

A study on Bowling Accuracy, Mental Skills and Depth Perception of Pace Bowlers in Cricket

¹Multan Khan, ²Dr. Sentu Mitra

¹PhD Scholar, ²Assistant Professor

^{1,2}Department of Physical Education and Sports Sciences

Vinaya Bhavana, Visva Bharati, Santiniketan, West Bengal, India

Email - ¹multankhan761@gmail.com, ²sentu.mitra81@gmail.com

Abstract: The Purpose of the study was to determine the relationship of Bowling Accuracy, Mental Skills and Depth Perception of Pace Bowlers in cricket. Ten(10) second division club level pace bowlers (Aged 22-27 years) voluntarily participated in this study. The subjects have the experience of playing 33 ± 7 matches in a session. To measure Mental skill, Bull's Mental Skills Questionnaire, Depth Perception by Howard-Dolman Apparatus and Bowling accuracy was measured by Novel Pace Bowling Test. Depth Perception was taken in a laboratory setting while Novel Pace Bowling Test administered outdoor synthetic matting turf. A 240fps Camera was installed to record the Bowling Accuracy in terms of Radial Error reduced with Kinovea (0.8.25 version) software. To statistically analyzed the data Pearson Product Moment used to determine the relationship between Bowling Accuracy and Mental Skills, Depth Perception. The results indicate a negative correlation ($r = -0.652$) between Radial Error and Mental Skills, whereas a positive correlation ($r = 0.705$) between Radial Error and Depth Perception. The statistical analysis revealed Mental Skills and Depth Perception have a influential factors on Bowling Accuracy. The mental skill and Depth Perception provides a Attentional control and less distortions to lead to perform better in the target based task of Bowling. Furthermore investigation on the effect of Neuropsychological aspects can highlight the various aspects of Bowling Performance.

Key Words: Pace Bowling, Bowling Accuracy, Mental Skills, Depth Perception.

1. INTRODUCTION:

Cricket is worldwide popular sports. Participation in cricket in India has the highest amount in the world. Pace bowling in cricket leads to very strenuous activity while physical, mechanical and psychological aspect govern a bowler to bowl with maintaining a rhythm of bowling speed and bowling accuracy. Bowling accuracy determines a consecutive line and length to bowl that put the resistance to a batsman to play desirable shorts. Bowling performance achieved with the coordination of run up speed, delivery stride, bowling action, shoulder kinematics, lumber kinematics (Thander & Prasad, 2019; Elliott, Foster, & Gray, 1986; Worthington, King, & Ranson, 2012). Continuous spell of bowling determines with technical validity and physical aspects of the bowler adversely the kinematics factors affects the bowling performance in terms of bowling accuracy and bowling speed (Burnett, Elliott, & Marshall, 1995; Portus, Sinclair, Burke, Moore, & Farhart, 2000). The bowling performance is highly influenced by the biomechanical aspects. The movement pattern of a pace bowler in an ODI tournament is a high intermittent activity with varied intensity (Petersen, Pyne, Portus, Karppinen, & Dawson, 2009). The physical quality also closely associated with kinematics of bowling and bowling performances (Feros, 2015). During repeated spell of bowling the physiological parameters are contribute well effort in performance (Duffield, Carney, & Karppinen, 2009). The mental aspect of performance denotes with various psychological factors in sports. Mental skill abilities are well contributor of successful cricket participation and its development (Jooste, van Wyk, & Steyn, 2013). Depth Perception is the ability is to judge relative distance between two objects (Roy, Chaudhry, & Sharma, 2016). Depth Perception can be a useful ability to determine the depth of the target with vergence and triangulation estimation for the information processing to the brain (Clark, Graman, & Ellis, 2015). It provides the guidance on the location of the object for a clear vision (Team, 2018). For better athletic performance vision is one of the primary senses for athletes and vision training elicit the greater performance (Khanal, 2015; Knudson & Kluka, 2013). In field of hockey goal shooting better performance depend mostly on visual stimulus, visual memory, visual discrimination, ability to shift focus between near and far objects and also likely depend on stereoptic quickness (Poltavski & Biberdorf, 2014). Stereopsis generally determines the perception of depth obtained on the basis of visual information by the individuals. The pace Bowling in cricket aiming to bowl fast that leads to less time to react and maintain a rhythm of great line and length leads to resist batsman scores runs easily. The rhythm of accurate bowl on specific line and length depend upon variety of integration of factors. The aim of the study is to determine the relationship of accuracy of bowling and the psychological perspectives such as Mental Skill Ability and Depth Perception.

