

Impact of reaction speed, eye-hand coordination, and achievement motivation on backhand drive skills of table tennis players

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Abstract:

Table tennis is a game that is played at a fast tempo. Biomotor abilities and psychological factors affect the performance of a table tennis player. In the table tennis, the backhand drive is one of the stroke techniques with a high level of difficulty. So, to improve the performance of athletes especially in supporting the improvement of the backhand drive technique, it is necessary to increase the biomotor components such as speed and coordination. An athlete who can maximize eye and hand coordination will be able to control the ball well and be able to return the ball in difficult positions and on target. At the same time, players with good hand reaction speed will quickly respond to the ball's arrival and be able to apply game techniques in table tennis. Meanwhile, one important aspect of the psychological factors in improving the performance of table tennis players is their motivation. This study aimed to examine the relationship between reaction speed, eye-hand coordination, achievement motivation, and the improvement of backhand drive skills of table tennis players. A survey method was used, and the participants included players from the Aneuk Nanggroe Banda Aceh Table Tennis Club. A path analysis was also employed to analyze the data and to comprehend the relationships between the variables, enabling the examination of both direct and indirect impacts. The results of the hypothesis testing showed that the significant impact of various factors on table tennis backhand drive skills. Reaction speed indicated a significant effect with a coefficient of 0.215, while eye-hand coordination had an effect of 0.262. Achievement motivation showed a substantial impact with a coefficient of 0.477. This study indicated that reaction speed had a considerable impact on achievement motivation, with a coefficient of 0.396, and an eye-hand coordination effect of 0.675. Additionally, reaction speed, eye-hand coordination, and achievement motivation were all essential factors that contributed to the improvement of backhand drive skills in table tennis players. By understanding these relationships, coaches and athletes should focus on developing specific attributes to enhance performance on the court.

Keywords: Table Tennis, Backhand Drive, Physical condition, Psychologist

Introduction

Sport is a crucial physical activity contributing to achieving both physical and spiritual health for humans. It has become increasingly popular in contemporary society as people seek healthy lifestyles. Among various physical activities, game sports such as football, volleyball, tennis, badminton, and others hold a prominent position in communities, with table tennis standing out as one of the most beloved and widespread athletics globally.

Table tennis, being renowned globally and falling into the category of sports games involving the use of a net, demands both good physical condition and skills from players. To excel in this game, players should master essential table tennis skills, including service, forehand and backhand drive, push, as well as block and cop. Among these skills, backhand drive technique possess a significant challenge for players (North et al., 2018).

Backhand drive requires striking the ball with the palm of the bat facing backwards or in a position where the

back of the hand faces forward and to the left of the body, forming a 90-degree angle at the elbow. Achieving proficiency in this technique requires both excellent physical condition and skills. During a backhand drive, players typically assume a "square stance", a ready position with their feet slightly wider than the shoulder-width apart (Oagaz et al., 2022). As the ball approaches, the bat is lifted with the help of the elbow movement, causing the angle to shift from 160 to 90 degrees. The stroke concludes with the ball being struck downward from the bottom up.

The majority of table tennis players continue to face difficulties in improving their backhand drive skills. This particular aspect is widely considered as one of the most challenging hitting techniques and serves as a weak point for many players. Consequently, during matches, opponents strategically target the backhand side to exploit vulnerabilities and gain valuable points.

To excel in table tennis, players must possess excellent physical condition and master essential skills. One crucial aspect is the reaction speed, which allows athletes to swiftly and accurately respond to stimuli received through the five senses, enabling them to execute quick and precise movement on the table (Yam & Pan, 2021). In addition to reaction speed, coordination is another crucial aspect of physical condition that plays a role in backhand drive.

Coordination is a highly intricate motor component, serving as a mechanism that harmonizes multiple body movements into a cohesive and well-organized action. Table tennis players rely on various aspects of coordination in the entire stroke process, from the preparatory stage to the execution and the final movement. The key to success lies in executing these movements with the utmost efficiency. Eye-hand coordination, which is one aspect of integration, holds a particular significance in the game. It involves the seamless integration of sight and hand movements when executing a backhand drive (Basiri et al., 2020).

Players should also possess motivation, as an important supporting factor for excelling in table tennis skills. This motivation is classified into two categories, namely extrinsic and intrinsic motivation. Extrinsic motivation is derived from outside sources, such as encouragement from parents, and friends, or receiving appreciation for the performance of oneself. Intrinsic motivation, on the other hand, is an impulse that arises within the individual.

