



## The Relationship Between Hand Reaction Speed And Hand-Eye Coordination On Forehand Stroke Accuracy In Table Tennis Players At PTM Garuda Satria Club Central Lampung

Fajar Kurniawan<sup>1A-E\*</sup>, Marta Dinata<sup>2B-D</sup>, Muhammad Fajril Rifaldo<sup>3B-D</sup>, Surisman<sup>4B-D</sup>

<sup>1,2,3,4</sup> Universitas Lampung, Lampung, Indonesia

[fajarkurniawan170204@gmail.com](mailto:fajarkurniawan170204@gmail.com)<sup>1\*</sup>, [mdinata356@gmail.com](mailto:mdinata356@gmail.com)<sup>2</sup>, [mfajrilrifaldo@fkip.unila.ac.id](mailto:mfajrilrifaldo@fkip.unila.ac.id)<sup>3</sup>,  
[surisman1962@fkip.unila.ac.id](mailto:surisman1962@fkip.unila.ac.id)<sup>4</sup>

### ABSTRACT

Table tennis is a high-speed open-skill sport that requires rapid reaction time and precise coordination to achieve accurate stroke performance. Forehand stroke accuracy plays a crucial role in scoring and maintaining game control, yet it is influenced by multiple perceptual-motor factors. This study aimed to determine the relationship between hand reaction speed and hand-eye coordination on forehand stroke accuracy among table tennis players at PTM Garuda Satria Club, Central Lampung. This research employed a quantitative correlational design using a survey method with test and measurement techniques. The population consisted of all active players at PTM Garuda Satria, with 25 male athletes selected through purposive sampling. Instruments included the Whole-Body Reaction Test to measure hand reaction speed, the Wall Toss Test to assess hand-eye coordination, and a forehand stroke accuracy test to evaluate target precision. Data were analyzed using Pearson product-moment correlation and multiple correlation analysis at a significance level of 0.05. The results indicated: (1) a very strong and significant negative relationship between hand reaction speed and forehand stroke accuracy ( $r = -0.919$ ;  $p = 0.000 < 0.05$ ), (2) a very strong and significant positive relationship between hand-eye coordination and forehand stroke accuracy ( $r = 0.878$ ;  $p = 0.000 < 0.05$ ), and (3) a very strong and significant simultaneous relationship between hand reaction speed and hand-eye coordination with forehand stroke accuracy ( $R = 0.928$ ;  $p = 0.000 < 0.05$ ). These findings confirm that perceptual-motor integration plays a dominant role in optimizing forehand performance in table tennis.

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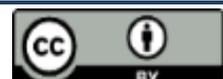
### AUTHORS' CONTRIBUTION

- Conception and design of the study;
- Acquisition of data;
- Analysis and interpretation of data;
- Manuscript preparation;
- Obtaining funding

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### INTRODUCTION

Sport is not merely a medium for physical fitness development, but also a systematic effort to cultivate discipline, emotional control, resilience, and competitive character. Within the Indonesian context, sport education and achievement programs emphasize the integration of physical, cognitive, and psychosocial dimensions in athlete development



(Giriwijoyo & Sidik, 2017). In competitive environments, performance outcomes are determined by the interaction between technical mastery and specific physical capacities. Athletes who possess refined technique but lack supporting biomotor components often fail to achieve optimal performance under competitive pressure.

Table tennis is characterized by high ball velocity, short rally time, minimal reaction windows, and the need for precise directional control. Research in sport biomechanics and motor control indicates that rally exchanges in table tennis may occur within milliseconds, requiring rapid perceptual processing and neuromuscular response (Faber et al., 2019; Kondric et al., 2020). The forehand stroke represents the most dominant attacking technique and serves as a primary determinant of rally control and scoring opportunities. However, technical execution alone does not guarantee success. Forehand stroke accuracy defined as the ability to direct the ball toward a specific target area consistently is influenced by reaction speed and hand-eye coordination efficiency.

Preliminary observations at PTM Garuda Satria Club, Central Lampung, revealed a discrepancy between technical proficiency and scoring effectiveness. Although players demonstrated adequate mechanical form, errors frequently occurred in forehand placement. Balls often missed the intended target, struck the net, or landed outside the table boundaries. This pattern suggests suboptimal integration of perceptual reaction and coordinative control rather than purely technical deficiencies. From a motor learning perspective, this gap reflects incomplete synchronization between stimulus recognition, neural processing, and motor execution (Schmidt & Lee, 2019). Thus, the central problem addressed in this study concerns whether hand reaction speed and hand-eye coordination significantly relate to forehand stroke accuracy among table tennis players at PTM Garuda Satria Club. Understanding this relationship is critical for evidence-based training design and athlete performance optimization.

