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The Dynamics of 13–14-Year-Old Boxers' Memory Indicators

Gafforov Nosirjon Nodirjon ugli
Ph.D. student of the Institute of Physical, Education and Sport Scientific Research

Abstract: This study analyzes the dynamics of visual, mechanical, logical, short-term, and long-term memory indicators in 13-14-year-old boxers. The research compares the effects of different training methods on memory development in control (CG) and experimental (EG) groups. Statistical analysis was used to determine the differences between the groups and the development of each type of memory. The results show that both groups demonstrated gradual improvement in all memory types over four stages, but no significant statistical differences were found between the groups. These findings suggest that both training methods equally support cognitive development in young boxers.

Key points: memory indicators, visual memory, mechanical memory, logical memory, short-term memory, long-term memory, boxers, cognitive development, training methods, pedagogical stages.

Introduction

Memory plays a crucial role in athletic performance, particularly in sports like boxing, where quick decision-making, recall of techniques, and strategic thinking are essential. Cognitive abilities such as visual memory, mechanical memory, logical reasoning, and both short-term and long-term memory are fundamental in helping athletes respond to dynamic situations in the ring. For young athletes, particularly those aged 13-14, the development of these memory types is integral to their overall progression in the sport.

In this context, the importance of training methods tailored to cognitive development has gained attention. Traditional training programs focus on physical conditioning, technical skill, and psychological readiness, but increasingly, innovative pedagogical approaches have been introduced to enhance cognitive functions such as memory. These include using experimental methods like advanced cognitive exercises, digital tools, and virtual simulations.

The aim of this study is to evaluate and compare the impact of traditional training methods (Control Group) and experimental training methods (Experimental Group) on the development of memory in 13-14-year-old boxers. By analyzing the changes in visual, mechanical, logical, short-term, and long-term memory indicators over four stages of training, this research seeks to determine whether the experimental methods offer significant advantages over conventional training approaches.

Through this investigation, the study aims to contribute to the understanding of how different training methods influence the cognitive development of young athletes, especially in terms of their memory abilities, and to provide insights into the potential benefits of integrating innovative pedagogical techniques into sports training programs.

The relationship between memory development and athletic performance has been explored across various sports disciplines, with a particular focus on cognitive skills such as attention, decision-making, and memory. In boxing, cognitive functions such as memory are crucial for quick reactions, adaptation to the opponent's movements, and execution of complex techniques. Literature on memory types (visual, mechanical, logical, short-term, and long-term) offers valuable insights into how these functions can be developed and utilized in sports training.

Visual memory has been extensively studied in the context of sports, as it directly influences an athlete's ability to recognize and react to fast-moving stimuli. According to research by Williams and Ford (2013), visual memory aids athletes in predicting an opponent's movements and making split-second decisions during competition [6]. In boxing, this translates to recognizing an opponent's attack pattern, positioning, and potential openings for counter-attacks. Studies like those by Thomas et al. (2018) highlight the role of visual memory in improving reaction times and tactical awareness in sports, supporting the hypothesis that enhancing visual memory could directly benefit boxing performance [5].

Mechanical memory, often linked to procedural or motor memory, involves the recall of sequences of movements or techniques that become automatic through repetition. In boxing, this is critical for the fluid execution of punches, footwork, and defensive maneuvers. Research by Schacter (2001) and other scholars in cognitive neuroscience supports the idea that motor memory is enhanced through repetitive practice and muscle conditioning, underscoring the importance of mechanical memory in skill acquisition [3]. While much of this research focuses on physical repetition, the impact of mental rehearsal and visualization techniques (such as those discussed by Cumming & Williams, 2012) suggests that cognitive aspects of mechanical memory may also be developed through mental practice and visualization exercises [2].

Logical memory, which is associated with reasoning, problem-solving, and strategy, plays a vital role in sports where athletes must not only react to immediate stimuli but also think ahead and anticipate future actions. Studies by Baddeley (2000) and others in the field of cognitive psychology indicate that logical memory and executive functions are essential for making strategic decisions. In boxing, the ability to remember and execute complex strategies under pressure is an example of logical memory in action. The research suggests that interventions targeting cognitive flexibility and reasoning, such as strategic drills and tactical training, can improve logical memory and decision-making abilities [1].

Both short-term and long-term memory are fundamental in the storage and retrieval of information over different time scales. Short-term memory allows athletes to retain information about a match, such as the current situation in the ring, while long-term memory stores more permanent information, such as techniques and strategies learned over time. Studies by Squire (1992) and others emphasize that short-term memory is crucial for immediate decision-making, while long-term memory is essential for building expertise and experience. In boxing, long-term memory may store the knowledge of various tactics, drills, and techniques, while short-term memory aids in making rapid decisions during bouts [4].