Success and achievement are closely related to motivation, both from within oneself and from external sources. Boredom negatively impacts the performance of players during practice or competition, and in such situation, the involvement of external encouragement becomes essential in providing support. Combining both intrinsic and extrinsic motivation plays a crucial role in overcoming boredom and sustaining a high level of performance (Diel et al., 2021)

Previous sources also highlighted the significance of eye-hand coordination, enabling players to effectively control the ball and execute accurate returns even in difficult positions. Players with good hand reaction speed exhibit quick responses to the incoming ball, further enhancing their performance. Beyond these two physical aspects, the psychological component also holds significant importance in determining the quality of table tennis players. Based on these findings, it was observed that reaction speed, eye-hand coordination, and motivation significantly influenced the improvement of backhand drive skills of players. Considering this above context, further testing of the hypothesis through a study is necessary to explore the direct and indirect effects of reaction speed, eye-hand coordination, and motivation on enhancing backhand drive skills in table tennis (Sung, 2019). This study will provide valuable insights to further enhance the performance of players and contribute to the entire understanding of the sport.

The research hypothesis can be described in the description below:

1. Reaction Speed Directly Affecting Backhand Drive Skills in Table Tennis.

Reaction speed is used to respond to stimuli given by the opponent, Table tennis players who have reaction speed will easily determine kinetic responses to react to stimuli or carry out backhand drive movement processes so that it will be possible for an athlete to gain speed to carry out backhand drive techniques, at the right time and the target that is seen, as a stimulus to do the backhand drive well and optimally (Papastergiou et al., 2021).

A player's good reaction speed is important because with good reaction speed, a player can make a punch or a good reaction too. Thus, it can be assumed that hand reaction speed directly affects backhand drive skills in table tennis (Skopek et al., 2023).

2. Hand-eye coordination Directly Influencing Backhand Drive Skills in Table Tennis.

The basic technique for the backhand drive begins with the "square stance" or "starting position". Square stance means a ready position, where the legs are slightly wider than the distance between the shoulders. Henceforth, we will also use the term "square stance" for this position. The left arm (if playing with the left hand) forms a 1600 angle at the elbow so that the racket is automatically under the ball (Zhu et al., 2023).

The ball comes to the racket and is moved upwards with the help of elbow movement so that the elbow angle changes from 1600 to 900. The ball is hit when it reaches its height. Meanwhile, the body weight is shifted forward. This shot is played with a forward movement. The elbow angle is not allowed to move freely but is held back slightly. Then, immediately return to the ready position to play the next backhand (Maheshwari et al., 2023). These movements must be carried out uninterruptedly, meaning sequentially from all members of the body in harmony, and smoothly with the support of other physical elements. Even though a player has good

strength and speed, if he does not have good coordination between the eyes and hands, the results of his backhand drive will not be ideal. Therefore, hand-eye coordination is very important in successfully executing a backhand drive shot. Thus, it can be assumed that hand-eye coordination has a direct influence on backhand drive skills in table tennis (Firdaus & Mario, 2022).

3. Achievement Motivation Directly Influencing Backhand Drive Skills in Table Tennis

The backhand drive movement process that needs to be considered apart from the standing position, arms, and bat is the rotation strength of the opponent's ball, then the movement to neutralize the ball again as soon as possible. It should be noted that doing that at the height that the player thinks is the most appropriate. A backhand shot that is launched unexpectedly is difficult for the opponent to block and often surprises and scores points. Nowadays, players have to equip themselves with attacks or backhand drive shots, weapons that are no less fierce than forehand attacks (Tahki et al., 2022).

Improving athlete performance in sport is closely related to the psychological aspect namely sports achievement motivation is the goal that athletes have to excel. Athletes will try to increase their efforts and be persistent in training to achieve various awards to increase their self-esteem. Sports achievement motivation can be measured through the choice of tasks, effort, persistence, and achievement (Maheshwari et al., 2023).

4. Hand reaction speed has a direct influence on achievement motivation

The speed of complex reactions is carried out in games and competitive sports, for example, boxing, fencing, and table tennis. Athletes continually receive a number of different stimuli and must determine the appropriate response from the various possibilities. The game of table tennis requires a fast tempo of play in order to receive and to return the ball on a table tennis, a player requires a high reaction time. A high reaction will certainly help the table tennis player in his efforts to attack or receive the ball easily. The player quickly responded to the incoming ball (Children, 2018).

