were indicated, α was set at .05 for all
9 analyses, and post hoc tests were performed using Newman-Keuls tests.

10 Results

11 Imagery Quality and Descriptive Results

12 The results for the imagery quality scores revealed that no participant reported
13 difficulty performing MI, and no difference was found between groups when we compared
14 the quality scores in the MI ($M_{score} = 4.15$, $SD = 0.75$) and MI+self-talk ($M_{score} = 4.72$, $SD =$
15 0.93) groups [$t(23) = -0.93$, $p = .15$, $\eta_p^2 = 0.02$].

16 Percentage of Success of the Service

17 The results for the percentage of successful serves revealed an absence of difference
18 between the Control, MI and MI+self-talk groups when considered independently of the
19 experimental phases. Indeed, the ANOVA computed on the percentage of success revealed no
20 significant main group effect [$F(2, 35) = 1.25$, $p = .29$, $\eta_p^2 = 0.06$]. However, differences were
21 observed not only between the performances obtained during the pre-test and post-test in all
22 groups, but also between the post-test results of the three groups. Indeed, the analysis revealed
23 a significant main phase effect [$F(1, 35) = 74.41$, $p = .001$, $\eta_p^2 = 0.68$] and an interaction
24 between group and phase [$F(2, 35) = 21.72$, $p = .001$, $\eta_p^2 = 0.55$]. As illustrated in Figure 1a,
25 the MI and MI+self-talk groups increased their performances from pre- to post-test and had

1 higher performances at the post-test than the participants of the Control group, whose
2 performance remained stable ($p_s < .01$).

3

4

Figure 1 near here

5

6 **Serve Speed**

7 The results for the serve speed of the successful services revealed an absence of
8 difference between the Control, MI and MI+self-talk groups when considered independently
9 of the experimental phases. Indeed, the ANOVA computed on serve speed revealed no
10 significant main group effect [$F(2, 35) = 0.58, p = .56, \eta_p^2 = 0.03$]. However, differences were
11 observed not only between the performances obtained during the pre-test and post-test for all
12 groups, but also but also between the post-test results of the three groups. Indeed, the analysis
13 revealed a significant main phase effect [$F(1, 35) = 22.71, p = .001, \eta_p^2 = 0.40$] and an
14 interaction between group and phase [$F(2, 35) = 13.46, p = .001, \eta_p^2 = 0.44$]. As illustrated in
15 Figure 1b, only participants in the MI+self-talk group increased their performance from pre-
16 to post-test ($p < .01$).

17 **Technical Quality**

18 The results for the technical quality scores revealed an absence of difference
19 between the Control, MI and MI+self-talk groups when considered independently of the
20 experimental phases. Indeed, the ANOVA computed on technical quality revealed no
21 significant main group effect [$F(2, 35) = 2.37, p = .11, \eta_p^2 = 0.11$]. However, differences were
22 observed not only between the performances obtained during the pre-test and post-test for all
23 groups, but also between the post-test results of the three groups. Indeed, the analysis revealed
24 a significant main phase effect [$F(1, 35) = 17.52, p = .001, \eta_p^2 = 0.34$] and an interaction
25 between group and phase [$F(2, 35) = 5.06, p = .05, \eta_p^2 = 0.23$]. As illustrated in Figure 1c, the

1 MI and MI+self-talk groups increased their performances from pre- to post-test ($ps < .01$).
2 Finally, the participants of the MI+self-talk group had higher performances at the post-test
3 than the participants of the Control and MI groups ($ps < .01$).

4 **Discussion**

5 The aim of this study was to evaluate the effect of motor imagery practice combined
6 or not with instructional self-talk on the performance of novice tennis players performing
7 services during a 5-day intervention.

