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The Role of Visual Motor Coordination in Predicting Forehand Drive Performance among Youth Table Tennis Athletes

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ABSTRACT

Problems: Hand eye coordination is a fundamental component in the performance of table tennis techniques, especially in the execution of forehand drive strokes that demand fast, precise, and stable sensorimotor integration. **Purpose**: This study aims to analyze the relationship between hand-eye coordination and forehand drive stroke accuracy in adolescent athletes who actively participate in table tennis extracurricular activities. **Methods**: The study used a correlational design involving 63 male participants through a total sampling technique. Data was collected through field tests using standardized instruments: eye-hand coordination test and forehand drive precision test. Data analysis includes normality tests as a prerequisite and Pearson correlation tests to test relationships between variables. **Results**: The results of the descriptive analysis showed an average of 21 ± 7 (range 17-28) and forehand drive accuracy of 87 ± 5 (range 73-102). The results of the Pearson correlation test showed a significant positive relationship between eye hand coordination and forehand drive accuracy ($r = 0.687$, $p = .018$), indicating that improved visual-motor coordination ability was associated with improved accuracy of punch techniques. **Conclusion**: These findings confirm the importance of eye-hand coordination exercises in youth table tennis coaching programs to improve the performance of basic techniques. This study provides practical implications for trainers in designing sensorimotor-based exercises and adds to the empirical literature related to the determinants of stroke accuracy in racquet sports.

Keywords: table tennis, hand-eye coordination, precision forehand drive, performance technique, sensorimotor integration.

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Introduction

Table tennis is one of the sports that demands speed, precision, visual-motor coordination, and decision-making skills in a very short time. At the competitive level, a player's technical performance is greatly influenced by the complex interaction between neuromotor factors, motion mechanics, perceptual abilities, and training experience (Sharma et al., 2023). Among these components, hand-eye coordination is one of the fundamental abilities that determine the effectiveness of basic technical movements, including forehand drive which is a core skill in table tennis (Basiri et al., 2020).

Eye-hand coordination describes an individual's ability to integrate visual input with motor responses quickly and accurately. In table tennis, the ball moves at high speed, has a fast-changing trajectory direction, and requires a precise timing response to the shot (Büchler et al., 2022). Therefore, players who have good visual-motor coordination tend to be better able to manage contact timing, direct shots, and produce consistent attack accuracy (Nascimento et al., 2021) (Gao et al., 2025). Various studies in sports science confirm that this ability is an important predictor of the performance of basic techniques in racket sports, including table tennis, badminton, and court tennis (Copaci et al., 2024).

Forehand drive, as one of the most commonly used punching techniques in ball exchange rallies, requires a combination of body position, hip rotation, arm stability, wrist control, as well as accurate reading of the ball's direction (Hassan & Karim, 2021). In the context of adolescent athletes, mastery of this technique is very important because it is the foundation for the development of advanced skills such as topspin, smash, and counter-attack. However, the effectiveness of this punch does not only rely on the technical aspect, but also on the player's coordination skills

(Sukamto et al., 2023) (Liu et al., 2023).

Although important, there are still limited studies that specifically review the relationship between eye-hand coordination and forehand drive accuracy in school-level adolescent athletes. In fact, in this age group, the process of neuromuscular development and motor ability is still in a rapid adaptation phase, so the analysis of the relationship between these two variables becomes relevant for the basis for the development of a more structured exercise program. Thus, this study aims to analyze the relationship between eye-hand coordination and forehand drive stroke accuracy in adolescent male athletes participating in table tennis extracurricular programs at the high school level.

This research is expected to make a theoretical contribution to the sports coaching science literature, as well as provide practical implications for coaches and educational institutions to develop more effective training strategies in developing table tennis technique skills based on neuromotor ability indicators.

Method

This study used a correlational approach to test the relationship between hand-eye coordination and forehand drive stroke accuracy in adolescent athletes. The research was carried out in one of the high schools that has a table tennis extracurricular program. The research subjects consisted of 63 male participants who were actively involved in the extracurricular activities. The sampling technique uses total sampling, so that all populations that meet the inclusion criteria are used as research samples.

Data collection was carried out through field tests using hand eye coordination measurement instruments and forehand drive stroke accuracy tests that have been used in previous studies. All measurement procedures are carried out in a standardized manner with the assistance of trainers to ensure the reliability of the test implementation.

Data analysis is carried out through two main stages. First, the analysis prerequisite test consists of a normality test to ensure that the data distribution meets parametric assumptions. Second, the hypothesis test uses the Pearson correlation test to determine the degree of relationship between the eye-hand coordination variable and the accuracy of forehand drive. The entire statistical analysis is done using statistical software that is commonly used in sports research.