Achievement motivation is an encouragement for someone to do something properly. Someone with a strong need for achievement tends to desire to be successful in completing challenging tasks, not to gain status benefits but simply for the sake of doing good. Achievement motivation is also a psychological encouragement that can influence a person to carry out basic backhand drive techniques well and correctly to achieve the desired goals (Lanzoni et al., 2021). Achievement motivation is the "need for achievement," namely the individual's desire to succeed in competition based on a standard of excellence (Kucukibis & Gul, 2019).

5. Hand-eye coordination Has a Direct Influence on Achievement Motivation

Eye-hand coordination is needed in many activities or daily human activities, including sports activities that require simple to complex movements. When a person moves, this movement occurs from the cooperation between the five senses (receptors or recipients of stimuli), which are passed on to the central nerves system to be processed. Then, from the central nerves, an order will be sent to the muscles to contract, resulting in a conscious movement (He et al., 2022). Carrying out conscious movements such as table tennis backhand drive must be done with full precision, accuracy, and skill to demand good and maximum eye-hand coordination (Chenchen et al., 2019).

The motivation needed to improve the performance of table tennis players focuses on achievement motivation in sports to become champions. A player with achievement motivation will be seen when in competition he will show a desire to succeed, sportsmanship, conscientiousness, carefulness in making decisions, hard work, and courage in acting to make decisions (Mao et al., 2023).

Materials and Methods

Study Design

A survey with a causal approach was employed to analyze the results using path analysis. This method allowed for the identification of direct and indirect effects of exogenous on endogenous variables (Akbari et al., 2018).

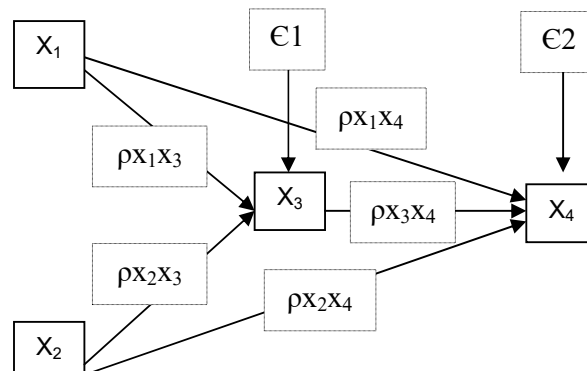


Figure 1. Research Constellation

Information:

- X_1 : Reaction Speed
 X_2 : Eye-Hand Coordination
 X_3 : Achievement Motivation
 X_4 : Table Tennis Backhand Drive Skills
 $\rho_{X_1X_4}$: The path coefficient from variable X_1 to X_4
 $\rho_{X_2X_4}$: The path coefficient between variable X_2 and X_4
 $\rho_{X_3X_4}$: The path coefficient from variable X_3 to X_4
 $\rho_{X_1X_3}$: The path coefficient between variable X_1 and X_3
 $\rho_{X_2X_3}$: The path coefficient from variable X_2 to X_3

Participants

This study was carried out at the Aneuk Nanggroe Table Tennis Club in Banda Aceh, Indonesia, with a population of 34 players.

Instrument

The data collection instruments used were as follows:

Backhand Drive Skills Data Collection Instrument

The data collection for backhand drive skills in table tennis used a test instrument (Xing et al., 2022), as shown in the following media:

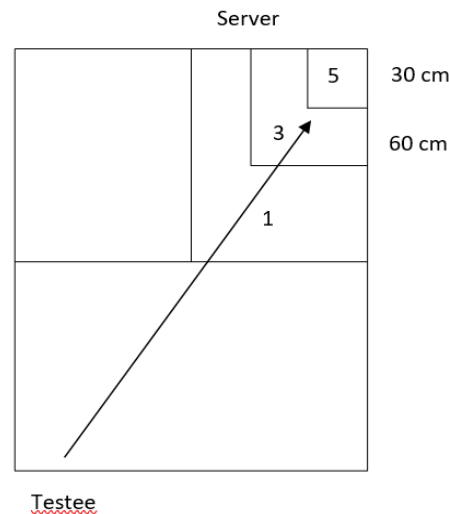
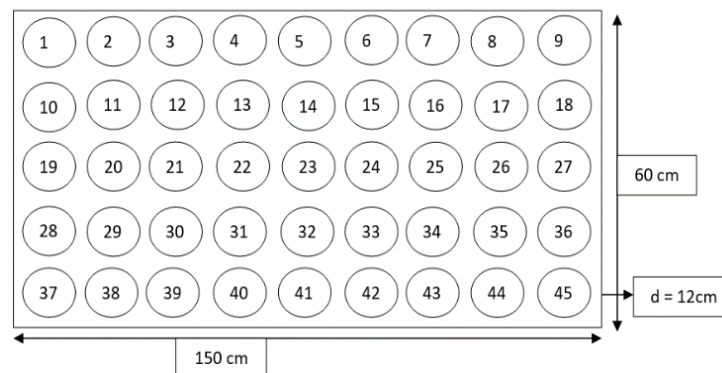