8 As hypothesized, the results of the study first show that the participants in the MI
9 groups, who performed motor imagery before the actual practice of the service, had a higher
10 percentage of successful performances than the participants in the Control group, who had no
11 instructions other than those concerning the steps to be taken for the serve. These results are
12 consistent with those of previous studies that have shown the beneficial effects of using MI
13 interventions in experienced (e.g., Dominique et al., in press; Cherappurath et al., 2020), non-
14 expert (e.g., Atienza et al., 1998; Dana & Gozalzadeh, 2017; Fekih et al., 2020; Guillot et al.,
15 2012) and novice (e.g., Féry et al., 2000; Noel, 1980) tennis players. Moreover, as in the
16 study by Guillot et al. (2013), the results of this experiment highlight the positive effects of
17 using an external visual MI practice in combination with physical practice for beginners. They
18 are also in line with previous studies that have shown that external visual imagery is effective
19 for form-based movement because players can easily visualize the overall positions and
20 movements necessary for a successful performance (Hardy & Callow, 1999; White & Hardy,
21 1995). Finally, the present study provides further support for practising MI on the tennis court
22 while wearing sports clothing and handling the racket (Guillot et al., 2005) and offers some
23 additional practical applications to coaches and players about using imagery, especially to
24 improve motor learning and performance in novice tennis players.

25 As also hypothesized, the participants who used instructional self-talk concurrently

1 with MI before serving significantly increased their percentage of success, serve speed and
2 technical quality scores from pre- to post-test and had higher technical quality scores than the
3 participants in the Control and MI groups. It is also important to note that the MI+self-talk
4 group was the only one to increase the serve speed. These results are consistent with those of
5 studies that have shown the beneficial effects of combining different mental strategies with
6 actual practice (e.g., MI and self-talk) to improve motor performance in tennis (Mamassis &
7 Doganis, 2004; Dohme et al., 2020). In addition, these results seem to show the beneficial
8 effect of the cognitive function of instructional self-talk in novice tennis players (Boudreault
9 et al., 2016; Hatzigeorgiadis et al., 2004; Latinjak et al., 2011), especially when it is combined
10 with MI (Dohme et al., 2020). Overall, these results demonstrate the beneficial effects of self-
11 talk on athlete performance (Hardy, 2006) even among beginners (e.g., Latinjak et al., 2018),
12 who tend to talk themselves through the phases of a movement (Fitts & Posner, 1967). As
13 previously noted by Landin and Hebert (1999), we might assume that the instructional self-
14 talk helped the participants to gain and maintain concentration during MI. Moreover, directing
15 novice tennis players to pay attention by using self-talk in order to appropriate cues when
16 learning a complex motor skill like the service should be encouraged for its instructional
17 purpose (Hardy et al., 2001), as it notably decreases interfering thoughts (Cutton & Landin,
18 2007) and/or improves the effective storage and retrieval of relevant task information (Singer,
19 2000). We might also consider that self-talk helps participants to imagine the critical parts of
20 the service (e.g., ball throw, arm-racket movement backwards, arm-racket movement forward,
21 point of contact or end of movement) during MI, which would give them an advantage over
22 participants who only use MI. Indeed, the participants of the MI+self-talk group had higher
23 MI quality scores than the participants of the MI group, although the difference was not
24 statistically significant. Additional research that includes other techniques like mental
25 chronometry might explore this hypothesis.

1 This study is not without limitations. The absence of a self-talk-only condition could
2 be considered a limitation. Indeed, although all the tennis players who benefited from MI (i.e.,
3 MI and MI+self-talk groups) increased their performances, with a greater effect for those who
4 used a combination of self-talk and MI, an instructional self-talk-only condition might also be
5 beneficial or even optimal. In addition, although the participants of the MI and MI+self-talk
6 groups declared that they had performed MI and MI+self-talk, respectively, during the
7 intervention phase, we do not know if they or the participants of the Control group used self-
8 talk during the actual service. Finally, the participants of the Control group may have been
9 less motivated than those of the other groups due to the experimental conditions. More
10 research is needed to confirm the results obtained in the current study, particularly by
11 controlling the use of self-talk during actual service, and to evaluate the effect of instructional
12 self-talk only and the motivation of the participants. In light of the results obtained in this
13 study, we recommend that coaches use a combination of MI and self-talk directly on the court
14 to promote the learning of complex motor tasks, such as serving in tennis.

