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Posted Date: 28 November 2025

doi: 10.20944/preprints202511.2162.v1

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Article

Mental Imagery in Fencing: Improving Point Control and Lunge Distance Through Visualization

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Abstract

Background: Visualization (motor imagery) is used in sports to enhance performance. Fencing relies on point control and lunge distance, yet little is known about how visualization affects these skills across experience levels. **Objective:** To examine the effects of brief visualization on point control and lunge distance in fencers of different experience levels. **Methods:** Nineteen fencers (age 10–56) completed pre- and post-tests of point control (10 hits) and lunge distance (maximum reach). Between tests, the experimental group performed a 1-minute guided visualization, while the control group (n = 20) repeated the tests without visualization. **Results:** Visualization significantly improved point control (+1.4 hits, 25.5%; $p = 0.0078$). Lunge distance increased (+15.6 cm, 11.1%) but was not significant ($p = 0.0830$). Less experienced fencers improved more in point control (39.0% vs. 14.8%), while experienced fencers improved more in lunge distance (12.8% vs. 7.2%). Control participants showed no meaningful gains, and between-group comparisons confirmed significant advantages for visualization in both skills ($p < 0.01$). **Conclusion:** Even a short visualization exercise improved fencing performance, with novices benefiting most in accuracy and experienced fencers in explosive reach. Visualization offers a low-cost, adaptable supplement to fencing training.

Keywords: visualization; mental imagery; fencing; point control; lunge distance

1. Introduction

Visualization, or mental imagery, is a well-established technique in sports psychology that involves rehearsing movements mentally without physical execution. Research has shown that imagery can enhance accuracy, strength, reaction time, confidence, and overall performance by engaging neural pathways similar to those activated during actual movement [1,2]. Importantly, these benefits extend beyond elite athletes; novices also gain from mental imagery, which can accelerate skill acquisition and support motor learning [3,4]. Bibliometric analyses confirm the growing importance of psychological skills training, including visualization, within sports and exercise medicine [5]. Moreover, visualization is increasingly recognized as a core element of psychological skills training across athletic disciplines [6,14,15].

Despite broad application across sports, fencing remains underexplored in this context. Fencing demands a combination of precision and explosiveness, requiring fine control of the weapon tip and rapid execution of dynamic movements, such as the lunge. Both point control and lunge distance are central to successful performance, yet few studies have directly examined whether visualization can improve these fundamental skills in fencers. This is a notable gap, as fencing provides a unique model to study visualization's effects on both fine motor accuracy and gross motor coordination [7].

The present study addresses this gap by testing the impact of a brief visualization exercise on point control and lunge distance in fencers. Additionally, it evaluates whether athletes with varying levels of experience respond differently to imagery. By combining controlled testing with subgroup comparisons, this study aims to clarify the role of visualization in fencing performance and provide practical insights for tailoring mental training across stages of athlete development.

2. Materials and Methods

The experiment consisted of two testing phases — pre-test and post-test — separated by a visualization exercise. Both phases included evaluation of point control and lunge distance.

Participants

Nineteen fencers aged 10 to 56 years participated in the experimental group. Participants were recruited from local fencing clubs and represented a diverse range of skill levels and years of training experience. All received a standardized explanation of the study procedures before testing [8,9]. A separate control group (n = 20) completed the same pre- and post-tests under identical conditions but did not perform the visualization exercise. This distinguished natural improvements during a retest versus visualization-specific effects.

Grouping

Participants were divided into two categories for subgroup analyses based on training history: less experienced fencers with <4 years of formal fencing training and more experienced fencers with ≥4 years of formal fencing training. This classification allowed investigation of whether visualization effects differed by training experience.

Pre-Test Procedures

Pre-Test procedures include point control test, lunge distance test and visualization exercise.

Point Control Test

Before the test, fencers were given one minute of practice to strike a target mounted on a wall. Four predetermined target locations were selected, each progressively increasing in difficulty [10,11]. During testing, participants attempted 10 hits on their designated target. The number of successful hits was recorded, and video recordings were used to verify accuracy. To avoid ceiling or floor effects, target difficulty was adjusted for subsequent attempts if necessary [8,12].