Figure 2. Backhand Drive Skills Test Media Form

Reaction Speed Data Collection Instrument

The data collection for reaction speed involved an analysis using a number board measurement tool (Rutkowski et al., 2021).



Eye-Hand Coordination Data Collection Instrument

The data collection for eye-hand coordination was conducted through an ability test (Utama et al., 2023) using a celluloid ball (Utama et al., 2023).

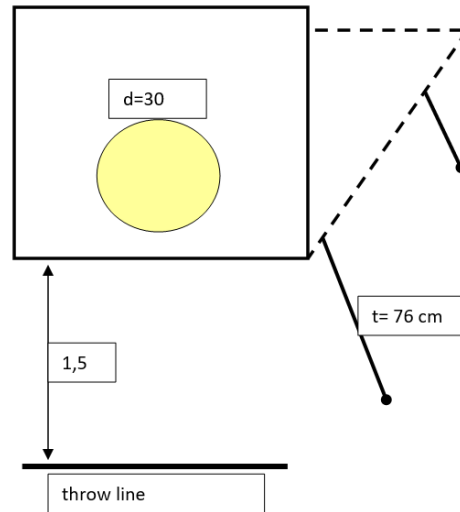


Figure 4. Eye-Hand Coordination Ability Test Media Form

Motivation Data Collection Instrument

The data collection for motivation achievement of players involved the use of a questionnaire (Kucukibis & Gul, 2019).

Result

The data presented in Table 1 pertained to the backhand drive skills factor, representing X_4 and served as an endogenous variable. Additionally, the factors of reaction speed, eye-hand coordination, and achievement motivation, representing X_1 , X_2 , and X_3 , respectively, were categorized as exogenous elements since they determined the value of backhand drive skills. Among all variables, X_3 was categorized an intervening element, as it played a role in influencing X_4 while also being affected by X_1 and X_2 .

Table 1. Description of Study Data Results

Statistic	Variable			
	X_1	X_2	X_3	X_4
Number of Samples	34	34	34	34
Maximum Value	69,59	72,18	71,21	76,96
Minimum Value	39,22	32,58	28,79	35,13
Mean	53,49	50,05	50	50,02
Range	30,37	39,60	42,42	41,83
Standard deviation	8,08	10,13	9,99	10,01

The data subsequently underwent several stages of testing, including the normality, significance, and linearity regression coefficient analysis.

Data Normality Analysis

The results of the normality analysis of the data were presented in the following table:

Table 2. Normality Analysis for Variable Data X_1 , X_2 , X_3 , and X_4

One-Sample Kolmogorov-Smirnov Test

		X_1	X_2	X_3	X_4
N		34	34	34	34
Normal Parameters ^{a,b}	Mean	50.0506	50.0000	50.0024	53.4926
	Std. Deviation	10.13160	9.99849	10.00125	8.08502
Most Extreme Differences	Absolute	.281	.260	.126	.103
	Positive	.281	.260	.126	.103
	Negative	-.219	-.260	-.078	-.085
Test Statistic		.281	.260	.126	.103
Asymp. Sig. (2-tailed)		.000 ^c	.000 ^c	.191 ^c	.200 ^{c,d}

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

Based on the SPSS V.23 output provided above, the data was found to be normally distributed. This was indicated by the "Test distribution is Normal" entry listed in point a. To verify the normality of the data, Asymp. Sig. (2-Tailed) was examined, which was listed in the bottom row of the table.

Significance and Linearity of Regression Analysis

Table 3 presented the results of testing the significance and linearity of the regression model based on the two criteria, namely when F_{count} was less and higher than f_{table} .