15 **Conclusion**

16 The objective of this study was to assess the effect of a combination of motor imagery
17 and instructional self-talk over a 5-day intervention on the performance of novice tennis
18 players practising the service. The results showed a beneficial effect of using motor imagery
19 before actual service and showed further improvement when imagery was combined with
20 self-talk. These results have ecological implications for novice and non-expert tennis players.
21 Indeed, the service is a complex but crucial skill with a determining role for engaging and
22 winning points during matches. The results seem to indicate that instructional self-talk can be
23 an additional tool in the hands of coaches to improve learning and performance.

24 **References**

25 Atienza, F. L., Balaguer, I., & García-Merita, M. L. (1998). Video modeling and imaging

- 1 training on performance of tennis service of 9- to 12-year-old children. *Perceptual and*
2 *Motor Skills*, 87(2), 519–529.
- 3 Boudreault, V., Trottier, C. & Provencher, M. (2016). Self-talk in sport : A critical
4 review. *Staps*, 111, 43-64. <https://doi.org/10.3917/sta.111.0043>
- 5 Cece, V., Guillet-Descas, E., & Martinent, G. (2020). Mental training program in racket
6 sports: A systematic review. *International Journal of Racket Sports Science*, 2(1), 55–
7 71.
- 8 Cherappurath, N., & Elayaraja, M. (2017). Combined effects of SAQ and PETTLEP imagery
9 training: A study on the learning process of new skills among novice tennis players.
10 *International Journal of Physical Education Sports and Health*, 2, 169–173.
- 11 Cherappurath, N., Elayaraja, M., Kabeer, D. A., Anjum, A., Vogazianos, P., & Antoniadis, A.
12 (2020). PETTLEP imagery and tennis service performance: an applied
13 investigation, *Journal of Imagery Research in Sport and Physical Activity*, 15(1),
14 20190013. <https://doi.org/10.1515/jirspa-2019-0013>
- 15 Coelho, R. W., De Campos, W., Silva, S. G. D., Okazaki, F. H. A., & Keller, B. (2007).
16 Imagery intervention in open and closed tennis motor skill performance. *Perceptual*
17 *and Motor Skills*, 105(2), 458–468. <https://doi.org/10.2466/pms.105.2.458-468>
- 18 Cumming, J., Nordin, S. M., Horton, R., & Reynolds, S. (2006). Examining the Direction of
19 Imagery and Self-Talk on Dart-Throwing Performance and Self Efficacy. *The Sport*
20 *Psychologist*, 20(3), 257–274.
21 <https://journals.humankinetics.com/view/journals/tsp/20/3/article-p257.xml>
- 22 Cutton, D., & Landin, D. (2007). The Effects of Self-Talk and Augmented Feedback on
23 Learning the Tennis Forehand. *Journal of Applied Sport Psychology*, 19(3), 288–
24 303. <https://doi.org/10.1080/10413200701328664>
- 25 Dana, A., & Gozalzadeh, E. (2017). Internal and external imagery effects on tennis skills