Recent sport science literature increasingly emphasizes perceptual-motor integration in open-skill sports. Reaction speed has been identified as a key determinant of performance in high-tempo sports such as badminton, tennis, fencing, and table tennis (Williams & Ford, 2018; Zwierko et al., 2021). Reaction time reflects the interval between stimulus presentation and motor response initiation, representing the efficiency of sensory processing and neuromuscular activation. Studies within the last decade demonstrate that faster reaction speed is associated with improved decision-making and stroke timing in racket sports (Huys et al., 2018; Yarrow et al., 2020). In table tennis specifically, elite athletes exhibit shorter visuomotor response latency compared to sub-elite players (Faber et al., 2019). This difference contributes to earlier ball interception and more stable stroke mechanics.

Hand-eye coordination, meanwhile, refers to the ability to synchronize visual perception with fine motor output. It plays a decisive role in ball sports requiring precise timing and spatial judgment (Magill & Anderson, 2021). Empirical findings suggest that coordination ability predicts skill consistency in sports such as baseball, cricket, and tennis (Sakamoto et al., 2020; Serrien & Baeyens, 2017). In table tennis, improved coordination correlates with enhanced ball placement accuracy and reduced unforced errors (Kondric et al., 2020).

Several Indonesian studies indexed in SINTA have examined physical factors influencing table tennis performance, including arm power, agility, and flexibility. However, most focus on isolated biomotor components rather than integrated perceptual-motor variables. International Scopus-indexed studies similarly tend to emphasize biomechanical analysis of stroke mechanics or physiological demands rather than correlational relationships between reaction speed, coordination, and shot accuracy simultaneously.

Furthermore, sport neuroscience research highlights that successful performance in fast ball sports depends on anticipatory skill, visual tracking efficiency, and motor synchronization (Voss et al., 2018; Mann et al., 2019). These findings reinforce the conceptual assumption that reaction speed and hand-eye coordination jointly influence stroke accuracy. Nevertheless, despite strong theoretical grounding, empirical studies directly examining the simultaneous relationship of both variables on forehand accuracy particularly within developing athlete populations remain limited.

Although numerous studies confirm that reaction speed contributes to performance in racket sports, few explicitly connect hand reaction speed with measurable forehand stroke accuracy in competitive table tennis settings. Most prior investigations either: Examine reaction time as an independent predictor of general performance level; Analyze coordination training effects without quantifying stroke accuracy outcomes; or Focus on biomechanical variables such as angular velocity, joint torque, and kinematic sequencing.

This creates a conceptual and methodological gap. First, the interaction between perceptual reaction and coordinative integration has rarely been examined simultaneously within a correlational framework. Second, limited research has been conducted in Indonesian club-level contexts, where training infrastructure and athlete development models may differ from elite international settings. Third, empirical data linking these variables to forehand-specific accuracy (rather than general skill score) are scarce. From a practical standpoint, coaches frequently design training programs emphasizing repetition and power development while underestimating perceptual-motor training components. Without scientific evidence clarifying the magnitude of these relationships, training interventions may remain inefficient or misdirected. Therefore, this study addresses a dual gap: (1) a theoretical gap concerning integrated perceptual-motor determinants of forehand accuracy; and (2) an empirical gap concerning Indonesian club-level table tennis athletes.

The primary objective of this study is to determine: The relationship between hand reaction speed and forehand stroke accuracy; The relationship between hand-eye coordination and forehand stroke accuracy; The simultaneous contribution of hand reaction speed and hand-eye coordination to forehand stroke accuracy among players at PTM Garuda Satria Club, Central Lampung. The novelty of this research lies in its integrative analytical approach. Unlike previous studies that isolate physical or technical components, this study examines two perceptual-motor variables concurrently and links them directly to a measurable performance outcome forehand stroke accuracy. The study also provides localized empirical evidence within the Indonesian athlete development context, contributing to SINTA-indexed literature and enriching the global Scopus discourse on perceptual-motor determinants in racket sports. Conceptually, this research strengthens

the theoretical framework of motor control in open-skill sports by empirically validating the interaction between reaction speed and coordination as predictors of skill accuracy. Practically, it offers coaches data-driven justification for incorporating reaction-based drills and coordination training into structured forehand development programs.

