Chapter III

PROCEDURE

In this chapter the procedure adopted for selection of subjects. Selection of variables, reliability of data, collection of data. Procedure and administration of tests and the statistical technique for analysing the data have been described.

Selection of Subjects

Sixty male national table tennis players were randomly selected as subjects for the purpose of this study, who took part at national championships held at Pune and Gurgaon in the year 2002 and 2003 respectively.

Selection of Variables

Proficiency in any sport requires the ideal combination and interaction of numerous abilities developed to an ideal degree. However, performance measures of these abilities vary from activity to activity.
Edwin Fleishman, Director of American Institutes for Research, completed numerous research investigations on the nature of human abilities and their relationship to task proficiency. He identified the dimensions underlying human performance in two categories; the physical proficiency (fitness) area and the psychomotor (psycho-physiological) area. The factors of strength, power, stamina, flexibility, coordination and balance constituted the physical proficiency whereas reaction time, speed of movement (response time), arm-hand steadiness, visual perception, manual dexterity and rate control were the abilities considered under psycho-physiological area.¹

To study the psycho-physiological profiles of male national table tennis players, the following psycho-physiological variables like reaction time, speed of movement, hand steadiness, depth perception, pulse rate and galvanic skin resistance were selected out of the variables mentioned earlier as they represent the performance of an individual in

terms of quickness of reactivity, muscle-twitch speed, motor stability and coordination, and visual efficiency and judgement, and arousal level respectively. The selection of these variables was also based on the feasibility criteria, the nature of subjects and the facilities available to conduct the tests, and their high relevancy to the present study.

**Reliability of Data**

The reliability of data was ensured by establishing the instrument reliability, tester competency and reliability of tests and the subjects reliability.

**Instrument’s Reliability**

Reaction time was measured by using electronic reaction time apparatus which was manufactured and supplied by Anand Agencies, Pune. This instrument had the transistorized chronoscope showing time upto four decimal places, and hence, it was accepted accurate enough for the purpose of this study.
The stop watch used for measuring performance of players for hand steadiness was calibrated and swiss made. The metric scale used for measuring speed of movement of subjects were of standard quality and which were also calibrated.

The Steadiness Tester was supplied by the National Psychological Corporation, Agra which was considered quite reliable for measuring hand steadiness.

Depth perception was measured by using Depth Perception Box manufactured by Biological Concern, Calcutta, a leading firm in the manufacturer and supply of the instruments and equipments used in psychological and physiological research.

The stop watch used to record pulse rate of players was calibrated and swiss made.

Galvanic skin resistance was measured by connectors joined with long cables and appropriate pre amplifiers which were standardized and calibrated.
Tester Competency and Reliability of Tests

The tester competency was evaluated together with reliability of the tests. To determine the reliability of tests, the performances of 10 players, selected at random were recorded twice, on the psycho-physiological variables of reaction time, speed of movement, hand steadiness, depth perception, pulse rate and galvanic skin resistance under identical conditions by the scholar. A Pearson’s product moment correlation was computed between the two measures of each variable and these reliability coefficients are shown in Table – 1.

**TABLE – 1**

**RELIABILITY COEFFICIENTS OF TEST-RETEST SCORE**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Tests</th>
<th>Coefficients of Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Reaction Time Test</td>
<td>.91*</td>
</tr>
<tr>
<td>2.</td>
<td>Nelson Speed of Movement Test</td>
<td>.78*</td>
</tr>
<tr>
<td>3.</td>
<td>Hand Steadiness Test</td>
<td>.80*</td>
</tr>
<tr>
<td>4.</td>
<td>Depth Perception Test</td>
<td>.85*</td>
</tr>
<tr>
<td>5.</td>
<td>Pulse Rate</td>
<td>.92*</td>
</tr>
<tr>
<td>6.</td>
<td>Galvanic Skin Resistance Test</td>
<td>.86*</td>
</tr>
</tbody>
</table>

*Significant, (r_{.05} = 0.25)
From the test-retest coefficients of correlation (Table-1) it was obvious that the tester reliability was significantly high, establishing the competency of the scholar to administer the tests.

The correlation coefficients also indicated the reliability of the tests selected, as very high correlations were obtained, when the tests were repeated.

**Subject Reliability**

The above test-retest method also established that subject reliability was significant at .05 level of confidence, as the same subjects were used under similar conditions by the same tester and no motivational techniques were used on both occasions or training given to them between test and retest.

**Collection of Data**

The necessary data of national table tennis players on the selected psycho-physiological variables was collected by administering the tests of these variables at free time available
during championship days. Three scores for each variable selected were obtained and the middle score was considered as final performance.

**Procedures and Administration of Tests**

**Reaction Time**

The reaction time was measured by the test of reaction time on Anand\(^2\) Electronic Reaction time apparatus. This test was preferred to other tests available as the instrument measures reaction time directly and accurately. The other available test for measuring reaction time, the Nelson Reaction Time Test\(^3\) was not used as it involved a long procedure of administration and was not considered accurate enough, because the time could not be read directly.

The procedure of reaction time test was explained and demonstrated to all the players before it was administered. No


motivational technique was used but the subjects were asked to do their best.

For measurement of reaction time the apparatus was set according to prescribed procedure. The detachable screen was fixed in the desired holes which divided the reaction time apparatus into two sides the subject’s side and tester’s side. The subject sat in a chair on subject’s side and the tester stood on the tester’s side. The tester rang a bell, which was a signal for the subjects to press the right or left key as selected by tester with selector switch. Then the tester pressed one of the short keys giving the required stimulus (light). The short key was a double key which gave the stimulus and also started the chronoscope.