Table 3. Result of the Significance and Linearity of the Regression Model Analysis

Variable	Sig. Deviation From Linearity		Regression Significance		Regression Equation Model	
	Linearity Test	Conclusion	Regression Significance Test	Conclusion	Regression Equation Test	Conclusion
(X ₁) to (X ₄)	Sig. 0,129 > 005	Linear	10,165 (f_{count}) > 4,15 (f_{table})	Significant Distribution	3,188 (f_{count}) > 1,693 (f_{table})	Valid
(X ₂) to (X ₄)	Sig. 0,135 > 0,05	Linear	11,004 (f_{count}) > 4,15 (f_{table})	Significant Distribution	3,317 (f_{count}) > 1,693 (f_{table})	Valid
(X ₃) to (X ₄)	Sig. 0,079 > 0,05	Linear	11,689 (f_{count}) > 4,15 (f_{table})	Significant Distribution	3,419 (f_{count}) > 1,693 (f_{table})	Valid
(X ₁) to (X ₃)	Sig. 0,654 > 0,05	Linear	7,015 (f_{count}) > 4,15 (f_{table})	Significant Distribution	2,469 (f_{count}) > 1,693 (f_{table})	Valid
(X ₂) to (X ₃)	Sig. 0,288 > 0,05	Linear	59,222 (f_{count}) > 4,15 (f_{table})	Significant Distribution	7,700 (f_{count}) > 1,693 (f_{table})	Valid

Model Testing

In path analysis, one of the fundamental prerequisites was the presence of a significant correlation between related variables. The correlation coefficient was used to calculate the degree of the relationship between the variables.

Table 4. Correlation Coefficient Matrix between Variables Based on the Association Index Calculation Results Using SPSS Software

		Correlations			
		Reaction Speed (X ₁)	Eye-Hand Coordination (X ₂)	Achievement Motivation (X ₃)	Backhand Drive Skills (X ₄)
X1	Pearson Correlation	1	.478**	.480**	.491**
	Sig. (2-tailed)		.004	.004	.003
	N	34	34	34	34
X2	Pearson Correlation	.478**	1	.806**	.421*
	Sig. (2-tailed)	.004		.000	.013
	N	34	34	34	34
X3	Pearson Correlation	.480**	.806**	1	.517**
	Sig. (2-tailed)	.004	.000		.002
	N	34	34	34	34
X4	Pearson Correlation	.491**	.421*	.517**	1
	Sig. (2-tailed)	.003	.013	.002	
	N	34	34	34	34

** . A significant correlation at level 0.01 (2-tailed).

* . A significant correlation at level 0.05 (2-tailed).

According to Table 4, it was evident that there was a significant association between the related variables.

Structural Model and Correlation Matrix between Variables

The structural model employed is shown in the diagram below:

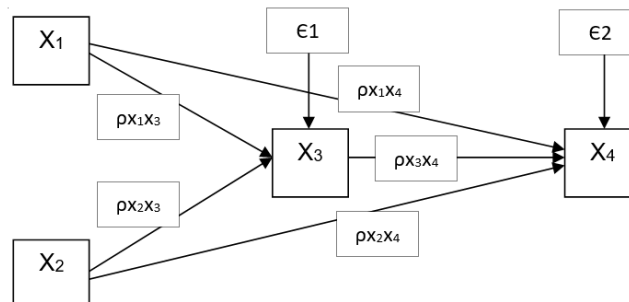


Figure 5. Structural Model

Calculation of Path Coefficient on Sub-Structure 1

The structural equation for substructure 1 was represented as follows:

$$X_4 = \rho_{X_3X_1}X_1 + \rho_{X_3X_2}X_2 + \epsilon_1$$

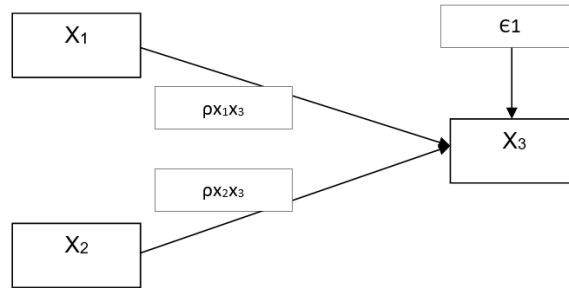


Figure 6. Sub-Structure 1 Model Diagram

Table 5. Sub-Structure 1 Model Summary

Model Summary ^b					
Model	R	R Square	Adjusted R Square	Std. The error in the Estimate	Durbin-Watson
1	.851 ^a	.725	.707	5.41558	1.891

a. The Predictors were Constant, Reaction Speed (X_1), and Eye-Hand Coordination (X_2)

b. Dependent Variable was Achievement Motivation (X_3)