In competitive table tennis, technical proficiency alone is insufficient to guarantee scoring effectiveness. Forehand stroke accuracy emerges from a complex integration of rapid perceptual processing, neuromuscular reaction, and coordinated motor execution. While prior research highlights the importance of reaction time and coordination independently, limited studies examine their simultaneous relationship with stroke accuracy—particularly within Indonesian club athletes. By investigating the relationship between hand reaction speed, hand-eye coordination, and forehand stroke accuracy at PTM Garuda Satria Club, this study contributes both theoretical advancement and practical training implications. The findings are expected to provide an empirical foundation for optimizing perceptual-motor training strategies and improving competitive performance in table tennis.

## **METHODS**

### **Research Design**

This study employed a descriptive quantitative approach with a correlational survey design. A quantitative framework was selected because the research variables were measured numerically and analyzed using statistical procedures to objectively test the proposed relationships (Sugiyono, 2019). The descriptive nature of the design aimed to portray the existing condition of hand reaction speed, hand-eye coordination, and forehand stroke accuracy without experimental manipulation. Correlational research is appropriate when the objective is to determine the degree and direction of association between independent and dependent variables without providing treatment (Arikunto, 2013). Recent sport science research supports correlational modeling in examining perceptual-motor determinants of performance (Faber et al., 2019; Kondric et al., 2020; Zwierko et al., 2021). This design aligns with contemporary analytical approaches used in racket sport performance studies (Mann et al., 2019; Sakamoto et al., 2020). The conceptual research model is presented in Table 1.

### **Population and Sample**

The population consisted of all active table tennis athletes at PTM Garuda Satria Club, Central Lampung. The sampling technique used purposive sampling, selecting participants based on predetermined inclusion criteria (Sugiyono, 2019). The criteria were: (1) active club membership, (2) male athletes aged 18–25 years, and (3) willingness to participate voluntarily.

Based on these criteria, 25 athletes were selected as the research sample. A sample size under 50 participants remains acceptable in correlational sport science studies when statistical assumptions are satisfied (Hopkins et al., 2016). The selected age range represents a developmental stage characterized by optimal neuromuscular responsiveness and coordination capacity (Williams & Ford, 2018).

## Research Instruments

Three standardized test instruments were employed to ensure construct validity and empirical relevance.

### Hand Reaction Speed (X1)

Reaction speed was measured using the Whole-Body Reaction Test, adapted to emphasize upper-limb response to visual stimuli. Reaction time reflects visuomotor processing efficiency and neuromuscular activation latency (Voss et al., 2018; Yarrow et al., 2020). The test recorded response time in milliseconds, with lower scores indicating faster reaction speed.

### Hand-Eye Coordination (X2)

Coordination was assessed using the Wall Toss Test, in which participants threw and caught a tennis ball against a target wall within a fixed time interval. This test has been widely used to evaluate perceptual-motor synchronization (Serrien & Baeyens, 2017; Sakamoto et al., 2020). The total number of successful catches represented coordination performance.

### Forehand Stroke Accuracy (Y)

Forehand accuracy was measured using a structured forehand target test developed based on biomechanical principles of stroke precision (Kondric et al., 2020). Athletes executed a series of forehand strokes directed toward marked target zones on the opponent's table. Each successful placement was scored, and total points represented accuracy level.

## Data Collection Procedure

Data collection was conducted in one testing session under standardized environmental conditions. Athletes completed a warm-up prior to testing to minimize injury risk and ensure neuromuscular readiness (Magill & Anderson, 2021). Testing order was randomized to reduce fatigue bias. Each participant performed: Reaction speed test (3 trials, best score recorded), Coordination test (1 timed session), Forehand accuracy test (20 structured strokes). This structured testing protocol aligns with sport performance assessment standards (Hopkins et al., 2016; Mann et al., 2019).

## Data Analysis Techniques

Descriptive statistics were used to determine mean, standard deviation, minimum, and maximum values for each variable. Assumption testing included:

1. Normality Test; Shapiro-Wilk test, suitable for samples  $< 50$  ( $p > 0.05$  indicates normal distribution).
2. Linearity Test; To confirm linear relationships between predictor and criterion variables.
3. Homogeneity Test; Levene's test to ensure variance equality.