Lunge Distance Test

Participants began in the standard en garde position and executed a forward lunge as far as possible while maintaining balance and correct fencing form. The distance from the initial front foot position to the landing position was measured in centimeters. Each fencer performed three lunges, and the maximum distance was recorded for analysis [20,25].

Visualization Exercise

Following the pre-tests, participants in the experimental group engaged in a guided visualization session lasting approximately five minutes in a quiet environment. They were instructed to close their eyes and mentally rehearse both tasks: point control and lunge imagery. In the point control imagery, fencers were asked to imagine extending the arm, aligning the blade, and striking the center of the target with precision. In the lunge imagery, fencers were asked to imagine pushing explosively off the back leg, extending the front leg forward, and maintaining balance through the landing position.

Participants were encouraged to use a first-person perspective, as this vantage point has been shown to provide behavioral advantages for motor learning [21]. Both kinesthetic (bodily sensations, muscle activation) and visual (seeing oneself perform successfully) imagery were emphasized. The exercise was standardized and led by the same instructor to ensure consistency.

Post-Test Procedures

Immediately after the visualization exercise, participants in the experimental group repeated the point control test and lunge distance test under identical conditions. Control group participants also repeated the tests, but without any visualization between sessions. This design allowed for direct within-group comparisons (pre vs. post) and between-group comparisons (experimental vs. control) [18,19].

Statistical Analysis

Data were analyzed using descriptive and inferential statistics. Pre- and post-test results for point control and lunge distance were compared within each group using paired-sample t-tests. Differences between the experimental and control groups were evaluated using independent-sample t-tests. Subgroup analyses compared less experienced (<4 years) and more experienced (≥ 4 years) fencers using the same approach. Results are reported as means \pm standard deviations, with percentage change calculated for each measure. Statistical significance was set at $p < 0.05$. All analyses were performed using Microsoft Excel 365 and verified with SPSS v29 (IBM Corp.).

3. Results

Demographics

Nineteen fencers from the LEO Fencing Club participated in the study, ranging from age 10 to 56 years. Years of fencing varied from none to 22 years of competitive practice. Of the participants, 78.9% were men and 21.1% were women. According to USA Fencing Age Classification, the distribution was: Y10 (5.3%), Y12 (10.5%), Y14 (15.8%), Cadet (26.3%), Junior (10.5%), Senior (15.8%), and Vet-50 (15.8%) (Figure 1) [26].