- 1 among novices. *Perceptual and Motor Skills*, 124(5), 1022–1043.
2 <https://doi.org/10.1177/0031512517719611>
- 3 Dohme, L.-C., Bloom, G. A., Piggott, D., & Backhouse, S. (2020). Development,
4 implementation, and evaluation of an athlete- informed mental skills training program
5 for elite youth tennis players. *Journal of Applied Sport Psychology*, 429–449.
- 6 Dominique, L., Coudeville, G., & Robin, N. (in press). Effet d'une routine centrée sur
7 l'imagerie mentale et sur l'efficacité du service chez des joueurs de tennis
8 experts. *Staps*. <https://doi.org/10.3917/sta.pr1.0027>
- 9 Fekih, S., Zguira, M. S., Koubaa, A., Masmoudi, L., Bragazzi, N. L., & Jarraya, M. (2020).
10 Effects of motor mental imagery training on tennis service performance during the
11 ramadan fasting: a randomized, controlled trial. *Nutrients*, 12(4), 1035.
12 <https://doi.org/10.3390/nu12041035>
- 13 Féry, Y. A., & Morizot, P. (2000). Kinesthetic and visual images in modelling closed motor
14 skills: the example of the tennis serve. *Perceptual and Motor Skills*, 90, 707–722.
- 15 Fitts, P. M., & Posner, M. I. (1967). *Human performance*. Belmont, CA: Brooks/Cole.
- 16 Fritsch, J., Jekauc, D., Elsborg, P., Latinjak, A.T., Reichert, M., & Hatzigeorgiadis, A. (2020).
17 Self-talk and emotions in tennis players during competitive matches. *Journal of*
18 *Applied Sport Psychology*, 1-21.
- 19 Gabr, W. A. (2010). Mental imagery and self-talk as approach to cope with pressure among
20 individual sports. *World Journal of Sport Sciences*, 3(S), 104–108.
- 21 Guillot, A., Collet, C., & Dittmar, A. (2005). Influence of environmental context on motor
22 imagery quality: An automatic nervous system study. *Biology of Sport*, 22, 215–226.
- 23 Guillot, A., Desliens, S., Rouyer, C., & Rogowski, I. (2013). Motor imagery and tennis serve
24 performance: The external focus efficacy. *Journal of Sports Science & Medicine*,
25 12(2), 332–338.

- 1 Hardy, J. (2006). Speaking clearly: A critical review of the self-talk literature. *Psychology of*
2 *Sport and Exercise*, 7(1), 81–97. <https://doi.org/10.1016/j.psychsport.2005.04.002>.
- 3 Hardy, L., & Callow, N. (1999) Efficacy of external and internal visual imagery perspectives
4 for the enhancement of performance on tasks in which form is important. *Journal of*
5 *Sport and Exercise Psychology*, 21, 95–112.
- 6 Hardy, J., Gammage, K., & Hall, C. R. (2001). A description of athlete's self-talk. *The Sport*
7 *Psychologist*, 15, 306–318. [https://doi.org/10.1016/S1469-0292\(01\)00011-5](https://doi.org/10.1016/S1469-0292(01)00011-5)
- 8 Hardy, J., Oliver, E., & Tod, D. (2009). A framework for the study and application of self-talk
9 within sport. In S.D. Mellalieu & S. Hanton (Eds.), *Advances in applied sport psychol-*
10 *ogy: A review* (pp. 37–74). London: Routledge.
- 11 Hatzigeorgiadis, A., Theodorakis, Y., & Zourbanos, N. (2004). Self talk in the swimming
12 pool: The effects of self talk on thought content and performance on waterpolo tasks.
13 *Journal of Applied Sport Psychology*, 16, 138-150.
14 <https://doi.org/10.1080/10413200490437886>
- 15 Hegazy, K., Sherif, A., & Houta, S. (2015). The effect of mental training on motor
16 performance of tennis and field hockey strokes in novice players. *Advances in*
17 *Physical Education*, 5, 77–83.
- 18 Landin, D., & Hebert, E. P. (1999). The influence of self talk on the performance of skilled
19 female tennis players. *Journal of Applied Sport Psychology*, 11, 263–282.
- 20 Latinjak, A. T., Hernando-Gimeno, C., Lorigo-Mendez, L., & Hardy, J. (2019).
21 Endorsement and constructive criticism of an innovative online reflexive self-talk
22 intervention. *Frontiers in Psychology* 10, 1819. doi: 10.3389/fpsyg.2019.01819.
- 23 Latinjak, A.T., Masó, M., & Comoutos, N. (2017). Goal-Directed Self-Talk Used During
24 Technical Skill Acquisition: The Case of Novice Ultimate Frisbee Players. *The Sport*
25 *Psychologist*, 32, 60–65.