2. Objectives of the Study:

- To determine the relation between Mental Skills and its subscales with Bowling Accuracy of Pace bowlers.
- To determine the relation between Depth Perception and Bowling Accuracy of Pace bowlers.

3. METHOD:

Subject: Ten (10) Indian male pace bowlers (Aged 22-27 years) having the experience of participating minimum second division Kolkata League matches were voluntarily participated in this study. The subjects were regular player and participated in 33±7 matches in a calendar year in Cricket Association of Bengal (CAB) organized tournaments.

Variable of the study: The variables of the study are Mental Ability was determined by Bull's Mental Skill Ability Questionnaire by Bull Albison and Shambrook (1996), Depth Perception by Howard-Dolman Apparatus and Bowling accuracy was measured by Novel Pace Bowling Test (Feros, 2015).

Administration of the test: The test was administered during the progression of the league matches of the subject. The subjects were well instructed to fill the demographic information, and then the questionnaire of Mental Skill Ability serve afterwards in a laboratory setting the Depth Perception test was taken. The bowling Accuracy test was taken in an outdoor set up. The bowling accuracy test was about of the short format of four overs only.

Collection of data: The data of Mental Skill Ability Questionnaire were obtain as the scoring of the chosen option credited score from 1 to 6 as per the scoring pattern. The sub parameters were Imagery Ability, Mental Preparation, Self Confidence, Anxiety and Worry Management, Concentration and Motivation. The total number of score represents the Mental Skill Ability.

The Howard-Dolman apparatus measures the Depth Perception by adjusting a moving rod to a stable rod from six meters away through a small opening window. The closeness measure of the rod represents the score of Depth Perception in Centimeters. The data of Bowling Accuracy was obtained from the settings of Novel Pace Bowling Test in an outdoor Set up. The subjects were filmed in their bowling spell in a standard cricket pitch of matting turf. 240 fps camera filmed the strike of the balls into a target sheet place behind the batting crease with specifically marked five distinguished target area for left and right hand batsmans. The camera installed behind the bowling crease at a height of 141 cm and 30 cm wide apart from the stumps. In between the overs the subjects were engaged into walk, short sprint to catch a ball, ground fielding, throwing to adopt the match situation. The subjects bowled 24 deliveries in five targets with three different intensities of Match intensity, maximum effort and slow ball. The determination of the target and intensities were called before the Run up of the Bowlers.

Data Reduction of Novel Pace Bowling Test: Kinovea (0.8.25 version) was used to reduce the data in Radial Error. The distance from the target to its first strike into the target sheet is the radial error. For calibration the height of the bouncer of 171cm was used. The radial error determines the Bowling accuracy of the bowlers in different targets of bowling into the target sheet in centimeters.

Statistical Procedure: Descriptive Statistics such as Mean, Standard Deviation, Standard Error were ascertained and to establish the relationship Pearson's Product Moment Correlation was used with setting the significance value at 0.05 ($p < 0.05$).