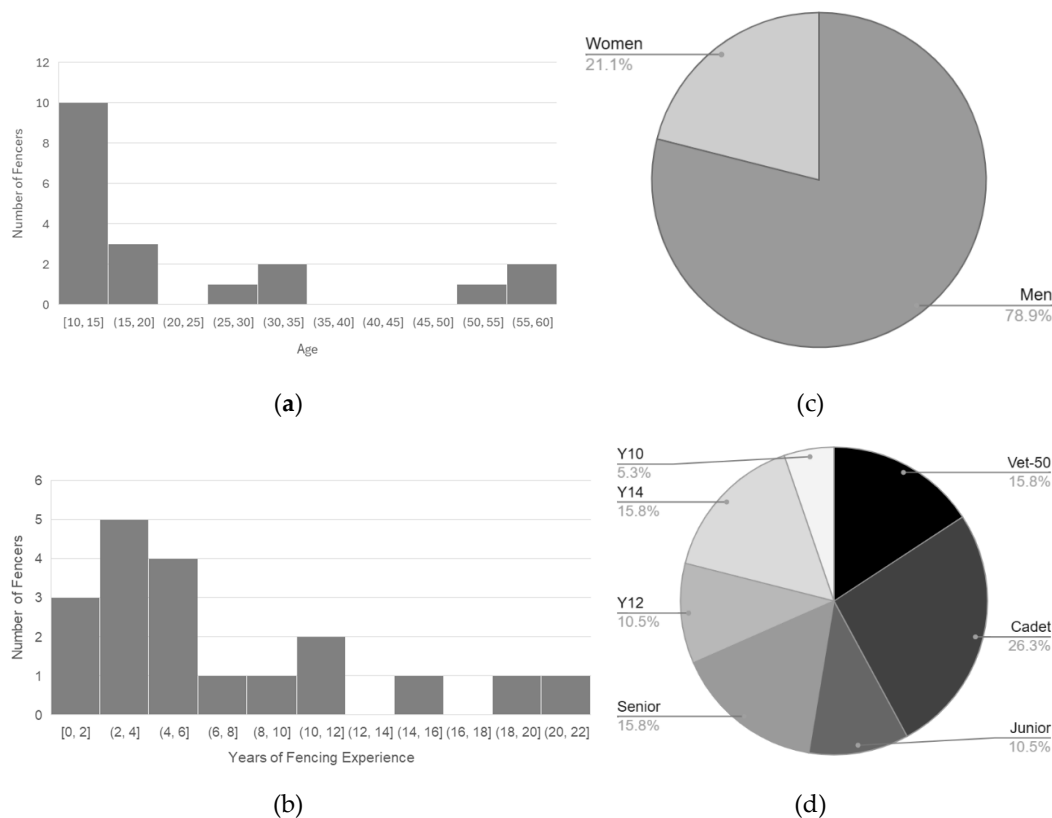


Figure 1. (a) Distribution of Age Among Tested Fencers. (b) Distribution of Years of Fencing Experience Among Tested Fencers. (c) Distribution of Gender among Tested Fencers. (d) Distribution of USA Fencing Age Classification among Tested Fencers [22].

Overall Effects of Visualization

Across all participants, visualization training improved performance in both tasks.

Point Control: The average number of successful hits increased from 5.3 (pre-test) to 6.7 (post-test), representing an improvement of 1.4 hits (25.5%). This effect was statistically significant ($p = 0.0078$) (Figure 2; Table 1). Prior research has emphasized the importance of attentional focus and tip accuracy in fencing performance [8,10].

Lunge Distance: The mean distance increased from 130.7 cm to 146.3 cm, corresponding to an improvement of 15.6 cm (11.1%). This difference did not reach statistical significance ($p = 0.0830$) (Figure 3; Table 1). Previous biomechanical studies suggest that improvements in lunge distance reflect coordination and lower-limb power [20,25].

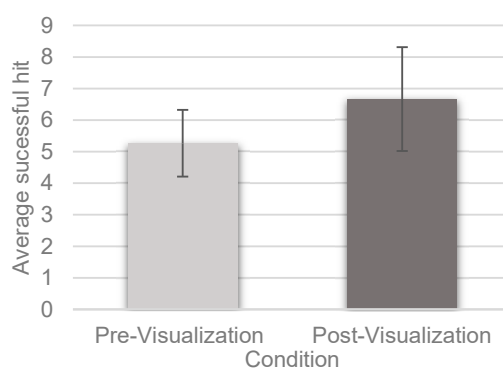


Figure 2. Average successful hits among 19 fencers. The left bar represents the results from pre-visualization, while the right bar represents the results from post-visualization. Error bars are the standard deviation. t-test (p -value: 0.00780924).

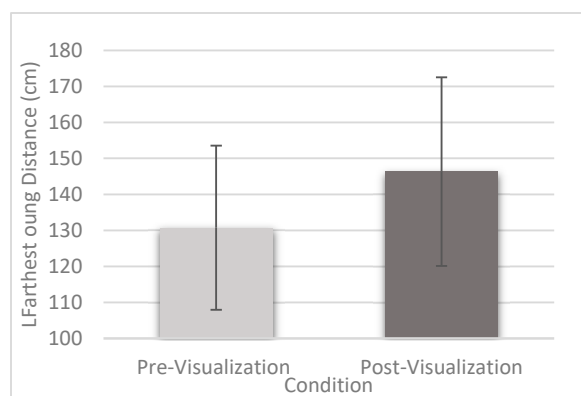


Figure 3. Average distance among 19 fencers. The left bar represents the results from pre-visualization, while the right bar represents the results from post-visualization. Error bars are the standard deviation. t-test (p -value: 0.08299625).

