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The Effect of Visual Training on the Psychomotor Performance of Male Volleyball Players under Environmental Evaluation Conditions

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A B S T R A C T

Purpose: The aim of the present study was to investigate the effect of visual training on the psychomotor performance of Iraqi male volleyball players under environmental evaluation conditions.

Methodology: This research was semi-experimental in nature and conducted in the field. A total of 45 participants who met the inclusion criteria and were interested in the study were purposefully selected and randomly assigned into three groups of 15: sport vision, combined, and traditional/specialized. To measure service and spike accuracy in volleyball, a test adapted from Giaruino et al. (2023) was employed.Trait and state anxiety were measured using the Illinois SCAT questionnaire (Martens, 1997) and the Competitive State Anxiety Inventory-2 (CSAI-2) developed by Martens et al. (1990), respectively. To induce environmental evaluation effects during the post-test, a combined supervision and comparison method was used, as suggested by Esmaeili et al. (2019). Data analysis was performed using multivariate analysis of covariance (MANCOVA) and the Bonferroni post hoc test. The sport vision training program was implemented based on the method proposed by Formenti et al. (2019).

Findings: The results of the study indicated no statistically significant differences in service and spike accuracy scores ($p \geq .05$). However, statistically significant differences in favor of the sport vision training group were observed for cognitive anxiety, somatic anxiety and self-confidence. ($p \leq .05$).

Conclusion: This research provides evidence that specialized sport vision training can serve as an effective tool for enhancing psychomotor skills and managing psychological pressure in athletes. These findings hold value for both sport coaches and sport psychologists in designing training programs and psychological preparation for athletes.

Keywords: sport vision, service and spike accuracy, cognitive anxiety, somatic anxiety, self-confidence, volleyball, environmental evaluation.

1. Introduction

Volleyball is a team sport that demands high levels of physical and perceptual capabilities (Altundağ, 2024; Moa, 2024; Vaalayi et al., 2023), and as a dynamic team sport, it requires a combination of motor skills, cognitive abilities, and psychophysical stability (Gabbett et al., 2008). In volleyball, the creation of mental imagery, self-talk, and perceptual experiences relates to cognitive-psychological and perceptual skills, such as reacting to external stimuli like sounds during coordination, decision-making, and reaction time (MacDonald & Minahan, 2018). Two key techniques—service accuracy and spiking—are critical to athlete performance success in volleyball. Executing accurate serves and effective spikes depends on a combination of technical, psychophysical, and psychological factors. Service accuracy demands proper technique, selective attention, and muscular power control. In contrast, successful spiking requires neuromuscular coordination, precise timing, and explosive power, which can be enhanced through physical and cognitive training (Sheppard et al., 2008).

Psychophysical skills, such as responding to visual stimuli and controlling breathing, play a key role in performing these techniques and are developed through mental training and muscle memory (Schmidt & Lee, 2011). Furthermore, psychological components such as concentration, motivation, and imagery—when practiced through relaxation techniques and positive self-talk—can reduce competitive anxiety and optimize performance (Weinberg & Gould, 2018).

Among modern training methods, visual training plays an effective role in improving visual information processing, quick decision-making, and precise execution of sports skills (Abernehy & Wood, 2001; Abernethy et al., 2012). Studies have shown that the visual system is a key factor in controlling sports movements, and its enhancement can lead to improved psychomotor performance in athletes (Mann et al., 2007).

In competitive situations, volleyball players face environmental stressors such as spectator pressure, opponent competitiveness, and time constraints, which can negatively affect the accuracy of technical skills like serving and spiking (Schweizer et al., 2011). Increased anxiety triggers a chain of psychological responses that impair performance, especially when the consequences of failure are significant (Vine et al., 2013, 2016). Carver et al. (2012) found that the presence of video cameras may increase self-awareness, which can interfere with task execution due to disrupted processing of relevant information (Carver & Scheier, 2012).

In many sports events (i.e., competitive settings), individuals often worry about the outcome of their performance; therefore, heightened awareness of such situations can lead to choking (Masters, 1992). One factor that potentially influences sports performance is the visual system, which must quickly scan the environment and gather appropriate information to implement the most effective motor program, allowing athletes to perform with optimal control. This includes strengthening the muscles responsible for eye movements.

One training approach that has drawn increasing attention from coaches is sport vision training. These programs, which focus on enhancing the muscles responsible for ocular motion, may improve rapid environmental scanning and reception of task-related visual stimuli, enabling decision-making and execution within milliseconds (Buscemi et al., 2024; Nazifi & Shahbazi, 2022; Zahedi & Yazdi, 2023). However, what remains essential is that the accuracy of execution and the use of acquired psychological skills must be evaluated under conditions of monitoring and assessment.

