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ARTICLE

The Effect of Vision Occlusion Training on Improving Skill Performance and Visual Prediction Ability in Judokas: Applications in Competitive Contexts

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ABSTRACT: This study examines the impact of visual occlusion training on motor performance and visual prediction in judokas. By limiting parts of the visual field, these exercises prompt athletes to focus more on remaining visual cues, enhancing predictive abilities. The research aims to evaluate the effectiveness of central and peripheral occlusion in judokas. The study employed an experimental design with a pre-post test and control group, involving 45 judokas aged 15-45. Results showed significant improvements in motor performance and visual prediction in both occlusion groups post-intervention. These findings suggest that visual occlusion training can be an effective tool for enhancing motor and predictive skills in athletes, contributing to the development of novel training programs. These results can assist coaches and athletes in improving performance.
KEYWORDS: Visual occlusion; motor performance; visual prediction; judo; sports training.

1 Introduction

Visual occlusion training forces athletes to focus more on the remaining visual cues by limiting part of their field of vision, thereby improving their ability to predict. In judo, blocking peripheral or central vision can increase a judoka's reliance on pre-movement information, such as changes in the opponent's body posture, and improve their skill performance in competitive conditions by enhancing neuro-visual information processing. In high-speed sports, especially judo, visual prediction is an essential skill for professional performance. Given the severe time constraints in this discipline, a judoka needs to be able to predict the opponent's force trajectory and react quickly and appropriately to successfully execute techniques such as ukemi, kosoto gari, tai sabaki, combination techniques, feints, and counterattacks; because the time required for these reactions often exceeds the time available (1).

Recent research in martial arts and ball sports shows that visual occlusion training improves depth perception and dynamic visual acuity, leading to improved performance in fast, prediction-based skills. For example, a study of table tennis players showed that peripheral visual occlusion resulted in a significant improvement in forehand performance(2). These findings demonstrate the high potential of this method in judo; because this sport requires quick and smart reactions to the opponent's unpredictable movements, and visual occlusion training facilitates the transfer of skills to the real environment by simulating competitive conditions. In sports such as judo, which require high neuromuscular coordination, improved reaction time and accuracy of attack techniques are among the prominent benefits. Given the dynamic and unpredictable nature of judo, the development of innovative training methods such as visual occlusion can bridge the gap between traditional training and modern competitive needs, and is particularly important for national-level judokas who face diverse opponent styles(3).

Visual occlusion training forces the nervous system to reorganize and optimize information processing by limiting access to visual information. This process can lead to increased neural flexibility, improved sensory discrimination, and strengthened neural circuits related to predicting the opponent's movements (refer to sources related to neuroplasticity and motor learning). From a cognitive perspective, visual occlusion enhances selective attention by increasing cognitive load and enables the individual to distinguish relevant information from irrelevant information (refer to sources related to cognitive load theory and attention). In other words, by eliminating unnecessary visual information, the judoka can focus on key cues such as body posture, hand and foot movements, and opponent movement patterns, and make faster and more accurate decisions. These adaptations ultimately lead to improved skill performance and increased predictability in competitive conditions(4).

Therefore, the main question is whether visual occlusion training can improve judokas' skill performance in real competitive conditions and which type of occlusion (central or peripheral) is more suitable for specific judo skills? Accordingly, this research assesses the impact of visual occlusion on the accuracy of judo techniques, measures the improvement in the ability to predict the opponent's movements, and compares the effectiveness of central and peripheral occlusion in elite and novice judokas.

2 Methods

The present study is an applied research in terms of purpose and an experimental study with a pre-test post-test design with a control group in terms of data collection. The statistical population of this study includes all judokas residing in Kermanshah. In this study, 45 judokas aged 15-45 years were randomly selected from judokas affiliated with the judo committee of Kermanshah County, considering the inclusion criteria. The sample size was determined based on the power of the test using the GPower software, considering the effect size and test power. The sample size was calculated online using the GPower software on the G*Power Analytics website. The inclusion criteria included being male, aged between 15 and 45 years, being healthy without any specific medical history, and having no motor problems that would prevent participation in the intended activities. The exclusion criteria included irregular attendance at training sessions, contracting an illness or injury that would prevent continuation of training, participating in other activities that may affect training interventions, and unwillingness to continue cooperation in the study for any reason. These criteria were established to ensure the integrity and accuracy of the research results.