Table 1. Results of point control and lunge distance tests before and after visualization. The actual names of fencers are not shown for privacy reasons. The calculated averages are shown at the bottom. The difference is the post-data minus pre-data. The definition of the “%” in the table is the percent improvement between “pre” and “post.”.

Fencer ID	Point Control				Lunge Distance (cm)			
	Pre	Post	Difference	%	Pre	Post	Difference	%
A	5	10	5	100.00	98	109	11	11.22%
B	7	9	2	28.57	122	134	12	9.84%
C	5	6	1	20.00	123	143	20	16.26%
D	5	7	2	40.00	146	153	7	4.79%
E	6	6	0	0.00%	175	194	19	10.86%
F	4	4	0	0.00%	177	186	9	5.08%
G	4	7	3	75.00	132	149	17	12.88%
H	4	5	1	25.00	95	111	16	16.84%
I	6	7	1	16.67	123	134	11	8.94%
I	7	7	0	0.00%	131	204	73	55.73%
K	5	9	4	80.00	118	124	6	5.08%
L	6	5	-1	-	127	145	18	14.17%
M	4	5	1	25.00	126	128	2	1.59%
N	6	6	0	0.00%	112	126	14	12.50%
O	5	7	2	40.00	156	155	-1	-0.64%
P	4	4	0	0.00%	146	150	4	2.74%
O	7	8	1	14.29	163	173	10	6.13%
R	6	7	1	16.67	144	156	12	8.33%
S	5	6	1	20.00	127	137	10	7.87%
Average	5.3	6.7	1.4	25.50	130.7	146.3	15.6	11.06%

Effects of Training Experience

When fencers were divided by training history, additional patterns emerged.

- Point Control: Fencers with <4 years of experience showed greater improvement, increasing from 5.1 to 7.1 hits (39.0%) (Table 2, Figure 4a). Those with ≥4 years of experience improved from 5.5 to 6.2 hits (14.8%) (Table 4, Figure 5a). These differences are consistent with evidence that novices benefit most from visualization in skill acquisition [3,4].
- Lunge Distance: Fencers with <4 years of experience improved by 8.9 cm (7.2%) (Table 3, Figure 4b). Fencers with ≥4 years of experience, improved by 18.1 cm (12.8%) (Table 5, Figure 5b). This aligns with previous findings that experienced fencers use imagery to refine explosive actions, such as lunges [16,25].

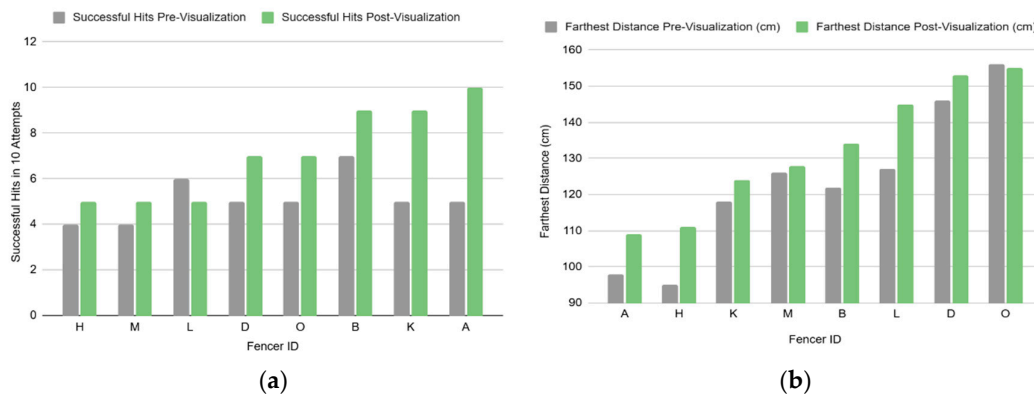


Figure 4. (a) Point Control Analysis in Fencers with Less than Four Years of Training. (b) Lunge Distance Analysis in Fencers with Less than Four Years of Training.