- 1 Latinjak, A. T., Torregrosa, M., & Renom, J. (2011). Combining self talk and performance
2 feedback: their effectiveness with adult tennis players. *The Sport Psychologist*, 25(1),
3 18–31. <http://dx.doi.org/10.1123/tsp.25.1.18>
- 4 Magill, R. (2004). *Motor learning and control: Concepts and applications*. New York:
5 McGraw-Hill.
- 6 Malouff, J. M., McGee, J. A., Halford, H. T., & Rooke, S. E. (2008). Effects of pre-
7 competition positive imagery and self-instruction on accuracy of serving in tennis.
8 *Journal of Sport Behaviour*, 31, 264–275.
- 9 Mamassis, G. (2005). Improving serving speed in young tennis players. *ITF Coaching and*
10 *Sport Science Review*, 35, 3–4.
- 11 Mamassis, G., & Doganis, G. (2004). The effects of a mental training program on juniors pre-
12 competitive anxiety, self-confidence, and tennis performance. *Journal of Applied*
13 *Sport Psychology*, 16(2), 118–137. <https://doi.org/10.1080/10413200490437903>
- 14 Morais, C., & Rui Gomes, A. (2019). Pre-service routines, mental toughness and performance
15 enhancement of young tennis athletes. *International Journal of Sport Psychology*, 50,
16 176–192. <https://doi.org/10.7352/IJSP.2019.50.176>
- 17 Noel, R. C. (1980). The effect of visuo-motor behavior rehearsal on tennis performance.
18 *Journal of Sport Psychology*, 2(3), 221–226. <https://doi.org/10.1123/jsp.2.3.221>
- 19 Robin, N., Toussaint, L., Charles-Charlery, C., & Coudevylle, G.R. (2019). Free Throw
20 Performance in Intermediate Basketball Players: The Effect of Dynamic Motor
21 Imagery with and without a Video of a Model. *Learning and Motivation*, 68.
- 22 Robin, N., Dominique, L., Toussaint, L., Blandin, Y., Guillot, A., & Le Her, M. (2007).
23 Effects of motor imagery training on service return accuracy in tennis: The role of
24 imagery ability. *International Journal of Sport and Exercise Psychology*, 5, 175–186.
25 <https://doi.org/10.1080/1612197X.2007.9671818>

- 1 Schack, T., Essig, K., Frank, C., & Koester, D. (2014). Mental representation and motor
2 imagery training. *Frontiers in human neuroscience*, 8, 328.
3 <https://doi.org/10.3389/fnhum.2014.00328>
- 4 Schuster, C., Hilfiker, R., Amft, O., Scheidhauer, A., Andrews, B., Butler, J., ... & Ettlin, T.
5 (2011). Best practice for motor imagery: A systematic literature review on motor
6 imagery training elements in five different disciplines. *BMC Medicine*, 9, 75.
7 <https://doi.org/10.1186/1741-7015-9-75>
- 8 Simonsmeier, B., Androniea, M., Buecker, S., & Frank, C. (2020). The effects of imagery
9 interventions in sports: a meta-analysis. *International Review of Sport and Exercise*
10 *Psychology*, <https://doi.org/10.1080/1750984X.2020.1780627>
- 11 Singer, R. N. (2000). Performance and human factors: considerations about cognition and
12 attention for self-paced and externally paced events.. *Ergonomics*, 43(10), 1661–
13 1680.
- 14 Theodorakis, Y., Weinberg, R., Natsis, P., Douma, I., & Kazakas, P. (2000). The effects of
15 motivational versus instructional self-talk on improving motor performance. *The Sport*
16 *Psychologist*, 14, 253-271. <https://doi.org/10.1123/tsp.14.3.253d>
- 17 Turan, M., Dişçeken, O., & Kaya, M. (2019). The impact of cognitive-based learning and
18 imagery training on tennis skills. *Universal Journal of Educational Research*, 7, 244–
19 249.
- 20 Van Raalte, J. L., Vincent, A., & Brewer, B. W. (2016). Self-talk: Review and sport-specific
21 model. *Psychology of Sport and Exercise*, 22, 139–148.
- 22 White, A., & Hardy, L. (1995). Use of different imagery perspectives on the learning and
23 performance of different motor skills. *British Journal of Psychology*, 86(2), 169–180.
24
25

1 We greatly appreciate the considerable time and effort of Cristophe Boudier, tennis coach at
2 the Amicale Tennis Club, and the subjects who participated in this project.