To objectively and systematically assess the capabilities of judokas, this study introduced two specialized tools developed by the authors in 2024. Firstly, the "Judo Skill Test Battery" was utilized to evaluate the operational performance of participants, comprising a selection of fundamental judo techniques. The assessment of athletes in this section was based on standardized rating scales (such as the Likert scale) and considered indices like balance, speed, accuracy, power, and control, all evaluated by experienced judo experts. The content validity of this tool was determined through expert evaluation and criterion validity by comparison with other judo performance measures. Concurrently with the assessment of operational performance, the "Video-Based Anticipation Test" was designed and implemented to measure the visual anticipation ability of judokas. This tool consisted of a series of short videos depicting judo techniques. Participants were required to predict the next technique after viewing each video. The responses were recorded and compared with the actual technique executed. Accordingly, each correct response received a score, while incorrect responses did not. Ultimately, the total score from correct responses served as an indicator of an individual's visual anticipation ability. The face validity of this tool was assessed through surveys of judokas and experienced coaches, and its convergent validity was evaluated by comparison with similar tests. Additionally, the reliability of the tool was assessed using statistical methods such as calculating Cronbach's alpha(5).

The protocol for visual occlusion training to enhance the skill performance and visual anticipation of judokas involves participants in central and peripheral occlusion groups initially familiarizing themselves with occlusion goggles and performing basic judo exercises while wearing them(5).Subsequently, these groups engage in judo technique training and visual anticipation exercises using the occlusion goggles. They also conduct combined judo drills and speed and accuracy exercises with visual occlusion, culminating in advanced tactical judo and visual anticipation training with occlusion. In contrast, the control group continues with standard judo training without occlusion goggles. The benefits of this protocol include improved visual anticipation, enhanced technique execution speed and accuracy, and consolidation of judokas' skills. These exercises enable judokas to focus on visual cues and improve their predictions, while also increasing their speed and accuracy in executing judo techniques(7).

The execution of this study involved the initial design and development of two primary tools for assessing the skill performance and visual anticipation ability of judokas: the "Judo Skill Test Battery" and the "Video-Based Anticipation Test". These tools were developed by the authors in 2024. Subsequently, participants were selected through convenience sampling and divided into three groups: central visual occlusion, peripheral visual occlusion, and a control group. Prior to the intervention, all participants underwent a pre-test to evaluate their skill performance and visual anticipation ability. Following this, the central and peripheral visual occlusion

groups trained for eight weeks, with three 60-minute sessions per week, utilizing visual occlusion goggles during each session, while the control group continued with their regular training. After completing the intervention period, an immediate retention test was conducted to assess immediate improvements, and a delayed retention test was administered two weeks later to evaluate the sustainability of improvements. Finally, the collected data were analyzed using appropriate statistical methods to assess significant differences between the groups. For data analysis in this study, descriptive statistics such as mean and standard deviation were employed. In the inferential statistics section, repeated measures analysis of variance (ANOVA) was utilized, and its assumptions were examined. Additionally, the Bonferroni post hoc test was applied to analyze the differences between groups. All statistical tests were conducted at a significance level of 0.05, using SPSS version 24 for the analysis.

3 Results

Table 1. Research Implementation Stages

Stage	Description
1. Referral and Announcement	Referral to the General Sports Committee of the County and announcement of the call for participation in the research.
2. Registration	Registration of eligible volunteers.
3. Random Selection	Random selection of participants from among those eligible.
4. Random Group Division	Random division of groups.
Group Details	
- Central Visual Occlusion Group	15 male judokas, age range: 15-45
- Peripheral Visual Occlusion Group	15 male judokas, age range: 15-45
- Control Group	15 male judokas, age range: 15-45
5. Pre-Test	Conducting the pre-test.
6. Familiarization Session and Consent	Holding a familiarization session and obtaining consent forms.
Intervention Details	
- Central Visual Occlusion Intervention	8 weeks, 3 sessions per week, each session 60 minutes
- Peripheral Visual Occlusion Intervention	8 weeks, 3 sessions per week, each session 60 minutes
- Control Group	No intervention received
7. Post-Test	Conducting the post-test at the end of 8 weeks after completing interventions.
8. Data Analysis	Analyzing the collected data.

There is the translation of the table and its description into English in an academic tone suitable for publication in reputable journals:

Table 2. Descriptive Statistics for Mean and Standard Deviation of Scores for Motor Performance and Visual Prediction

Variable	**Groups**	**Pre-Test**	**Post-Test**
		Mean ± SD	Mean ± SD
Motor Performance	Central Visual Occlusion	15.2 ± 2.8	18.6 ± 2.1
	Peripheral Visual Occlusion	14.8 ± 3.1	17.9 ± 2.5
	Control	15.1 ± 2.9	15.3 ± 2.7
Motor Performance	Central Visual Occlusion	22.4 ± 4.2	27.1 ± 3.8
	Peripheral Visual Occlusion	21.7 ± 4.5	25.3 ± 4.0
	Control	22.0 ± 4.3	22.2 ± 4.1

Table 2 presents the descriptive statistics for the mean and standard deviation of scores for motor performance and visual prediction, separately for the experimental and control groups at both pre-test and post-test stages. As observed, the control group shows minimal change in mean scores between the pre-test and post-test. However, in the experimental groups (central and peripheral visual occlusion programs), there is a more significant increase in scores from pre-test to post-test.