Hypothesis testing employed Pearson Product Moment correlation to determine the direction and strength of relationships between X1-Y and X2-Y. Multiple correlation analysis was conducted to evaluate the combined contribution of X1 and X2 toward Y. The strength of correlation coefficients followed established interpretation guidelines

(Sugiyono, 2019). Statistical analysis was conducted using SPSS version 26 with a significance level of  $\alpha = 0.05$ .

**Table 1.**  
 Interpretation of Correlation Coefficients

Correlation Coefficient Interval	Interpretation of Relationships
0,00 - 0,19	Very weak
0,20 - 0,39	Weak
0,40 - 0,59	Medium
0,60 - 0,79	Strong
0,80 - 1,00	Very powerful

## RESULTS AND DISCUSSION

### Result

#### Descriptive Analysis

The data analyzed in this study were obtained from 25 table tennis players at PTM Garuda Satria Club, Central Lampung. The variables examined included hand reaction speed (X1), hand-eye coordination (X2), and forehand stroke accuracy (Y). Descriptive statistics were calculated to provide an overview of central tendency and data dispersion.

**Table 3.**  
 Descriptive Statistics

Statistics	Hand Reaction Speed (sec) (X1)	Eye-Hand Coordination (X2)	Forehand Stroke Accuracy (Y)
N	25	25	25
Mean	0.193	21.04	63.88
Median	0.194	21.00	64.00
Mode	0.207	22	64
Std. Deviation	0.013	2.475	9.130
Minimum	0.161	17	49
Maximum	0.213	27	81

The average hand reaction speed was 0.193 seconds, indicating relatively fast response latency among players. The mean score of hand-eye coordination was 21.04 successful catches, while the average forehand stroke accuracy score reached 63.88 points, suggesting moderate-to-good accuracy performance.

#### Hand Reaction Speed Distribution

**Table 4.**  
 Hand Reaction Speed Frequency Distribution

No	Category	Frequency (f)	Percentage (%)
1	Very Good	0	0%
2	Good	18	72%
3	Enough	7	28%
4	Less	0	0%
5	Very Less	0	0%
<b>Total</b>		<b>25</b>	<b>100%</b>

Most athletes (72%) were categorized as "Good," indicating that reaction speed is generally well-developed within the club.

## Eye-Hand Coordination Distribution

**Table 5.**

Eye-Hand Coordination Frequency Distribution

No	Category	Frequency (f)	Percentage (%)
1	Very Good	0	0%
2	Good	0	0%
3	Enough	17	68%
4	Less	8	32%
5	Very Less	0	0%
<b>Total</b>		<b>25</b>	<b>100%</b>

The majority (68%) fell within the "Enough" category, indicating that coordination ability remains an area for performance improvement.

## Forehand Stroke Accuracy Distribution

**Table 6.**

Forehand Stroke Accuracy Frequency Distribution

No	Category	Frequency (f)	Percentage (%)
1	Very Good	2	8%
2	Good	15	60%
3	Enough	8	32%
4	Less	0	0%
5	Very Less	0	0%
<b>Total</b>		<b>25</b>	<b>100%</b>

Most players (60%) demonstrated good forehand accuracy, though variability suggests influence from perceptual-motor factors.

## Normality Test

The Shapiro-Wilk test was applied because the sample size was less than 50.

**Table 7.**

Normality Test Results

Variable	Sig. (p)	$\alpha$	Remark
Hand Reaction Speed (X1)	0.482	0.05	Normal
Eye-Hand Coordination (X2)	0.345	0.05	Normal
Forehand Stroke Accuracy (Y)	0.247	0.05	Normal

All variables showed  $p > 0.05$ , indicating normally distributed data.

## Linearity Test

**Table 8.**

Linearity Test Results

Variable Relationship	Deviation from Linearity (Sig.)	$\alpha$	Remark
Reaction Speed - Accuracy	0.279	0.05	Linear
Coordination - Accuracy	0.673	0.05	Linear

Because all significance values were greater than 0.05, the relationships were confirmed to be linear.

## Homogeneity Test

**Table 9.**

Homogeneity Test Results

Variable	Sig. (p)	$\alpha$	Remark
Reaction Speed - Accuracy	0.116	0.05	Homogeneous
Coordination - Accuracy	0.273	0.05	Homogeneous

The data met homogeneity assumptions ( $p > 0.05$ ).