Based on the results obtained from the data analysis output in the Model Summary table, it showed that the coefficient of determination (R_{Square}) was 0.725. This indicated that 72.5% of the variation in the dependent variable (X_3) was attributed to the influence of two independent elements, X_1 and X_2 . Consequently, the changes in the dependent variable were impacted by 72.5% due to the presence of the independent factors. The remaining 27.5% of the variation was influenced by other variables not included in the model. The magnitude of the residual coefficient for (ρ_{X_4}) was calculated as $\epsilon_1 = \sqrt{1-0.725} = 0.524$. This residual coefficient (0.524) represented the influence of other variables, apart from X_1 and X_2 on X_3 .

Table 6. Summary of Calculation Results and Testing of Sub-Structure Path Coefficient 1

Path	Path Coefficient	t_{Count}	t_{table}		Result
			$\alpha = 0,05$	$\alpha = 0,01$	
$P_{X_3X_1}$	0.396	2,912	1,693	2,448	Significant
$P_{X_3X_2}$	0,675	5,576	1,693	2,448	Significant

Table 6 showed that there were two significant path coefficients, namely the correlation between X_1 and X_3 known as $P_{X_3X_1}$ and among X_2 and X_3 depicting $P_{X_3X_2}$. The findings of Sub-Structure 1 (X_1 , X_2 , and X_3) shown in Table 6 indicated the following coefficients:

- $\rho_{X_4X_1} = \text{Beta} = 0,396$ [$t = 2,912$ and probability (sig) = 0,07]
- $\rho_{X_4X_2} = \text{Beta} = 0,675$ [$t = 5,576$ and probability (sig) = 0,00]

Calculation of Path Coefficient on Sub-Structure 2

The structural equation for Sub-Structure 2 was as follows:

$$X_4 = \rho_{X_4X_1}X_1 + \rho_{X_4X_2}X_2 + \rho_{X_4X_3}X_3 + \epsilon_2$$

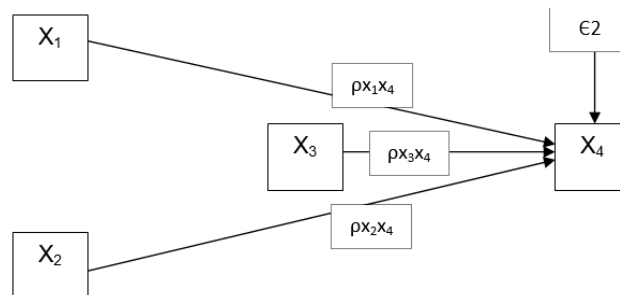


Figure 7. Sub-Structure 2 Model Diagram

Table 7. Model 1 Sub-Structure 2 Summary

Model Summary ^b					
Model	R	R Square	Adjusted R Square	Std. The error in the Estimate	Durbin-Watson
1	.956 ^a	.914	.905	2.06236	1.663

a. The Predictors were Constant, Reaction Speed (X_1), Eye-hand Coordination (X_2), Achievement Motivation (X_3)

b. Dependent Variable was Table Tennis Backhand Drive Skills (X_4)

Based on the obtained results from the data analysis in the Model Summary as shown in Table 7, it was evident that the coefficient of determination (R_{square}) was 0.914. This indicated that 91.4% of the variation in the dependent variable (X_3) was influenced by two independent elements, X_1 and X_2 . Consequently, the presence of the independent variables accounts for 91.4% of the changes in the dependent factors. The remaining 8.6% of the variation was influenced by variables not considered in the model.

Table 9. Summary of Calculation Results and Testing of Sub-Structure Path Coefficients 2

Path	Path Coefficient	T_{count}	T_{table}		Result
			$\alpha = 0,05$	$\alpha = 0,01$	
$P_{X_3X_1}$	0.396	2,912	1,693	2,448	Significant
$P_{X_3X_2}$	0,675	5,576	1,693	2,448	Significant

Table 9 presents three significant path coefficients in Sub-Structure 2, which are as follows:

- (1) The path coefficient between X_1 and X_4 , denoting $\rho_{X_4X_1}$.
- (2) The path coefficient between X_2 and X_4 , representing $\rho_{X_4X_2}$.
- (3) The path coefficient between X_3 and X_4 , indicating $\rho_{X_4X_3}$.