Recent literature has explored the impact of different training methods on cognitive development in sports. Traditional methods, often focused on physical conditioning and technique, are contrasted with newer, more experimental approaches that incorporate cognitive training, such as the use of digital tools, virtual reality, and cognitive exercises. However, there is limited evidence on the specific effects of these methods on memory development in young athletes, especially in the context of boxing.

Aim of the Research: The aim of this research is to evaluate and compare the effects of traditional and experimental training methods on the development of memory indicators (visual, mechanical, logical, short-term, and long-term memory) in 13–14-year-old boxers.

Tasks of the Research:

1. **Assess Memory Indicators:** To measure and compare the development of visual, mechanical, logical, short-term, and long-term memory in 13-14-year-old boxers.
2. **Evaluate Training Methods:** To analyze the impact of traditional training methods (control group) and experimental training methods (experimental group) on the memory development of young boxers.

3. **Compare Groups' Performance:** To determine if there are significant differences in memory improvement between the control and experimental groups across different types of memory.
4. **Monitor Memory Changes:** To track the changes in memory indicators over the four stages of the study and identify the patterns of improvement in both groups.

Methodology: This research employs a quasi-experimental design to evaluate the impact of traditional and experimental training methods on the memory development of 13-14-year-old boxers. The participants (n=44) will be divided into two groups: A **Control Group (CG)**, receiving standard training, and an **Experimental Group (EG)**, engaging in innovative cognitive-enhancing techniques. Both groups will undergo training for 8 weeks, with three sessions per week.

Memory Indicators Assessed:

- ✓ **Visual Memory**: Recall of visual information, such as movement patterns.
- ✓ **Mechanical Memory**: Retention of motor skills and movement sequences.
- ✓ **Logical Memory**: Retention and application of strategies.
- ✓ **Short-term Memory**: Temporary retention of information.
- ✓ **Long-term Memory**: Retention of information over extended periods.

Memory performance will be measured at four stages using standardized cognitive tests, and the data will be analyzed using statistical methods to assess the effectiveness of each training approach.

Results: This research examines memory dynamics in young boxers' control (CG) and experimental (EG) groups, concentrating on five different forms of memory—visual, mechanical, logical, short-term, and long-term—across four educational phases. In order to demonstrate the efficacy of experimental interventions and normal cognitive development, statistical significance is examined using tt-values and pp-values. Memory indicator dynamics in control and experimental groups of boxers aged 13–14.

13–14-year-old fighters Examination of the Results of Visual Memory: The CG developed 0.36 from 3.04±0.353.04 \pm 0.35 to 3.64±0.363.64 \pm. From 3.06±0.243.06 pm 0.34 to 3.67±0.343.67 pm, EG grew. Statistics Displayed: pp-values >0.05, indicating no appreciable changes; tt-values 0.66 to 0.84. Scientists' perspectives: Visual memory is crucial in boxing because it allows for the rapid perception of visual information, such as an opponent's movement. The fact that the gains made by the two groups did not differ significantly suggests that traditional training methods are almost as effective as experimental ones. Future studies may focus on using cutting-edge strategies like virtual reality (VR) training, which could enhance visual memory by simulating combat scenarios more accurately (Table-1).

Table-1. Dynamics of memory indicators in control and experimental groups of 13-14-year-old boxers (n=44)

Types of memory	Group/ math-statis	Stages of pedagogical research			
		First stage	Second stage	Third stage	Fourth stage
Visual memory	CG	3.04±0.35	3.17±0.31	3.31±0.27	3.64±0.36
	EG	3.06±0.24	3.24±0.14	3.29±0.17	3.67±0.34
	t	0.71	0.72	0.66	0.84
	p	>0.05	>0.05	>0.05	>0.05
Mechanical	CG	2.61±0.14	2.68±0.14	2.71±0.20	2.85±0.27
	EG	2.57±0.21	2.65±0.16	2.72±0.17	2.84±0.34
	t	0.87	0.77	0.64	0.49
	p	>0.05	>0.05	>0.05	>0.05
Logical	CG	2.55±0.26	2.67±0.17	2.74±0.27	2.89±0.34
	EG	2.54±0.27	2.6±0.16	2.77±0.34	2.86±0.3

	t	0.67	0.74	0.68	0.41
	p	>0.05	>0.05	>0.05	>0.05
Short-term	CG	2.42±0.34	2.54±0.24	2.63±0.27	2.75±0.64
	EG	2.44±0.32	2.52±0.32	2.67±0.34	2.74±0.73
	t	0.91	0.57	0.81	0.47
	p	>0.05	>0.05	>0.05	>0.05
Long-term	CG	2.28±0.31	2.33±0.13	2.37±0.34	2.45±0.62
	EG	2.27±0.27	2.34±0.11	2.39±0.27	2.47±0.25
	t	0.64	0.33	0.61	0.34
	p	>0.05	>0.05	>0.05	>0.05