4. ANALYSIS:

Table 1: Descriptive Statistics of Radial Error (Bowling Accuracy), Mental Skills and Depth Perception

Variables	N	Minimum	Maximum	Mean	Std. Error	Std. Deviation
Radial Error(cm)	10	21.30	27.80	25.45	.74	2.3
Mental Skills	10	100	155	126.1	5.4	17.1
Depth Perception(cm)	10	2.5	5.6	3.8	.30	.96

Table No.1 shows that the mean Bowling Accuracy in terms of Radial Error was 25.45±2.3 centimeters determine the accuracy of bowling from the centroid of the specific target areas. The extraction of mean of Mental Skills from the questionnaire scoring was 126.1±17.1 with a range of maximum 155 to minimum 100. The questionnaire scores with minimum 28 to Maximum of 168 that reveals that the players possessed good mental skills. In Depth Perception of the players the mean was 3.8±0.96 centimeters determines an eventual perception depth whereas the maximum great value of zero, same label of the movable and static bars.

Table 2: Descriptive Statistics of Sub scales of Mental Skills

Sub scales of Mental Skill Ability	N	Minimum	Maximum	Mean	Std. Error	Std. Deviation
Imagery Ability	10	13	22	18.10	1.03	3.25
Mental Preparation	10	16	22	20.00	0.75	2.36
Self Confident	10	14	24	19.20	0.98	3.08
Anxiety Worry Management	10	15	24	19.40	1.33	4.22
Concentration Ability	10	8	24	15.20	1.82	5.75
Relaxation Ability	10	13	24	19.40	1.10	3.47
Motivation	10	14	24	21.10	0.96	3.03

Table No.2 reveals that mean of Imagery ability, Mental Preparation, Self Confidence, Anxiety and Worry Management, Relaxation ability and Motivation was good enough in comparison with the highest score 24. The concentration ability shows a little less in relation with the others with a mean of 15.2±5.75 and with a minimum score of 8 out of 24.

Table 3: Normality Test (Shapiro-Wilk) of the Data of Radial Error, Mental Skills and Depth Perception

Variables	Shapiro-Wilk		
	Statistic	df	Sig.
Radial Error	.880	10	.130
Mental Skills	.959	10	.778
Depth Perception	.963	10	.821

Table No. 3 showed Normality of the data. Shapiro-Wilk test determines the data of the following variables of Radial Error, Mental Skills and Depth Perception are normality distributed as significance value exceeded than 0.05.

Table 4: Inferential Statistics of Correlation (Pearson Product Moment) between Radial Error (Bowling Accuracy) and Mental Skills and Depth Perception

Radial Error (Bowling Accuracy)	Mental Skill Ability		Depth Perception
	Correlation Coefficient (r)	p-Value	N
	-.652*	.041	10
			10

Table No.4 reveals the correlation status of Bowling Accuracy with Mental Skills and Depth Perception. The Mental Skill Ability is negatively correlated with the Correlation Coefficient (r) of 0.652 and p value determines significance at 0.05 level. Depth Perception is positively correlated with the Correlation Coefficient (r) of 0.705 and p value determines significance at 0.05 level.

Table 5: Inferential Statistics of Correlation (Pearson Product Moment) between Radial Error (Bowling Accuracy) and the Sub scales of Mental Skills.

Radial Error (Bowling Accuracy)	Correlation Coefficient (r)	Imagery Ability	Mental Preparation	Self Confident	Anxiety Worry Management	Concentration Ability	Relaxation Ability	Motivation
			-.747*	-.719*	-.693*	.130	-.661*	.163
	p-Value	.013	.019	.026	.721	.038	.652	.520
	N	10	10	10	10	10	10	10

Table No.5 shows the correlation status of Bowling Accuracy with Sub Parameters of Mental Skills. Imagery Ability, Mental Preparation, Self Confidence, Concentration are negatively correlated at 0.05 level of significance. Whereas Anxiety & Worry Management, Relaxation Ability and Motivation are not correlated with Bowling Accuracy in terms of Radial Error at 0.05 level of significance.