## Pearson Correlation Test

**Table 10.**  
 Pearson Correlation Results

Variable Relationship	r	Sig.	Interpretation
Reaction Speed – Accuracy	-0.919	0.000	Significant (Very Strong, Negative)
Coordination – Accuracy	0.878	0.000	Significant (Very Strong, Positive)

The negative correlation (-0.919) indicates that lower reaction time (faster reaction) is associated with higher forehand accuracy. The positive correlation (0.878) shows that better coordination corresponds to higher accuracy. Both relationships are statistically significant ( $p < 0.01$ ).

## Multiple Correlation Test

**Table 11.**  
 Multiple Correlation Results

Variables	R	R <sup>2</sup>	F-value	Sig.
X1 & X2 → Y	0.928	0.861	68.219	0.000

The multiple correlation coefficient ( $R = 0.928$ ) indicates a very strong combined relationship. The coefficient of determination ( $R^2 = 0.861$ ) shows that 86.1% of the variance in forehand stroke accuracy is explained jointly by hand reaction speed and hand-eye coordination. Since  $F_{\text{calculated}} (68.219) > F_{\text{table}} (3.44)$  and  $p < 0.05$ , the simultaneous relationship is statistically significant.

## Summary of Findings

1. Hand reaction speed has a very strong and significant negative correlation with forehand stroke accuracy.
2. Hand-eye coordination has a very strong and significant positive correlation with forehand stroke accuracy.
3. Both variables simultaneously contribute significantly (86.1%) to forehand stroke accuracy.

These findings empirically confirm that perceptual-motor components play a dominant role in determining technical precision in competitive table tennis performance.

## Discussion

The findings of this study demonstrate that hand reaction speed has a very strong and significant relationship with forehand stroke accuracy among table tennis players at PTM Garuda Satria Club, Central Lampung ( $r = -0.919$ ;  $p < 0.05$ ). The negative correlation coefficient indicates an inverse relationship, meaning that the faster the player's reaction time (lower reaction score), the higher the level of forehand stroke accuracy achieved. This result confirms that perceptual-motor speed is a decisive determinant in open-skill sports, particularly in fast racket games such as table tennis.

From a motor control perspective, reaction speed reflects the efficiency of stimulus identification, central processing, and neuromuscular activation (Schmidt & Lee, 2019). In table tennis, where ball travel time is extremely short, players must process visual information rapidly and initiate a motor response within milliseconds (Faber et al., 2019;

Kondric et al., 2020). Faster reaction speed enables earlier preparation of stroke mechanics, more stable body positioning, and optimal timing of ball contact. According to Mann et al. (2019) and Voss et al. (2018), elite athletes exhibit superior visuomotor processing speed, which directly contributes to higher technical precision under time constraints.

Empirical studies over the last decade consistently reinforce this mechanism. Zwierko et al. (2021) reported that reaction time significantly predicts stroke success in high-speed racket sports. Similarly, Yarrow et al. (2020) emphasized that rapid sensorimotor integration improves anticipatory timing and reduces execution error. These findings align with the present study's evidence that reaction speed is not merely a supportive biomotor component but a core determinant of shot accuracy.

The second major finding shows that hand-eye coordination also has a very strong and significant relationship with forehand stroke accuracy ( $r = 0.878$ ;  $p < 0.05$ ). The positive coefficient indicates that better coordination corresponds with improved shot precision. Hand-eye coordination refers to the harmonious integration of visual perception and motor execution (Magill & Anderson, 2021). In table tennis, players must visually track ball trajectory, estimate speed and spin, and synchronize arm movement with predicted ball position.

Research in perceptual-motor performance highlights that coordination skill enhances movement consistency and spatial accuracy (Serrien & Baeyens, 2017; Sakamoto et al., 2020). Athletes with superior coordination can maintain stable racket angle, adjust force application, and control ball placement more precisely. Kondric et al. (2020) further explain that stroke accuracy is influenced by the alignment between visual tracking and fine motor control, particularly during high-tempo rallies.

The present findings are also consistent with several Indonesian SINTA-indexed studies. Research conducted by Fadhillah et al. (2025) found a significant relationship between hand-eye coordination and forehand sidespin service ability among PTM Kurai Taji athletes. Their findings support the notion that coordination plays a substantial role in stroke precision, particularly in complex spin-based techniques. Similarly, Qomarullah's study on tennis service performance reported a strong correlation between reaction speed and service accuracy, though coordination showed a lower correlation in that context. Compared to Qomarullah's findings, the present study demonstrates a stronger coordination effect, likely due to the faster rally tempo and shorter response window characteristic of table tennis compared to court tennis.