Figure 5. (a) Point Control Analysis in Fencers with More than Four Years of Training. (b) Lunge Distance Analysis in Fencers with More than Four Years of Training.

Table 2. Point Control Data for Fencers with Less than Four Years of Training.

Fencer ID	Pre	Post	Difference	Percent Improvement
Fencer H	4	5	1	25.00%
Fencer M	4	5	1	25.00%
Fencer L	6	5	-1	-16.67%
Fencer D	5	7	2	40.00%
Fencer O	5	7	2	40.00%
Fencer B	7	9	2	28.57%
Fencer K	5	9	4	80.00%
Fencer A	5	10	5	100.00%
Average	5.1	7.1	2.0	39.0%

Table 3. Lunge Distance Data for Fencers with Less than Four Years of Training.

Fencer ID	Pre	Post	Difference	Percent
Fencer A	98	109	11	11.22%
Fencer H	95	111	16	16.84%
Fencer K	118	124	6	5.08%
Fencer M	126	128	2	1.59%
Fencer B	122	134	12	9.84%
Fencer L	127	145	18	14.17%
Fencer D	146	153	7	4.79%
Fencer O	156	155	-1	-0.64%
Average	123.5	132.4	8.9	7.2%

Table 4. Point Control Data for Fencers with More than Four Years of Training.

Fencer ID	Pre	Post	Difference	Percent Improvement
Fencer P	4	4	0	0.00%
Fencer F	4	4	0	0.00%
Fencer N	6	6	0	0.00%
Fencer S	5	6	1	20.00%
Fencer C	5	6	1	20.00%
Fencer E	6	6	0	0.00%
Fencer G	4	7	3	75.00%
Fencer R	6	7	1	16.67%
Fencer I	6	7	1	16.67%
Fencer I	7	7	0	0.00%

Fencer O	7	8	1	14.29%
Average	5.5	6.2	0.7	14.8%

Table 5. Lunge Distance Data for Fencers with More than Four Years of Training

Fencer ID	Pre	Post	Difference	Percent Improvement
Fencer N	112	126	14	12.50%
Fencer I	123	134	11	8.94%
Fencer S	127	137	10	7.87%
Fencer C	123	143	20	16.26%
Fencer G	132	149	17	12.88%
Fencer P	146	150	4	2.74%
Fencer R	144	156	12	8.33%
Fencer O	163	173	10	6.13%
Fencer F	177	186	9	5.08%
Fencer E	175	194	19	10.86%
Fencer J	131	204	73	55.73%
Average	141.2	159.3	18.1	12.8%

Control Group

The control group performed the same pre- and post-tests without visualization training. Results showed minimal or negative changes:

- Point Control: Average scores declined slightly from 6.1 to 5.75 hits (−0.35 hits; −6.6%) (Table 6).
- Lunge Distance: Distances increased only marginally, from 105.1 cm to 107.9 cm (+2.9 cm; 2.8%) (Table 6).

Table 6. Results of point control and lunge distance tests in the control group. The actual names of fencers are not shown for privacy reasons. The calculated averages are shown at the bottom. The difference is the post data minus pre data. The definition of the “%” in the table is the percent improvement between “pre” and “post.”.

Control ID	Point Control				Lunge Distance (cm)			
	First	Second	Difference	%	First	Second	Difference	%
A	5	3	-2	-40.00%	129	132	3	2.33%
B	6	5	-1	-16.67%	156	165	9	5.77%
C	7	6	-1	-14.29%	122	124	2	1.64%
D	7	5	-2	-28.57%	128	131	3	2.34%
E	4	1	-3	-75.00%	146	157	11	7.53%
F	3	3	0	0.00%	130	131	1	0.77%
G	7	4	-3	-42.86%	110	109	-1	-0.91%
H	4	4	0	0.00%	140	148	8	5.71%
I	4	2	-2	-50.00%	102	101	-1	-0.98%
J	3	4	1	33.33%	119	120	1	0.84%
K	6	7	1	16.67%	139	141	2	1.44%
L	6	9	3	50.00%	141	143	2	1.42%
M	6	4	-2	-33.33%	101	108	7	6.93%
N	4	5	1	25.00%	81	86	5	6.17%
O	7	9	2	28.57%	120	119	-1	-0.83%
P	10	9	-1	-10.00%	61	63	2	3.28%
O	8	8	0	0.00%	45	48	3	6.67%
R	8	8	0	0.00%	35	38	3	8.57%
S	8	10	2	25.00%	58	56	-2	-3.45%
T	9	9	0	0.00%	39	39	0	0.00%
Average	6.1	5.75	-0.35	-6.61%	105.1	107.95	2.85	2.76%