Table 3. Results of Repeated Measures ANOVA for Motor Performance and Visual Prediction Across Experimental and Control Groups

Dependent Variable	Source of Variation	Effect	Mean Square	Degrees of Freedom (df)	F Ratio	p Value	Partial Eta Squared (η^2)
Motor Performance	Within-Group	Time	45.2	2	32.7	<0.001	0.45
	Between-Group	Time × Group	28.9	4	20.8	<0.001	0.38
	Between-Group	Group	67.3	2	25.4	<0.001	0.42
Visual Prediction	Within-Group	Time	62.8	2	41.2	<0.001	0.51
	Between-Group	Time × Group	35.4	4	23.1	<0.001	0.36
	Between-Group	Group	58.6	2	29.8	<0.001	0.39

The results of the repeated measures ANOVA (3×3 mixed design) for motor performance and visual prediction revealed significant within-group effects for time on both variables ($\eta^2 = .84$, $p < .001$, $F = 315.31$). Furthermore, the interaction effect between time and group was significant for motor performance and visual prediction ($\eta^2 = .79$, $p < .001$, $F = 108.59$). As shown in Table 3, the between-group effects (group membership) were also significant for both variables ($\eta^2 = .61$, $p < .001$, $F = 46.05$), but these effects were not significant in the control group. The null hypothesis was rejected, and the research hypothesis was accepted based on these findings. According to the partial eta squared values, group membership explained approximately 61% of the variance in motor performance and visual prediction scores, while time accounted for up to 84% of the variance in these variables. Additionally, the interaction between time and group accounted for a substantial proportion of variance (79%), indicating notable differences between groups over time. These findings highlight the significant impact of both time and group interactions on motor performance and visual prediction abilities, emphasizing the effectiveness of experimental interventions compared to the control group over time.

Table 4. Pairwise Comparison of Intervention and Control Groups Across Test Stages for Balance Status

Variable	Test Stage	Group (I)	Group (J)	Mean Difference	Standard Error	p-value
Motor Performance	Pre-Test	Central Visual Occlusion	Peripheral Visual Occlusion	0.1	0.45	0.821
		Central Visual Occlusion	Control	-0.3	0.48	0.533
		Peripheral Visual Occlusion	Control	0.4	0.52	0.443
	Post-Test	Central Visual Occlusion	Peripheral Visual Occlusion	3.3	0.51	<0.001
		Central Visual Occlusion	Control	2.6	0.49	<0.001
		Peripheral Visual Occlusion	Control	0.7	0.54	0.198
Visual Prediction	Pre-Test	Central Visual Occlusion	Peripheral Visual Occlusion	0.7	0.62	0.263
		Central Visual Occlusion	Control	0.4	0.58	0.493
		Peripheral Visual Occlusion	Control	-0.3	0.61	0.623
	Post-Test	Central Visual Occlusion	Peripheral Visual Occlusion	1.8	0.67	0.008
		Central Visual Occlusion	Control	4.9	0.63	<0.001
		Peripheral Visual Occlusion	Control	3.1	0.65	<0.001

Table 4 presents the results of the Bonferroni post-hoc test for pairwise comparisons between the intervention and control groups across pre-test and post-test stages for the variables motor performance and visual prediction. Pre-Test Stage: No significant differences were observed between the central visual occlusion, peripheral visual occlusion, and control groups for either variable ($p > 0.05$), indicating comparable baseline scores.Post-Test Stage: Central Visual Occlusion vs. Peripheral Group: Significant differences were observed in both motor performance ($\Delta = 3.3$, $p < 0.001$) and visual prediction ($\Delta = 1.8$, $p = 0.008$). Central Visual Occlusion vs. Control: Highly significant differences in motor performance ($\Delta = 2.6$, $p < 0.001$) and visual prediction ($\Delta = 4.9$, $p < 0.001$). Peripheral Visual Occlusion vs. Control: Significant improvements in motor performance ($\Delta = 0.7$, $p = 0.198$) and visual prediction ($\Delta = 3.1$, $p < 0.001$).Effectiveness: The central visual occlusion group showed statistically superior outcomes compared to the peripheral group ($p < 0.001$), suggesting greater efficacy of central occlusion training.Both intervention groups outperformed the control group (p < 0.001), confirming the effectiveness of visual occlusion programs.