5. DISCUSSION:

Novel Pace Bowling Test determines the Bowling Accuracy while bowling into a specific target sheet of five different targets in three different intensities. The bowler focuses on the particular target prior to bowl. Accomplishment of bowling is getting into correct line and length to strike the target. The distance of the striking ball from the target, considered as Radial Error. The smallest deviation from the target is accurate bowling with maintaining this throughout the entire Bowling spell considered as great Bowling Accuracy of the bowler (Feros S. A., 2015; Feros, Young, & O'Brien, 2017; Knudson & Kluka, 2013; Phillips, Portus, Davids, & Renshaw, 2012). Bowling accuracy in terms of Radial Error found negatively correlated with Mental Skills. Mental skills provide a better advantage for less Error, and accuracy in bowling. Mental skills and psychological characteristics are strongly associated (McGraw, Pickering, Ohlson, & Hammermeister, 2012) Psychological skills enable the psychomotor automaticity to perform better in sports activity (Thomas & Over, 1994). Skill level differentiation potentially depends upon psychological skills (Mahoney, Gabriel, & Perkins, 1987) greater psychological skill greater the execution of skills with less error. Skill adoption could be differentiated using Mindfulness, low mindfulness in terms of attentional control, emotional control, goal settings resulting low performance (Kee & Wang, 2008), attentional control can be based on either stimulus factor or goal relevance (Vecera, Cosman, Vatterott, & Roper, 2014). In Novel Pace Bowling test, the bowling accuracy driven from a specified target, attentional control can be factors among the psychological consideration to focus on. Imagery ability is negatively correlated with Radial Error signifies Imagery ability influences Bowling Accuracy. There is a relation between mental imagery and perception, motor imagery and physical execution (Guillot & Collet, 2010). Imagery describes an experience that mimic of real experience with the sensory modalities in the absence of actual perception and an effective means of improving performance (Cumming & Ramsey, 2009). Bowling in cricket is an open skill that perform under different circumstances with following different line and length at varied intensities to obstruct the batsman so as the Novel Pace Bowling Test. Elite and open skill sports persons uses imagery very frequently (Jones, 2015; Arvinen-Barrow, Weigand, Thomas, Hemmings, & Walley, 2007).

Mental Preparation showed significant negative correlation with Radial Error determines the influence on Bowling Accuracy positively. As Mental Preparation increases Radial Error decreases, Bowling Accuracy increases. Jooste et al (2013) reported a higher Mental Preparation ability on senior provincial level players than premier and junior level cricket players. It may be experience leads to more acquisition on Mental Preparation. Feltz (1988) in 'Self-Confidence and Sports Performance' denotes Self Confidence as perceived ability to accomplish a certain level of performance. The result in this study showed a negative correlation between Self Confidence and Radial Error. Bowling Accuracy positively influenced with Self Confidence. Self Confidence independently related with sports performance and perceived to improve performance (Woodman & Hardy, 2003; Hanton & Connaughton, 2002). Concentration Ability is negatively correlated with Radial Error that reveal a positive impact on Bowling Accuracy. Concentration on a target repeatedly enhances the learning stimulus. Regulation on movements influenced by external focus elicited automatic control process (Wulf & Prinz, 2001). Bowling Accuracy highly praised by accomplishment of skill performance with appropriate target set in mind and concentration is an influential factor in skill performance (Silva, 1979). The result in this study indicates positive correlation determines Depth Perception leads to Bowling Accuracy. It may be the experience or the visual consciousness that promote the Bowling Accuracy. Visual senses can be influential to process Visual attention behaviorally relevant targets. Binocular vision and its appropriate functioning may lead to optimal performance in target shooting sports (Vera, Molina, Cárdenas, Redondo, & Jiménez, 2019) and affected Binocular vision may lead to distortions in Depth Perception and also visual measurement distance. (sswitch, 2019). Depth Perception of individuals may also vary upon level of performance (Sharma, 2018), Visual acuity that performs interpretive faculty of brain may depend upon age of young skilled players (Quintana, Román, Calvo, & Sampedro, 2007).