In this context, visual training programs are designed to improve focus, spatial perception, and motor timing, and they can help athletes perform better under environmental pressure (Hanton et al., 2008). Indeed, coordination, concentration, balance, and accuracy are fundamental skills required in any sports event. Some researchers argue that these skills can be enhanced through visual training, as studies have shown that the visual system responds well to the added load in such training programs (Wilson, 2011, 2012).

Recent studies on athletes have demonstrated that visual training not only improves motor skills such as service accuracy but also positively impacts cognitive performance (e.g., selective attention and information processing speed) and psychophysical status (e.g., reduced anxiety and increased self-confidence) (Harris et al., 2019).

Despite growing interest in the use of visual training for sports performance, it remains unclear whether such training transfers effectively to on-field settings. Schwab et al. (2012) reported that a group of hockey players who participated in a six-week sport vision training program improved in the same visual tasks used during training, yet no improvement was observed in transfer tasks (Schwab & Memmert, 2012). Additionally, Abernethy and Wood (2001) found that while generalized visual training improved certain visual skill

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measures, similar gains were observed in control and placebo groups, and these improvements did not reflect in field-based tennis transfer tests (Abernehy & Wood, 2001).

Nevertheless, limited research has examined this topic among Iraqi volleyball players, and the current study seeks to contribute to a better understanding of the effects of visual training under environmental evaluation conditions.

Despite the recognized importance of technical skills (such as service and spike accuracy) and psychological factors (such as concentration, motivation, and imagery) in sports success, few studies have explored these relationships among Iraqi volleyball players. Most previous research has been conducted under non-evaluative, unmonitored conditions, and given the cultural differences, training tools, and sports infrastructure in Iraq, the findings may not be generalizable. The primary aim of this study is to examine the effect of visual training on psychological skills and performance accuracy (service and spike accuracy) of Iraqi volleyball players under simulated competitive conditions. The findings of this study may assist coaches and athletes in designing more effective training programs.

2. Methods and Materials

2.1. Study Design and Participants

The present study, in terms of data collection, is a semi-experimental research and in terms of results and purpose, it is applied. It was conducted in the field using a pre-test–post-test design. The research population consisted of right-handed Iraqi male volleyball players familiar with volleyball skills who had at least five years of non-professional volleyball experience. A total of 68 individuals who met the inclusion criteria (normal vision, at least five years of volleyball experience, no eye surgery or lens use, no use of glasses, male and right-handed, no use of sedatives, no membership in professional volleyball teams) were selected. Subsequently, in order to determine the level of trait anxiety, after completing the Illinois SCAT questionnaire and excluding those with trait anxiety scores above 15, finally 45 participants (age 26.28 ± 0.48, height 1.81 ± 0.04, weight 88.93 ± 5.83, trait anxiety 16.73 ± 1.07) who met the research criteria were purposefully selected and randomly assigned into three groups (15 each): sport vision, traditional, and combined.

After setting up the cameras and evaluators and providing the necessary explanations, before the execution, each participant was informed that if selected among the top performers, they would receive a prize of 300,000 dinars (financial incentive) and was asked to complete the CSAI-2 questionnaire.

2.2. Measures

To assess trait anxiety, the Illinois SCAT questionnaire (Martens, 1997) was used; state anxiety was measured using the Competitive State Anxiety Inventory-2 (CSAI-2) (Martens, Burton, Vealey, Bump, & Smith, 1990). This inventory evaluates three subscales: cognitive anxiety, somatic anxiety, and self-confidence. The volleyball service accuracy test protocol included ten service attempts for each participant. Each service score was recorded. The individual's score was the sum of scores from the ten services. For the spike accuracy test, the participant performed ten spikes and the scores for each execution were recorded. In the pre-test, the participants' service accuracy, spike accuracy, cognitive skills, and psychophysical skills were recorded.

2.3. Intervention

According to prior coordination in this research, the three training groups—sport vision, traditional/specialized, and combined—conducted their specific programs over 27 sessions of 90 minutes each. The program included ten minutes of warm-up, 30 minutes of sport vision training or intervention, 20–30 minutes of volleyball physical skills training, and ten minutes of cool-down and stretching based on the method of Formenti et al. (2019). In the post-test, a combined supervision and comparison method was applied (Esmaeili et al., 2019). Four video cameras were installed at a distance of two meters from the sidelines and baselines of the volleyball court, and participants were informed that their skill execution would be recorded (performance pressure). Additionally, four prominent coaches from the federation—who were involved in selecting players for the national volleyball team and were members of club coaching staff in Iraq—were invited in advance. Participants were told their performance would be monitored and evaluated by these individuals for potential selection (evaluation pressure).

2.4. Data Analysis

Data analysis was conducted using multivariate analysis of covariance and Bonferroni post hoc tests with SPSS version 23, at a significance level of less than .05.