Results

For more clarity about the description of research data, the following will describe the data from each variable.

Table 1. Descriptive statistics of hand eye coordination and forehand drive accuracy

Variabel	N	Mean ± SD	Max	Min
Hand eye coordination	63	21 ± 7	28	17
Forehand drive	63	87 ± 5	102	73

The results of the descriptive analysis showed that the participants' eye-hand coordination (N = 63) had an average score of 21 ± 7, with a score range between 17 to 28, reflecting variations in coordination skills between individuals. Meanwhile, the precision of the forehand drive shows more consistent performance, with an average score of 87 ± 5, a minimum score of 73, and a maximum of 102. In general, these results indicated that the participants' forehand drive technique ability was relatively stable, while eye-hand coordination showed greater variation within the sample group.

Table 2. Correlational analysis result

Variable	r	P value
Hand eye coordination and forehand drive	0.687	0.018

Pearson's correlation analysis showed that there was a significant relationship between eye-eye coordination and forehand drive accuracy. The test results showed a correlation value of r = 0.687, p = .018, which indicated a strong positive relationship between the two variables. These findings suggest that improved eye-hand coordination ability is associated with increased forehand drive stroke accuracy. Thus, visual-motor coordination plays an important role in the performance of the punching technique in table tennis.

Discussion

The findings showed a positive and significant correlation between eye-hand coordination and forehand drive accuracy (r = 0.687; p = 0.018), indicating that the better an athlete's visual-motor coordination skills, the higher the accuracy of his forehand drive strokes. These findings are consistent with the results of previous research. A study

found that eye hand coordination was significantly correlated with the accuracy of fourhand strokes in table tennis players (Haryanto & Becerra-Patiño, 2023). Similarly, a research shows that eye coordination along with wrist flexibility make a significant contribution to the ability to perform forehand shots (Maulana & Hernawan, 2023) (Permadi et al., n.d.).

Theoretically, eye hand coordination allows players to accurately track the ball estimating the trajectory, speed, and point of contact so that hand and racket movements can be optimally adjusted. This combination is important in table tennis, where response times are very short and the margin of error is small (Miall & Reckess, 2002) (Parisot & De Vleeschouwer, 2019). Players with good coordination tend to have more precise hitting timing, stable racket control, and body and arm orientation that supports accuracy (Park & Jeong, 2023) (Anderson, 2022). Therefore, the results of this study support the theoretical framework that neuromotor aspects such as visual-motor coordination are important predictors of technique performance in racquet sports.

In addition, variations in eye hand coordination scores (mean = 21 ± 7) in the sample showed that not all adolescent athletes had the same level of coordination even though they trained in extracurricular programs. This variability can reflect differences in exercise experience, exercise frequency, individual neuromotor development, or even biological factors. This shows the importance of specific coordination training not only technical training, especially in young athletes. Coaches should incorporate elements of coordinated exercises (e.g. ball tracking exercises, reaction exercises, drill hand-eye coordination) into the regular program, so that the results of techniques such as forehand drives can be consistent and accurate.

In addition to correlations, the literature also shows that a combination of aspects such as wrist flexibility, muscle strength, and coordination together determine the effectiveness of a stroke (Shahid et al., 2023) (Facciorusso et al., 2024) for example a shared contribution of wrist flexibility and coordination to table tennis forehand.

This underlines that optimal training should be holistic: it trains strength, flexibility, and visual-motor coordination at the same time.

However, this research has limitations. Because the design is correlational, the relationships found are associative, not causal. That is, although there is a strong correlation, we cannot conclude that improved coordination directly leads to an increase in forehand drive accuracy. In addition, other variables such as muscle strength, flexibility, frequency of exercise, motivation, and psychological aspects are not comprehensively controlled, so they may contribute to performance variations. In addition, the study sample was from only one high school and consisted of male athletes, this limited the generalization of results to a wider population (e.g. female athletes, non-school clubs, different ages).

Therefore, follow-up research is recommended using experimental or longitudinal designs, expanding the population (including women's players, various clubs, wider age ranges), and considering additional control variables such as muscle strength, flexibility, frequency of exercise, as well as psychological or cognitive variables such as concentration, reaction response, and playing experience.

Conclusion

This study found that there was a positive and significant relationship between hand-eye coordination and forehand drive accuracy in table tennis teen athletes. These findings suggest that the hand's eye coordination ability contributes significantly to the quality of basic punch techniques such as forehand drives. Therefore, table tennis coaches and coaching programs should integrate hand-eye coordination exercises into the training curriculum to improve the accuracy and consistency of player performance. Further research can expand the sample, use experimental or longitudinal designs, and include other variables such as muscle strength, flexibility, reaction speed, and psychological aspects to make understanding of performance determinants more comprehensive.

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