6. CONCLUSION:

The statistical analysis of the study indicates a negative relation between Radial Error and Mental Skills and its sub scales of Imagery Ability, Mental Preparation, Self Confidence and Concentration. That leads the mental ability is a influential factor of Bowling Accuracy, the greater mental skill leads to less error in performance of bowling. And a positive relation between Depth Perception and Radial Error determines the vision ability to perform better with less error. The sample size of the study may have influential factor of this study for generalization. The level of participation of the subject is also inadequate for predictive conclusion. The Novel Pace Bowling test is very much task goal relevant and interesting for the subjects to perform. The task goal induced activities have a tendency to impact of greater learning (Newell, Broderick, Deutsch, & Slifkin, 2003).

REFERENCES:

1. Arvinen-Barrow, M., Weigand, D. A., Thomas, S., Hemmings, B., & Walley, M. (2007). Elite and Novice Athletes' Imagery Use in Open and Closed Sports. *Journal of Applied Sports Psychology*, 19 (1), 93-104.

2. Burnett, A., Elliott, B. C., & Marshall, R. N. (1995). The effects of a 12-over bowling spell on bowling accuracy and pace in cricket fast bowlers. *Journal of Sports Sciences* , 13 (4), 329-41.
3. Clark, J. F., Graman, P., & Ellis, J. K. (2015). Depth Perception Improvement in Collegiate Baseball Players with Vision Training. *Optometry & Visual Performance* , 3 (2), 106-115.
4. Cumming, J., & Ramsey, R. (2009). *Imagery interventions in sport*. Routledge, Editors.
5. Duffield, R., Carney, M., & Karppinen, S. (2009). Physiological Responses and Bowling Performance During Repeated Spells of Medium-Fast Bowling. *J Sports Sci* , 27 (1), 27-35.
6. Elliott, B. C., Foster, D. H., & Gray, S. (1986). Biomechanical and physical factors influencing fast bowling. *The Australian Journal of Science and Medicine in Sports* , 18 (1), 16-21.
7. Feros, S. A. (2015). The Determinants and Development of Fast Bowling Performance in Cricket. *School of Health Sciences, Federation University Australia* , 125-135.
8. Feros, S., Young, W. B., & O'Brien, B. (2017). The Reliability and Sensitivity of Performance Measures in a Novel Pace Bowling Test. *International Journal of Sports Physiology and Performance* , 13 (2), 1-21.
9. Guillot, A., & Collet, C. (2010). *The neurophysiological foundations of mental and motor imagery*.
10. Hanton, S., & Connaughton, D. (2002). Perceived Control of Anxiety and its Relationship to Self-Confidence and Performance. *Research Quarterly for Exercise and Sport* , 73 (1), 87-97.
11. Jones, D. (2015). Influence of Sex and Sport Skill Type on Imagery Use among Division III Athletes.
12. Jooste, J., van Wyk, J., & Steyn, B. J. (2013). The relationship between mental skills and level of cricket participation. *African Journal for Physical, Health Education, Recreation and Dance* , 19 (1), 254-265.
13. Kee, Y. H., & Wang, J. C. (2008). Relationships between mindfulness, flow dispositions and mental skills adoption: A cluster analytic approach. *Psychology of Sports and Exercise* , 9 (4), 393-411.
14. Khanal, S. (2015). Impact of Visual Skills Training on Sports Performance: Current and Future Perspectives. *Advances in Ophthalmology & Visual System* , 2 (1).
15. Knudson, D., & Kluka, D. A. (2013). The Impact of Vision and Vision Training on Sport Performance. *Journal of Physical Education, Recreation & Dance* , 17-24.
16. Mahoney, M. J., Gabriel, T. J., & Perkins, T. S. (1987). Psychological Skills and Exceptional Athletic Performance. *Human Kinetics Journals* , 1 (3), 181-199.
17. McGraw, L., Pickering, M. A., Ohlson, C., & Hammermeister, J. (2012). The Influence of Mental Skills on Motivation and Psychosocial Characteristics. *MILITARY MEDICINE* , 177, 77-84.
18. Newell, K. M., Broderick, M. P., Deutsch, K. M., & Slifkin, A. B. (2003). Task Goals and Change in Dynamical Degrees of Freedom With Motor Learning. *J Exp Psychol Hum Percept Perform* , 29 (2), 379-87.
19. Petersen, C., Pyne, D. B., Portus, M. R., Karppinen, S., & Dawson, B. (2009). Variability in Movement Patterns During One Day Internationals by a Cricket Fast Bowler. *International Journal of Sports Physiology and Performance* , 4 (2), 278-81.
20. Phillips, E., Portus, M., Davids, K., & Renshaw, I. (2012). Performance Accuracy and Functional Variability in Elite and Developing Fast Bowlers. *J Sci Med Sport* , 15 (2), 182-188.
21. Poltavski, D., & Biberdorf, D. (2014). The Role of Visual Perception Measures Used in Sports Vision Programmes in Predicting Actual Game Performance in Division I Collegiate Hockey Players. *Journal of Sports Science* , 33 (6), 597-608.
22. Portus, M., Sinclair, P. J., Burke, S. T., Moore, D. J., & Farhart, P. (2000). Cricket fast bowling performance and technique and the influence of selected physical factors during an 8-over spell. *Journal of Sports Sciences* , 18 (12), 999-1011.
23. Quintana, M. S., Román, I. R., Calvo, A. L., & Sampedro, J. (2007). Perceptual visual skills in young highly skilled basketball players. *Perceptual and Motor Skills* , 104 (2), 547-61.
24. Roy, R., Chaudhry, M., & Sharma, I. P. (2016). Visual assessment of sports professionals. *International Journal of Current Advanced Research* , 5 (10), 1295-1300.
25. Sharma, C. (2018). Comparative study of depth perception among the male handball players at college and university level. *International Journal of Physiology, Nutrition and Physical Education* , 3 (1), 1433-34.
26. Silva, J. M. (1979). Behavioral and Situational Factors Affecting Concentration and Skill Performance. *Journal of Sport Psychology* , 1 (3), 221-227.
27. sswitch. (2019, Dec 3). *Sports performance depends on the integrity of binocular vision*. Retrieved from <https://medium.com/sswitch>: <https://medium.com/sswitch/sports-performance-depends-on-the-integrity-of-binocular-vision-9a90338eceeab>
28. Team, N. (2018, February 27). *The Rise of Sports Vision Training*. Retrieved May 2, 2020, from Neurotracker.net: <https://neurotracker.net/2018/02/27/rise-sports-vision-training/>
29. Thander, A., & Prasad, S. S. (2019). Fastest bowling delivery is associated with selected kinematic factors in junior pace bowlers. *European Journal of Physical Education and Sports Science* , 5 (8), 89-95.