Based on the results of the path analysis of Sub-Structure 2 (X_1 , X_2 , X_3 , and X_4), the coefficients were as follows:

- a. $\rho_{X_4X_1} = \text{Beta} = 0.219$ [$t = 3,201$ and probability (sig)=0,03]
- b. $\rho_{X_4X_2} = \text{Beta} = 0.262$ [$t = 2,970$ and probability (sig) = 0,06]
- c. $\rho_{X_4X_3} = \text{Beta} = 0.477$ [$t = 6,338$ and probability (sig) = 0,00]
- d.

Based on the analysis, the path coefficient X_1 to X_4 , X_2 to X_4 , and X_3 to X_4 were found to be 0.219, 0.262, and 0.477, respectively. The combined contribution of X_1 , X_2 , and X_3 simultaneously to X_4 was $R_{\text{square}} = 0.914$ or 91.4%, indicating that 91.4% of the variations in X_4 were influenced by X_1 , X_2 , and X_3 . The calculated residual coefficient (ϵ_2) for ρ_{X_4} was 0.293, signifying the impact of additional variables beyond X_1 , X_2 , and X_3 , on X_4 .

Based on the results of the path coefficients in Sub-Structure 1 and 2, the causal relationship between variables X_1 , X_2 , and X_3 to X_4 was shown as a whole in the following diagram:

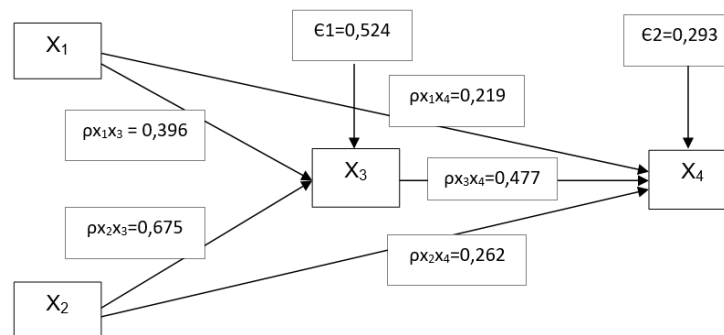


Figure 8. Causal Relationship between Variables X_1 , X_2 , and X_3 to X_4

The results of the path coefficients in Sub-Structure 1 and 2 were represented by the following structural equations:

a. Sub-Structure 1:

$$X_3 = \rho_{X_3X_1}X_1 + \rho_{X_3X_2}X_2 + \epsilon_1 \text{ and } R_{X_3X_2X_1}$$

$$X_3 = 0,396X_1 + 0,675X_2 + 0,524\epsilon_1 \text{ and } R_{X_3X_2X_1} = 0,725$$

b. Sub-Structure 2:

$$X_4 = \rho_{X_4X_1}X_1 + \rho_{X_4X_2}X_2 + \rho_{X_4X_3}X_3 + \varepsilon_1 \text{ and } R^2_{X_4X_3X_2X_1} \\ X_4 = 0,219X_1 + 0,262X_2 + 0,477X_3 + 0,293\varepsilon_2 \text{ and } R^2_{X_4X_4X_2X_1} \\ = 0,914$$

Hypothesis Testing

After obtaining the results of the analysis and the statistical tests for the proposed hypotheses, a summary of the findings was presented in Table 10.

Table 10. Recapitulation of Hypothesis Testing Results

No	Hypothesis	Statistic Test	H ₀ Decision	Conclusion
1	Reaction speed has a direct effect on achievement motivation	H ₀ : $\rho_{X_3X_1} = 0$ H ₀ : $\rho_{X_3X_1} > 0$	H ₀ Rejected	Direct Effect
2	Eye-hand coordination has a direct effect on achievement motivation	H ₀ : $\rho_{X_3X_2} = 0$ H ₀ : $\rho_{X_3X_2} > 0$	H ₀ Rejected	Direct Effect
3	Reaction speed has a direct effect on table tennis backhand drive skills	H ₀ : $\rho_{X_4X_1} = 0$ H ₀ : $\rho_{X_4X_1} > 0$	H ₀ Rejected	Direct Effect
4	Eye-hand coordination has a direct effect on table tennis backhand drive skills	H ₀ : $\rho_{X_4X_2} = 0$ H ₀ : $\rho_{X_4X_2} > 0$	H ₀ Rejected	Direct Effect
5	Achievement motivation has a direct effect on table tennis backhand drive skills	H ₀ : $\rho_{X_4X_3} = 0$ H ₀ : $\rho_{X_4X_3} > 0$	H ₀ Rejected	Direct Effect