Between Group Comparisons

Comparisons between the visualization and control groups showed significant differences (Figure 6).

- **Point Control:** The visualization group showed significantly greater improvement than the control group. t-test ($p = 0.0027$). This confirms that visualization training, rather than test repetition, accounted for the gains [7,17].
- **Lunge Distance:** Improvements in the visualization group were also significantly greater than those in the control group ($p = 0.0078$).

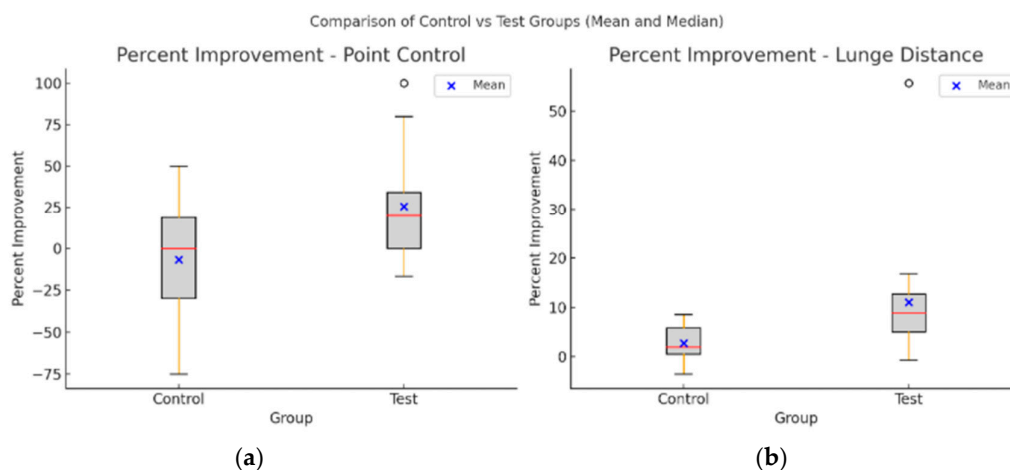


Figure 6. The Test group shows a much higher average improvement in both metrics: point control and lunge distance. The red lines in the box plots represent the median; Blue Xs represent the mean, and gray boxes represent the interquartile range (IQR). (a) The percentage improvement between the Control Group and Test Group in the Point Control test. The Control group has wide variability and several negative performances in Point Control. t-test (p -value: 0.00267). (b) Average percent improvement between the Control Group and Test Group in the Lunge Distance test. t-test (p -value: 0.00783).

4. Discussion

This study investigated whether a brief visualization exercise could enhance two key fencing skills—point control and lunge distance—and whether these effects varied by level of training experience. The findings indicate that visualization enhances fencing performance, but the nature of these benefits depends on both the fencer's level of expertise and the type of technical skill.

Visualization and Point Control

Visualization significantly improved point control, with fencers increasing their average number of successful strikes by 25.5%. This effect was most pronounced in less experienced athletes (<4 years), who improved by 39.0% compared to only 14.8% in more experienced athletes. These results support the idea that novices, who are still forming stable motor representations unique to sport, gain more from mental rehearsal of fine motor skills. Imagery strengthens neural pathways associated with precision movements, enabling athletes to consolidate technical accuracy even without physical practice [3,4,13].

Visualization and Lunge Distance

Unlike point control, improvements in lunge distance were greater among more experienced fencers. While novices showed modest gains (7.2%), experienced fencers improved their reach by an average of 12.8%. These findings align with prior research suggesting that athletes with well-established motor schemas can utilize imagery to refine explosive movements by enhancing proprioceptive awareness, muscular coordination, and timing [5,16].