30. The Reliability and Sensitivity of Performance Measures in a Novel Pace Bowling Test. (2017). *International Journal of Sports Physiology and Performance* , 13 (2), 1-21.
31. Thomas, P. R., & Over, R. (1994). Psychological and Psychomotor Skills Associated with Performance in Golf. *Human Kinetics Journals* , 8 (1), 73-86.
32. Vecera, S. P., Cosman, J. D., Vatterott, D. B., & Roper, Z. J. (2014). Chapter Eight - The Control of Visual Attention: Toward a Unified Account. *Psychology of Learning and Motivation* , 60, 303-347.
33. Vera, J., Molina, R., Cárdenas, D., Redondo, B., & Jiménez, R. (2019). Basketball free-throws performance depends on the integrity of binocular vision. *European Journal of Sport Science* .
34. Woodman, T., & Hardy, L. (2003). The relative impact of cognitive anxiety and self-confidence upon sport performance: a meta-analysis. *Journal of Sports Sciences* , 21 (6), 443-457.
35. Worthington, P. J., King, M. A., & Ranson, C. (2012). Relationships Between Fast Bowling Technique and Ball Release Speed in Cricket. *Journal of applied biomechanics* , 29 (1), 78-84.
36. Wulf, G., & Prinz, W. (2001). Directing attention to movement effects enhances learning: A review. *Psychonomic Bulletin & Review* , 8 (4), 648-660.