3. Findings and Results

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According to the results presented in the above table, in the pre-test, the highest level of cognitive anxiety was observed in the sport vision group, while in the post-test, it was highest in the traditional/specialized group. The highest somatic anxiety score in the pre-test was also recorded in the sport vision group, and in the post-test, in the traditional/specialized group. The lowest self-confidence score in the pre-test belonged to the combined group, and in the post-test, to the traditional group. Overall, the lowest competitive state anxiety in both the pre-test and post-test was observed in the combined group, while the highest was seen in the sport vision group (pre-test) and the traditional/specialized group (post-test).

The highest volleyball service accuracy score in both the pre-test and post-test was recorded in the combined group. The lowest score in the pre-test was observed in the sport vision group and in the post-test in the traditional/specialized group. The highest spike accuracy in the pre-test belonged to the traditional/specialized group, and the lowest to the sport vision group. In the post-test, the highest spike accuracy was in the combined group, and the lowest in the traditional/specialized group

Table 1

Comparison of Means and Standard Deviations of the Examined Components

Variable	Group	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD
Cognitive Anxiety	Sport Vision	12.06	1.27	13.33	1.04
	Combined	11.43	1.13	13.93	1.16
	Traditional/Specialized	11.93	1.27	15.60	0.73
Somatic Anxiety	Sport Vision	10.93	1.22	11.60	1.45
	Combined	10.40	1.45	12.26	1.48
	Traditional/Specialized	10.06	1.48	13.66	1.54
Self-Confidence	Sport Vision	28.20	1.37	27.60	1.45
	Combined	27.13	1.45	26.13	1.45
	Traditional/Specialized	28.00	1.46	24.86	1.35
Service Accuracy	Sport Vision	41.20	3.18	39.46	3.09
	Combined	42.73	2.15	40.66	2.43
	Traditional/Specialized	42.06	1.57	38.26	1.48
Spike Accuracy	Sport Vision	35.40	2.02	33.93	2.18
	Combined	35.66	1.87	34.33	2.49
	Traditional/Specialized	35.73	1.38	32.20	1.61

After ensuring that the necessary assumptions were met—including normal distribution of data, homogeneity of variance across groups, and linear relationship of covariates with dependent variables (service accuracy group p = .33, F(2) = 1.16; spike accuracy group p = .01, F(2) = 421.74; cognitive anxiety group p = .22, F(2) = 49.47; somatic anxiety group p = .09, F(2) = 62.98; self-confidence group p = .16, F(2) = 165.58), and confirmation of the Box's test assumption (BOX = 30.30; p = .16; F(20, 98.6331) = 1.30)—the data were analyzed using ANCOVA.

Table 2

ANCOVA Results Comparing the Effect of Intervention on the Examined Variables

Source	Variable	SS	df	MS	F	Sig.	Eta²	Power
Pre-test	Service Accuracy	170.77	1	170.77	476.70	.000	.92	1.00
	Spike Accuracy	96.92	1	96.92	228.48	.000	.86	1.00
	Cognitive Anxiety	19.07	1	19.07	52.99	.000	.57	1.00
	Somatic Anxiety	65.16	1	65.16	158.80	.000	.80	1.00
	Self-Confidence	77.98	1	77.98	429.78	.000	.91	1.00
Group	Service Accuracy	33.98	2	16.99	47.43	.000	.71	1.00
	Spike Accuracy	43.92	2	21.96	51.77	.000	.73	1.00
	Cognitive Anxiety	42.78	2	21.39	56.43	.000	.75	1.00
	Somatic Anxiety	60.69	2	30.34	73.92	.000	.79	1.00
	Self-Confidence	51.07	2	25.53	140.75	.000	.87	1.00
Error	Service Accuracy	13.25	37	0.35	–	–	–	

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	Spike Accuracy	15.69	37	0.42	–	–	–
	Cognitive Anxiety	14.03	37	0.36	–	–	–
	Somatic Anxiety	16.00	37	0.41	–	–	–
	Self-Confidence	7.07	37	0.18	–	–	–

According to the information in Table (2), there were statistically significant differences between the three groups in all the examined variables (p = .000).

Table 3

Bonferroni Post Hoc Test Results for Pairwise Comparisons of the Examined Variables and Group Differences

Variable	Group 1	Group 2	Mean Difference	Standard Error	Significance Level
Service Accuracy	Sport Vision	Combined	0.32	0.24	0.57
	Sport Vision	Traditional/Specialized	2.06	0.24	0.000
	Combined	Traditional/Specialized	1.73	0.22	0.000
Spike Accuracy	Sport Vision	Combined	-0.19	0.26	1.00
	Sport Vision	Traditional/Specialized	2.03	0.26	0.000
	Combined	Traditional/Specialized	2.23	0.24	0.000
Cognitive Anxiety	Sport Vision	Combined	-0.63	0.23	0.02
	Sport Vision	Traditional/Specialized	2.38	0.22	0.000
	Combined	Traditional/Specialized	-1.75	0.227	0.000
Somatic Anxiety	Sport Vision	Combined	-1.16	0.24	0.000
	Sport Vision	Traditional/Specialized	-2.92	0.24	0.000
	Combined	Traditional/Specialized	-1.76	0.24	0.000
Self-Confidence	Sport Vision	Combined	0.44	0.16	0.03
	Sport Vision	Traditional/Specialized	2.52	0.16	0.000
	Combined	Traditional/Specialized	2.08	0.16	0.000