The multiple correlation analysis further strengthens the theoretical framework. The simultaneous relationship between hand reaction speed and hand-eye coordination with forehand accuracy yielded  $R = 0.928$  ( $p < 0.05$ ), categorized as very strong. The coefficient of determination ( $R^2 = 0.861$ ) indicates that 86.1% of the variance in forehand stroke accuracy can be explained collectively by these two variables. This substantial explanatory power confirms that stroke accuracy is predominantly influenced by integrated perceptual-motor abilities rather than isolated physical strength alone.

Modern sport science increasingly emphasizes integrated performance models. Williams and Ford (2018) argue that expertise in dynamic sports results from the interaction

of perception, cognition, and motor execution. Hopkins et al. (2016) similarly emphasize that performance variance in skill-dominant sports is largely explained by coordination and reaction variables rather than anthropometric factors. The present study empirically supports this theoretical standpoint.

The remaining 13.9% of unexplained variance suggests the involvement of other factors such as arm muscle strength, stroke biomechanics, playing experience, and psychological control. Bompaa and Buzzichelli (2019) highlight that technical accuracy also depends on muscular endurance and strength stability. Meanwhile, psychological readiness, including focus and emotional regulation, influences decision-making quality during rallies (Gucciardi et al., 2017; Laborde et al., 2018). Experience level may also enhance anticipatory ability and spatial prediction (Mann et al., 2019).

From a biomechanical viewpoint, reaction speed affects temporal synchronization, while coordination affects spatial precision. Reaction speed determines *when* the stroke is executed; coordination determines *how accurately* it is directed. The synergy between these two abilities creates optimal timing and placement. According to motor learning theory, effective skill execution depends on temporal accuracy (timing control) and spatial accuracy (movement control) simultaneously (Schmidt & Lee, 2019). Therefore, training programs that isolate one component may produce suboptimal results.

The field observations at PTM Garuda Satria Club support this interpretation. Although players displayed acceptable technique mechanics, errors frequently occurred during fast exchanges. This indicates that technique rehearsal alone is insufficient without integrating reaction-based drills and coordination training. Contemporary training approaches in racket sports incorporate light stimulus systems, random ball-feeding drills, and visual tracking exercises to enhance perceptual speed (Zwierko et al., 2021; Faber et al., 2019).

The findings also contribute theoretically to the open-skill performance model. Open-skill sports require constant environmental adaptation, making perceptual-motor variables highly influential (Magill & Anderson, 2021). In table tennis, ball speed, spin variation, and opponent unpredictability demand rapid adaptation. Therefore, athletes with faster reaction time and superior coordination demonstrate more stable technical output under dynamic conditions. In the Indonesian context, this research fills an empirical gap by quantifying the simultaneous contribution of reaction speed and coordination to forehand accuracy. Most previous local studies examined single physical components such as wrist flexibility or arm power. The present study integrates perceptual and coordinative dimensions within a unified correlational model, providing stronger explanatory evidence.

Practically, these findings suggest that coaches should design structured training programs incorporating reaction drills (e.g., visual stimulus response training, unpredictable ball feeds) and coordination exercises (e.g., wall toss drills, multi-ball tracking). Integrative training may enhance forehand precision more effectively than repetition-based practice alone. Such recommendations align with contemporary periodization principles emphasizing neuromotor specificity (Bompaa & Buzzichelli, 2019). In conclusion, this study confirms that forehand stroke accuracy in table tennis is strongly influenced by hand reaction speed and hand-eye coordination, both independently and simultaneously. The

very strong combined correlation ( $R = 0.928$ ) highlights the dominant role of perceptual-motor integration in determining technical precision. These findings reinforce modern sport science perspectives that performance accuracy in high-speed racket sports emerges from synchronized temporal and spatial control mechanisms. Consequently, systematic development of reaction speed and coordination should become a central component of table tennis training programs to optimize competitive performance.

## CONCLUSION

Based on the results of statistical analysis and discussion, it can be concluded that hand reaction speed and hand-eye coordination have a very strong and significant relationship with forehand stroke accuracy among table tennis players at PTM Garuda Satria Club, Central Lampung.

First, hand reaction speed showed a very strong negative correlation with forehand stroke accuracy ( $r = -0.919$ ;  $p < 0.05$ ). The negative direction indicates that the faster the player's reaction time (lower reaction score), the higher the accuracy of the forehand stroke. This finding confirms that rapid stimulus-response processing plays a crucial role in determining precise stroke execution in high-speed table tennis rallies.