Discussion

Based on the hypotheses result, the following observations were made:

The results indicated a positive effect of reaction speed (X_1) and eye-hand coordination (X_2) on achievement motivation (X_3). The structural equation derived from the path analysis showed that X_3 is influenced by X_1 and X_2 as represented by the equation $X_3 = 0.396X_1 + 0.675X_2 + 0.524\varepsilon_1$. Moreover, when considering the combined contribution of X_1 and X_2 to X_3 , it was evident that 72.5% of the variation in X_3 was influenced by these variables.

Based on the results of hypothesis testing through path analysis, it was found that X_1 , X_2 , and X_3 had a positive effect on X_4 . The structural equation representing this relationship was expressed as $X_4 = 0.219X_1 + 0.262X_2 + 0.477X_3 + 0.293\varepsilon_2$. Furthermore, when considering the combined contributions, it became evident that a significant 91.4% of the variations in backhand drive skills were influenced by other variables. Based on these significant results, it was evident that enhancing X_4 required attention and improvement in the variables of X_1 , X_2 , and X_3 .

Conclusion

In conclusion, based on the analysis of data on backhand drive skills, reaction speed, eye-hand coordination, and achievement motivation among table tennis players, the following were concluded:

1. Reaction speed had a direct effect on achievement motivation with a percentage of 15.68% of the variation.
2. Eye-hand coordination had a direct impact on achievement motivation, contributing to 45.56% of the variation.
3. Reaction speed had a direct effect on backhand drive skills, influencing 4.79% of the variation.
4. Eye-hand coordination had a direct impact on backhand drive skills with a percentage of 6.86% of the variation.
5. Achievement motivation had a direct effect on backhand drive skills contributing to 22.75% of the variation.

Table tennis was a fast tempo that demanded proficient hitting skills. The results suggested that improving backhand drive performance in table tennis required enhancing motor components such as speed, coordination, and skills. Players who maximize eye-hand coordination, controlled the ball effectively and executed precise returns, even in a challenging position. Additionally, hand reaction speed also played a vital role in backhand drive skills, enabling players to respond swiftly and apply gaming techniques effectively during matches.

The findings were interpreted based on the data analysis as follows:

First, faster reaction speeds positively impacted backhand drive skills, highlighting its significance as a crucial physical component in table tennis. Players with swift reactions promptly respond to stimuli, executing the skill with enhanced speed and precision (Pluta et al., 2021).

Second, the results showed that eye-hand coordination directly affected backhand drive skills. This discovery underscored the importance of eye-hand coordination as an essential physical component in table tennis. Coordination, a complex motor ability, played a critical role in mastering various techniques and affected the activation of muscle groups during the performance of specific movement skills (Asar et al., 2022).

Third, it was evident that there was a direct effect of achievement motivation on backhand drive skills. This

result emphasized the role of achievement motivation, a psychological aspect, in table tennis. High motivation drove players to exert greater efforts and persistently train to achieve success and gain recognition, thereby boosting their self-esteem. Effort, perseverance, and achievements were crucial indicators of sports achievement motivation (Marchese et al., 2022).

Fourth, the analysis showed that there was a direct effect of reaction speed on achievement motivation. The result showed that reaction speed, an essential physical requirement, impacted achievement motivation, and psychological aspects in sports, particularly in table tennis. A backhand drive involved a series of challenging movements, and various psychological factors, including achievement motivation. Developing reaction speed backhand drive in table tennis required a strong sense of achievement motivation, indicating a direct relationship between reaction speed and achievement motivation (Alkhawaldeh, 2022).

Fifth, this study showed that there was an impact of eye-hand coordination on achievement motivation. This result highlighted the influence of eye-hand coordination, a crucial physical requirement on achievement motivation, and psychological aspects in sports, specifically in table tennis. Seamless Eye-hand coordination involved synchronized movements of all body members, supported by other physical elements. Good strength and speed skills were not enough to perfect backhand drive skills without proper eye-hand coordination. This indicated a direct correlation between eye-hand coordination and achievement motivation (Yam & Pan, 2021).

Conflicts of Interest

The authors declared no conflict of interest.

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