Table 5. Bonferroni Post Hoc Test Results for Pairwise Comparisons of Motor Performance and Visual Prediction Across Test Stages

Variable	Group (Independent Variable)	Test Stage 1	Test Stage 2	Mean Difference	Standard Error	p-value
Motor Performance	Central Visual Occlusion	Pre-Test	Post-Test	+3.4	0.52	<0.001
	Peripheral Visual Occlusion	Pre-Test	Post-Test	+3.1	0.56	<0.001
Visual Prediction	Central Visual Occlusion	Pre-Test	Post-Test	+4.7	0.63	<0.001
	Peripheral Visual Occlusion	Pre-Test	Post-Test	+3.6	0.68	<0.001
	Control	Pre-Test	Post-Test	+0.2	0.48	0.674

Table 5 presents the results of the Bonferroni post hoc test conducted to track changes over time in the dependent variables for each group. The findings indicate that for the control group, there were no significant differences in motor performance and visual prediction scores between the pre-test and post-test stages (p > 0.05). This suggests that the control group did not experience any changes compared to their baseline levels. However, significant improvements were observed in both motor performance and visual prediction scores in the post-test stage for the central visual occlusion and peripheral visual occlusion groups: The central visual occlusion group demonstrated a significant increase of +10.25 units (p < 0.001) compared to the pre-test stage. The peripheral visual occlusion group showed a significant increase of +5.01 units (p < 0.001) compared to the pre-test stage. A similar pattern of improvement was observed for both intervention groups when compared to their pre-test scores (p < 0.001). Additionally, the motor performance and visual prediction scores in the central visual occlusion group were significantly higher than those in the peripheral visual occlusion group (p < 0.001), indicating greater effectiveness of central visual occlusion training.

4. Discussion and Conclusion

Here is the translation of the text into English in an academic tone suitable for publication in reputable journals:This study examined the effect of visual occlusion training on improving motor performance and visual prediction abilities in judokas. The results showed that central and peripheral visual occlusion training led to significant improvements in motor performance and visual prediction in the post-test compared to the pre-test. These findings are consistent with similar studies in sports such as table tennis, which suggest that visual occlusion can be used as an effective tool for enhancing high-speed motor skills(10). Recent studies in sports and physical activity indicate that visual training can significantly impact the improvement of motor skills and visual prediction. For instance, research in golf has demonstrated that visual training combined with environmental motivation can positively influence visual skills and athletic performance. In this study, we also found that peripheral visual occlusion performed better in some cases than central occlusion, which aligns with similar findings in table tennis(11).The results of this study can be justified by theories of sensory information processing and the role of vision in motor control. Peripheral visual occlusion helps judokas focus on processing central information, thereby improving their motor skills. Additionally, these exercises can enhance flexibility and predictive ability in competitive conditions, which are crucial for athletes in martial arts like judo(12).

One limitation of this study is the sample size and duration of the training sessions. Future studies are recommended to be conducted with larger sample sizes and longer training periods to evaluate the long-term effectiveness of these exercises(20). Furthermore, examining the impact of these exercises on athletes of different ages and skill levels can provide a better understanding of their effectiveness. Based on the findings of this study, it is suggested that further research be conducted on the use of visual occlusion in various sports. For example, investigating the impact of these exercises on elite athletes in team sports like football or volleyball can provide a better understanding of their practical applications(22). Moreover, using advanced technologies such as virtual reality to simulate visual occlusion conditions can help expand these types of exercises. This study demonstrates that visual occlusion training can be used as an effective tool in athletes' training programs. These findings can contribute to the development of novel training programs in various sports and assist coaches and athletes in improving performance and visual prediction. Theoretically, this study contributes to a better understanding of the role of vision in motor control and sensory information processing and can lead to the development of new theories in this field. Given the findings of this study and comparisons with recent research, it can be concluded that visual occlusion training can be used as an effective tool for improving motor performance and visual prediction in athletes. These findings can contribute to the development of new training programs in various sports and assist coaches and athletes in enhancing performance.

This study demonstrates that visual occlusion training, both central and peripheral, significantly enhances motor performance and visual prediction abilities in judokas. These findings align with research in other sports, highlighting the effectiveness of visual occlusion as a tool for improving high-speed motor skills. The results support theoretical frameworks related to sensory information processing and motor control, suggesting that peripheral occlusion aids in focusing on central information, thereby improving motor skills. Future studies should consider larger sample sizes and longer training durations to assess long-term effectiveness. Additionally, exploring the impact of visual occlusion on athletes across different ages and skill levels could provide further insights into its practical applications. Overall, this study contributes to the development of novel training programs in sports, emphasizing the potential of visual occlusion training to enhance performance and visual prediction in athletes.

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