Second, hand-eye coordination demonstrated a very strong positive correlation with forehand stroke accuracy ( $r = 0.878$ ;  $p < 0.05$ ). This means that players with better coordination between visual tracking and hand movement tend to achieve higher accuracy in directing the ball to target areas.

Third, simultaneously, hand reaction speed and hand-eye coordination produced a very strong multiple correlation ( $R = 0.928$ ;  $p < 0.05$ ), with a coefficient of determination ( $R^2$ ) of 0.861. This indicates that 86.1% of the variance in forehand stroke accuracy is explained by the combined contribution of both variables. Thus, perceptual-motor integration is a dominant factor in optimizing forehand performance.

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## REFERENCES

- Aramde, M. (2021). Kontribusi Kecepatan Reaksi dan Koordinasi Terhadap Keterampilan Pukulan Tenis Meja. *Jurnal Ilmu Keolahragaan Indonesia*, 5(2), 77-85.
- Arba'1, B. M., Damrah., Welis, W., Wahyuri, A. S., Putra, T. N., Sandy, B. (2022). Pengaruh Power Otot Tungkai, Kecepatan Reaksi, dan Koordinasi Mata Tangan Kaki Terhadap Kemampuan Lari 100 Meter. *Jurnal Kejaora*, 7(2).  
<https://doi.org/10.36526/kejaora.v7i2.2194>
- Arikunto, S. (2013). *Prosedur Penelitian: Suatu Pendekatan Praktik*. Jakarta: Rineka Cipta.
- Azriqiansyah, M. & Zulkifli. (2025). Kontribusi power Otot Lengan dan Koordinasi Mata Tangan Terhadap Kemampuan Smash Tenis Meja Ekstrakurikuler Siswa SMP Muhammadiyah 2 Pekanbaru. *JOLEH: Journal of Sport Education and Humanity*, 1(1), 15-22. <https://andeslubspublisher.com/joleh>
- Azzahratur, R. F., Sulistianta, H., Rifaldo, M. F., & Siswoyo, J. (2025). Model Latihan Kecepatan (Speed) Futsal Pada Ekstrakurikuler SMA Negeri 6 Bandar Lampung. *Jurnal Ilmiah PGSD FKIP Universitas Mandiri*, 11(4).
- Bompa, T. O., & Buzzichelli, C. (2019). *Periodization: Theory and methodology of training* (6th ed.). Human Kinetics. <https://us.humankinetics.com/products/periodization-6th-edition>
- Faber, I. R., Elferink-Gemser, M. T., & Nijhuis-Van der Sanden, M. W. G. (2019). A comparison of perceptual-motor skills between elite and sub-elite youth table tennis players. *Journal of Sports Sciences*, 37(6), 679-686.  
<https://doi.org/10.1080/02640414.2018.1527945>
- Fadhilah, M. A., Jonni., Firdaus, K., Sari, D. S. (2025). Hubungan Kelentukan Pergelangan Tangan dan Koordinasi Mata Tangan Dengan Kemampuan Servis Forehand sidespin Atlet Tenis Meja Persatuan Tenis Meja PTM Kurai Taji Kota Pariaman. *Jurnal JPDO*, 8(1), 70. <https://doi.org/10.24036/JPDO.8.1.2025.70>
- Firmansyah, D. E. (2022). Teknik Pengambilan Sampel Umum dalam Metodologi Penelitian: Literature Review. *Jurnal Ilmiah Pendidikan Holistik (JIPH)*.  
<https://doi.org/10.55927/jiph.v1i2.937>
- Kurdi & Qomarrullah, R. (2020). Hubungan Kecepatan Reaksi Tangan dan Koordinasi Mata Tangan Pada Servis Tenis Lapangan Mahasiswa Universitas Cendrawasih. *JTIKOR*, 5(1), 22-27. <https://ejournal.upi.edu/index.php/JTIKOR>
- Gucciardi, D. F., Hanton, S., & Fleming, S. (2017). Are mental toughness and mental health contradictory concepts in elite sport? *Journal of Science and Medicine in Sport*, 20(3), 307-311. <https://doi.org/10.1016/j.jsams.2016.08.009>