13 to 14-year-old fighters Analysis of the Mechanical Memory Results: The CG Progress: 2.85 +/- 0.272.8 ppm Hours: 0.27 to 2.61±0.142.61 p.m. EG Progression at 0.14: 2.84±0.342.84 \pm 2.57±0.212.57 p.m. to 0.34 hours 0.21. tt-values ranged from 0.49 to 0.87, and pp-values were larger than 0.05, indicating that there were no significant variations in the statistical data. From a Scientific Perspective: Mechanical memory formation appears to be minimal, which is in line with the notion that rote memorization is less significant in dynamic sports like boxing. While it might not translate to in-ring adaption right away, this type of memory is more helpful when doing technical exercises. If training emphasizes logical and visual memory more, it may increase situational awareness and strategic awareness.

Boxers aged 13 to 14 have logical memory. Analyzing the Results: CG Progression: 2.89±0.342.89 \pm 0.34 to 2.55±0.262.55 \pm 0.26. EG Progression: 2.86±0.302.86 \pm 0.30 as opposed to 2.54±0.272.54 \pm 0.27. The statistical results showed no significant differences, with tt-values ranging from 0.41 to 0.74 and pp-values greater than 0.05. Scientific Viewpoint: In order to build strategic thinking and decision-making skills in boxing, logical memory is essential. Although there have been gains, the lack of notable group differences indicates that additional cognitively demanding tasks would need to be included in the experimental program. Incorporating video analysis or problem-solving exercises, for example, may improve logical memory recall.

Boxers aged 13 to 14 years Short-Term Memory Analysis Outcomes: CG Development: 2.42±0.342.42 \pm 0.34 to 2.75±0.642.75 \pm 0.64. EG Progression: 2.74±0.732.74 \pm 0.73 to 2.44±0.322.44 \pm 0.32. Findings from Statistics: o tt-values: 0.47–0.91; o pp-values: >0.05, indicating no discernible variations. Scientific Viewpoint: Both groups' short-term memory, which is necessary for instantaneous recollection of combinations or instructions, improved steadily. Regardless of the experimental settings, the comparable trajectory indicates that regular training regimens have a significant impact on short-term memory. The use of high-pressure exercises requiring prompt decision-making may encourage additional improvement.

Results of the Analysis of Long-Term Memory (Incomplete Data): Over time, both groups demonstrated slight gains. According to scientific opinion, long-term memory is essential for maintaining strategic knowledge and technical proficiency. The slight gains seen might indicate the need for improved retention techniques like scenario-based learning or spaced repetition. Future studies should examine how multimodal teaching strategies—such as integrating spoken, written, and visual instructions—affect athletes' long-term memory.

Conclusion

The study evaluating the dynamics of memory indicators in 13–14-year-old boxers reveals several important insights about cognitive development and the effectiveness of various training methods. The control (CG) and experimental (EG) groups both showed gradual improvements across all types of memory (visual, mechanical, logical, short-term, and long-term) over the four stages of the study. However, statistical analysis indicated no significant differences between the two groups, suggesting that the experimental interventions did not provide a marked advantage over the traditional methods employed in the control group.

Visual Memory: Both groups showed consistent improvements in visual memory, crucial for rapid recognition and reaction to visual stimuli in boxing. The lack of significant differences indicates that traditional training methods are equally effective as experimental interventions in improving visual memory.

Mechanical Memory: Improvements in mechanical memory, which involves rote memorization of movements or sequences, were modest for both groups. This suggests that boxing training may not rely heavily on rote memorization but instead emphasizes adaptability and decision-making, which may not be fully captured by mechanical memory alone.

Logical Memory: Both groups exhibited slight improvements in logical memory, which is essential for strategic thinking and reasoning in boxing. The lack of significant differences between the groups reinforces the idea that logical thinking is developed through consistent training and experience.

Short-term and Long-term Memory: The data trends in these areas also demonstrated gradual improvements without significant differences between the groups, indicating that both training regimens foster memory retention over time.

While both the control and experimental groups showed positive memory improvements, the lack of significant differences suggests that traditional methods of training may be just as effective as more innovative or experimental approaches in fostering memory development. This outcome challenges the notion that experimental tools and interventions necessarily provide superior results. However, it is important to note that this study focused on a relatively short period, and long-term or more intensive interventions may yield different results.

Future research could explore the integration of advanced cognitive training tools (e.g., virtual reality for visual memory training) or more complex training protocols targeting specific types of memory (like logical and short-term memory) to better understand their impact on athletic performance. Furthermore, studies incorporating more diverse and age-specific variables could help refine our understanding of the relationship between cognitive training and sports performance in youth athletes.

Overall, the findings support the conclusion that memory development in young boxers is a multifaceted process influenced by consistent practice, cognitive engagement, and age-related maturation, with little difference between conventional and experimental approaches in the context of this study.

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