Comparison with Control Group

The inclusion of a control group confirmed that the observed benefits were not due to natural improvements from repeated testing. Control participants showed no meaningful gains in point control and only minimal improvement in lunge distance, in contrast to the significant improvements in the visualization group. This strengthens the conclusion that visualization was the key factor in driving performance gains. Similar patterns have been observed in other sports, where even brief imagery interventions led to measurable improvements in skill performance [7,17].

Practical Applications

These findings highlight the value of tailoring visualization exercises to the athlete's developmental stage. For novices, emphasizing imagery of precise blade control may accelerate the acquisition of technical skills. For experienced athletes, focusing on explosive and dynamic actions such as the lunge may refine already well-developed motor patterns. Importantly, visualization requires no equipment and is time-efficient, making it an accessible tool for daily training sessions.

Limitations and Future Directions

Several limitations should be acknowledged. The sample size was modest, and while point control improvements reached statistical significance, lunge distance did not achieve significance across all participants. Visualization sessions were standardized and brief, which may not fully account for individual differences in imagery ability. Previous research has shown that interference during imagery can influence outcomes, highlighting the importance of considering imagery quality and cognitive load [23]. Furthermore, as with all small-sample experimental designs, results must be interpreted cautiously in light of potential biases and analytic challenges [24]. Future research should explore longer-term interventions, personalized imagery scripts, and interactions with psychological variables such as confidence and attentional control. Neuroimaging studies could further clarify the neural mechanisms of visualization in fencing, building on past research that demonstrates sport-specific brain adaptations [9,12].

5. Conclusions

Overall, this study provides evidence that even short visualization exercises can improve fencing performance. The specific benefits vary with training experience—point control gains being most prominent in novices and lunge distance gains in experienced athletes. By integrating targeted visualization into practice routines, coaches may be able to accelerate skill acquisition, optimize performance, and complement traditional physical training methods.

Author Contributions: First Author: Troy Song is affiliated with Brain Peace Science Foundation, New Haven, CT, USA. Troy Song's contributions include conceptualization, methodology development, experiment design and data collection, data analysis, and the manuscript drafting. Second Author: Adam Liu is affiliated with the Brain Peace Science Foundation, New Haven, CT, USA. Adam Liu's contributions include assisting with data collection, manuscript figure preparation, and manuscript drafting. Third Author (Corresponding Author): Kun Liu, PhD, is affiliated with Yale School of Medicine, Department of Psychiatry; Brain Peace Science Foundation, New Haven, CT, USA. Dr. Liu conceived and supervised the study, guided data analysis, and revised the manuscript. Correspondence: Kun Liu, PhD, Department of Psychiatry, Yale School of Medicine, Brain Peace Science Foundation, 178 Cold Spring Street, New Haven, CT 06511, USA, Email: kun.liu@yale.edu.

Acknowledgments: We gratefully acknowledge LEO Fencing Club and Rogue Fencing Academy providing access to fencing facilities and equipment used in this study. We also thank the Brain Peace Science Foundation (BPSF) for the institutional support. All authors (Troy Song, Adam Liu, and Kun Liu) are affiliated with BPSF. Their roles in study design, data collection, analysis, and manuscript preparation were conducted as part of their research activities within BPSF.

Conflict of Interest: All authors are affiliated with the Brain Peace Science Foundation (BPSF), which also provided funding for this study. The authors affirm that this dual role of BPSF as funder and institutional home does not constitute a conflict of interest. No commercial or financial relationships influenced the study outcomes.

Data Availability Statement: The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request. Due to privacy considerations, individual fencer identifiers have been anonymized.

Ethics Statement: This study involved non-invasive testing of fencing skills in voluntary participants. All participants, or their legal guardians in the case of minors, provided informed consent before taking part. No personal identifying information was collected, and all data were anonymized for analysis. As the study did not involve medical intervention, biological sampling, or sensitive personal information, formal institutional review board (IRB) approval was not required under prevailing guidelines.

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