The data in Table (3) indicate that, except for service accuracy and spike accuracy in the comparison between the sport vision and combined groups ($p \geq .05$), statistically significant differences were observed in all other pairwise comparisons across the studied variables ($p \leq .05$).

4. Discussion and Conclusion

The purpose of the present study was to compare the effects of a period of sport vision training (general visual stimuli with general motor actions), combined training (general visual stimuli with sport-specific motor actions), and specialized training (sport-specific visual stimuli in a specific sport context) on service accuracy, spike accuracy, cognitive and somatic anxiety, and self-confidence in Iraqi male volleyball players under environmental evaluation conditions. According to the data in Table (2), the results of multivariate covariance analysis indicated that under psychological pressure, there were statistically significant differences among the three groups in all studied variables ($p \leq .05$). The Bonferroni post hoc test results (Table 3) revealed that except for service and spike accuracy in the comparison between the sport vision and combined groups ($p \geq .05$), all other pairwise comparisons across the examined variables showed statistically significant differences ($p \leq .05$).

Given the absence of a significant difference in service and spike accuracy between groups, the findings are in line with Simons et al. (2016), who showed that for simple motor tasks, there is little difference between general and specialized training. Similarly, Guell et al. (2018) reported that under pressure conditions, differences between various training methods tend to diminish (Guell, 2018). In contrast, findings by Farrow and Abernethy (2003) demonstrated that specialized visual training in sports such as tennis improved performance under competitive conditions (Farrow & Abernethy, 2003), and Williams et al. (2004) found advantages for specialized training even in relatively simple skills. These results are inconsistent with Formenti et al. (2019), who argued that the environment in which training is conducted (specialized training settings) plays a key role in enhancing perception and action in sport-specific skills, supporting an ecological perspective (Formenti et al., 2019). However, unlike typical conditions, the present study was conducted under evaluative and environmentally pressurized settings, comparing service and spike accuracy across three

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groups. One explanation may be that the level of cognitive–motor stimulation was similar across participants, resulting in equivalent activation of the visuomotor system and similar performance outcomes (Formenti et al., 2019). It is also possible that the pressure from environmental evaluation was so dominant that it overshadowed the effects of the training types (Janelle, 2002).

This study revealed that under environmental evaluative pressure, the group that underwent sport vision training experienced significantly lower levels of cognitive and somatic anxiety compared to the other groups (specialized and combined training). This finding aligns with the prior results (Vine et al., 2013, 2016). Vine et al. (2013) reported that visuomotor training reduced competitive anxiety in basketball players by redirecting athletes' focus from threat to task (Vine et al., 2013). In contrast, Wilson (2012) found that while visual training can improve attention, it does not directly reduce anxiety, emphasizing the importance of other factors like competitive experience (Wilson, 2012). Hill et al. (2010) reported no significant difference in anxiety between visual training and control groups and suggested that such training may only benefit elite athletes (Hill et al., 2010). These results suggest that specialized sport vision training can be an effective method for managing anxiety in competitive settings. This may be because athletes in the sport vision group learned to manage their focus in stressful situations, thereby experiencing less cognitive anxiety (fear of failure) and somatic anxiety (muscle tension). These outcomes are consistent with the attentional control theory (ACT) and the hypothesis of movement automatization. The study supports the idea that specialized sport vision training can enhance not only athletic performance but also emotional regulation under pressure. It is also possible that sport vision training, by enhancing selective attention, helped athletes allocate their attentional resources to task-relevant stimuli and avoid stressors, or that improved eye-hand coordination and motor memory reduced the need for conscious processing, thereby decreasing anxiety related to error monitoring (Beilock & Carr, 2005). Furthermore, vision training may have moderated physiological responses to stress (e.g., heart rate, muscle tension) by improving arousal regulation (Wilson, 2012).

This study provided evidence that specialized sport vision training can be utilized as an effective tool for improving psychomotor skills and managing pressure conditions in athletes. These findings are valuable for both coaches and sport psychologists in designing training programs and preparing athletes mentally for competition.

Authors' Contributions

All authors significantly contributed to this study.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

In this study, to observe ethical considerations, participants were informed about the goals and importance of the research before the start of the interview and participated in the research with informed consent.

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