- Hopkins, W. G., Marshall, S. W., Batterham, A. M., & Hanin, J. (2016). Progressive statistics for studies in sports medicine and exercise science. *Medicine & Science in Sports & Exercise*, 48(6), 1137–1144. <https://doi.org/10.1249/MSS.0000000000000912>
- Kondric, M., Zagatto, A. M., & Sekulic, D. (2020). The physiological demands of table tennis: A review. *Journal of Human Kinetics*, 75, 21–37. <https://doi.org/10.2478/hukin-2020-0035>
- Kurniawan, R., & Rangkuti, Y. afriandy. (2020). Hubungan koordinasi mata- tangan dengan ketepatan pukulan fourhand tenis meja mahasiswa pko fik unimed. *Journal Physical Health Recreation*. <https://doi.org/10.55081/jphr.v1i1.247>
- Laborde, S., Dosseville, F., & Allen, M. S. (2018). Emotional intelligence in sport and exercise: A systematic review. *Scandinavian Journal of Medicine & Science in Sports*, 26(8), 862–874. <https://doi.org/10.1111/sms.12510>
- Mann, D. L., Savelsbergh, G. J. P., & Ward, P. (2019). Perceptual-cognitive expertise in sport: A meta-analysis. *Journal of Sport and Exercise Psychology*, 41(4), 243–257. <https://doi.org/10.1123/jsep.2018-0317>
- Magill, R. A., & Anderson, D. I. (2021). *Motor learning and control: Concepts and applications* (12th ed.). McGraw-Hill Education. <https://www.mheducation.com>
- Nasution, U., Ahady, M. Y., Pratiwi, V., Albanjari, F. Z., Tarigan, E. S. B., & Siregar, X. T. B. (2024). Smash Skills In Table Tennis Games. *Pendidikan Amarta*. <https://doi.org/10.57235/qistina.v3i1.2376>
- Sakamoto, K., Goto, H., & Nakazawa, K. (2020). Visual-motor coordination and performance consistency in racket sports athletes. *Human Movement Science*, 69, 102561. <https://doi.org/10.1016/j.humov.2019.102561>
- Schmidt, R. A., & Lee, T. D. (2019). *Motor control and learning: A behavioral emphasis* (6th ed.). Human Kinetics. <https://us.humankinetics.com>
- Serrien, D. J., & Baeyens, J. P. (2017). Coordination and control in sports performance: Neural mechanisms and behavioral implications. *Frontiers in Psychology*, 8, 1285. <https://doi.org/10.3389/fpsyg.2017.01285>
- Sihombing, G. O. G., Dewi, R. K., & Nurkadri, N. (2024). UNIMED Court Tennis Community Forehand Drive Capability Review. *Education Sports*. <https://doi.org/10.31599/4c36xp29>.
- Tomoliyus, T., & Sunardianta, R. (2020). Validitas dan relianilitas instruemn tes reactive agility tenis meja. *Jurnal Keolahragaan*, 8(2), 148 – 157.
- Umam, I. (2022). Pengaruh Latihan Multiball Tenis Meja Terhadap Kemampuan Ketepatan Pukulan Forehand dan Backhand pada Siswa Kelas VI-C SD Negeri 24 Banda Aceh. Universitas Bina Bangsa Getsempena.
- Voss, M. W., Kramer, A. F., Basak, C., Prakash, R. S., & Roberts, B. (2018). Are expert athletes “expert” in the cognitive laboratory? *Journal of Applied Sport Psychology*, 30(2), 195–213. <https://doi.org/10.1080/10413200.2017.1367034>
- Williams, A. M., & Ford, P. R. (2018). Expertise and expert performance in sport. *International Review of Sport and Exercise Psychology*, 11(1), 1–27. <https://doi.org/10.1080/1750984X.2017.1287009>

- Wood, R.J. (2015). Tes Lempar Dinding Tangkap Alternatif. Diakses pada 10 November 2025, dari <https://www-topensports-com>.
- Yarrow, K., Brown, P., & Krakauer, J. W. (2020). Inside the brain of an elite athlete: The neural processes that support high-level performance. *Nature Reviews Neuroscience*, 21(10), 585–596. <https://doi.org/10.1038/s41583-020-00343-7>
- Yunus, Y., Hudain, M. A., & Samsia, S. (2023). Hubungan kekuatan otot lengan dan kecepatan reaksi tangan terhadap kemampuan pukulan forehand dalam permainan tenis meja. *SportEdu Journal*.
- Zwierko, T., Lesiakowski, P., & Struzik, A. (2021). Visual reaction time and coordination in elite racket sports athletes. *International Journal of Environmental Research and Public Health*, 18(7), 3565. <https://doi.org/10.3390/ijerph18073565>