3

4

5

6

7

8

9

10

11

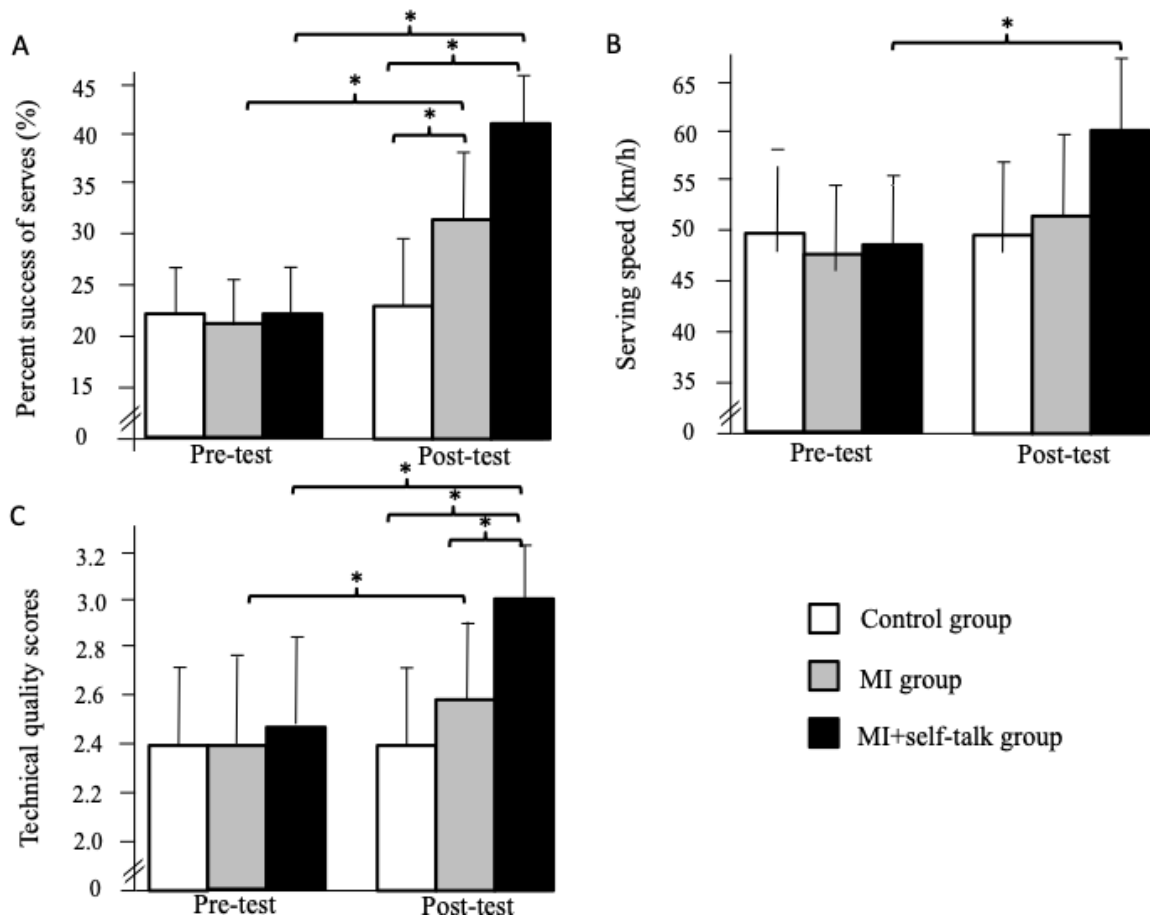
12

13

14

15

16



1

2 *Figure 1.* Significant interaction between the group (MI vs. MI+self-talk vs. Control) and the
 3 phase (pre-test vs. post-test) concerning the percentage of service success (A), the speed serve
 4 (B), and the technical quality scores (B), (* $p < .01$)

5