As soon as the player received the light stimulus, he lifted his finger from the right or left key which stopped the chronoscope and the reaction time to the light stimulus was read and recorded from the chronoscope. Three trials were provided to each subject and the average of the three readings was the reaction time score.
Speed of Movement

Nelson Speed of Movement Test⁴ was used to measure speed of movement. Some other tests referred to the electrical circuit procedure for measuring speed of movement but the details of these were not available and hence could not be considered. Nelson’s test was meant to measure the combined reaction and speed of movement of the hands and arms and was found suitable for all ages. The equipment needed was a metric scale, table and chair and a chalk piece.

Before conducting the speed of movement test, all the details of the test were clearly explained to the players and each player was given give practice trials at the beginning to familiarize him with the procedure of the test.

The player was seated in a chair, facing the table, with his hands resting over the edge of the table. The palms were kept facing each other with the inside border of the little fingers resting along two lines which were marked on the edge of the table 12 inches apart. The research scholar held the

⁴Ibid., p. 220.
scale near the top so that it hung midway between the subject's palms with the 'base line' of the scale positioned evenly with the upper edges of the subject's index fingers and subject looked on the concentration zone. After a preparatory command "ready" the meter scale was dropped and the subject stopped it is quickly as possible with an inward horizontal movement of arms.

Only three trials were given to each player and the distance the scale fell through the hands before it was stopped every time was recorded. The average of the three trials was taken as the distance score. This distance score was then converted to time score by applying the following formula:

\[ \text{Time} = \sqrt{\frac{2x \text{Distance the scale falls}}{\text{Acceleration due to gravity}}} \]

**Hand Steadiness**

The hand steadiness was measured by the Test of hand steadiness on the Steadiness Tester, supplied by the National Psychological Corporation, Agra. This apparatus had nine
holes of different diameters arranged in sequence from big hole to small hole, four in the top row and five in the bottom row and a light indicator. There was an electrical circuit key which was attached to the light indicator as well as to the different holes which when inserted in a hole and touched any side of the hole put the light indicator on and this was a signal for the error score to be recorded which was written under a particular hole as all the holes had been assigned certain error score.

Prior to the hand steadiness data collection each player was given five trials at the beginning to facilitate orientation into the procedure of this test.

For measurement of hand steadiness the player sat in a chair and held the key in the hand he preferred. The hand holding the key was not allowed to touch any part of the hand steadiness apparatus. When the subject was ready, on the command “start” he inserted the key one by one in all the holes as fast as he could because the time was also clocked to complete all the holes. The stop watch being started on the
command "start" and stopped after the key was inserted in the last hole. The test desired the subject to insert the key in the sequence in which they were given form bigger hole to smaller hole. Whenever the light indicator was put on, the error score of that hole in which the key was inserted at that time was noted and the total error score was recorded in this manner.

Three trials were given to each player and the average of the three total error scores and the three time scores were recorded as the error score and time score for each player. This error score and time score were then converted to standard scores (Z-scores) and the average of these two constituted the hand steadiness score for each player.

In this test greater error score and more time taken to complete all the holes meant lack of steadiness and vice versa, and the standard scores were assigned accordingly, in a reverse manner less time for more points.
Depth Perception

The depth perception was measured by using Depth Perception Box, supplied by the Biological Concern, Calcutta. This box contained three steel rods of similar diameters which could be seen through the slit against an illuminated white background. Two of the rods (outers) were fixed rods whereas the middle rod (inner) could be moved towards or away from the observation slit. A metric scale on the top of the box indicated the distance of the movable rod from the fixed rods on either side as desired. The center point of the metric scale which was directly above the line joining the fixed rods was marked zero, and the scale read from zero to fifty centimeters on either side of zero. An iron plate of similar width as that of the box but projected upwards prevented the player to see the metric scale.

Before collecting the data on depth perception all the players were explained the test clearly and the necessary amount of practice trials were given to all till they became familiar with the procedure of the test.
The player sat on a stool of adjustable height in such a position that the observation slit of the box was in level with his eyes and at such a distance from where he could see the steel roads only agains the illuminated white background and no other part inside the box. The research scholar stood on one side of the box and moved the middle rod towards inner side of the box (slit side) and then slowly towards fixed rods (inner to middle) and asked the subject to indicate when the player felt that the middle rod has come in line with the fixed rods. The research scholar noted the actual distance from the zero mark. Similarly outer to middle (from illuminated white background side to middle) the rod was moved and reading noted.

Three trials each from inner to middle and from outer to middle were given to each player and the least distance for both sides out of the three trials was taken as the depth perception score. This score was further rounded off to the nearest centimeter as per the prescribed procedure.
The inner to middle score and the outer to middle score were then correlated to reduce the depth perception score to single instead of two scores but based on a very high correlation \( r = .91 \).

Depth perception was selected as it had greater relevancy with the table tennis, as the person has to make judgment in relation to three dimensions.

**Pulse Rate**

The pulse rate was counted by palpating at the wrist (radial artery) for one minute. The score was expressed in terms of number of pulse beats per minute.\(^5\)

The test was conducted in early hour of day when the players were at rest. Total number of pulse beats per minute for each player was recorded as the score.

**Galvanic Skin Resistance**

Psycho-physiological techniques, wee one is not dependent upon the subject or the subject cannot manipulate

---

\(^5\) Lawrence E. Morehouse an Augustus T. Miller, "Physiology of Exercise" (Saint Louis : C.V. Mosby Co., 1971) p. 82.
the situation in anyway. Under such circumstances psychophysiological measures seem to be more acceptable. The electrical resistance of the skin varies spontaneously and in response to stimuli as well. Such responses to stimuli were called psycho galvanic reflex and certain other terms, like Galvanic skin response (G.S.R.) electrodermal response.

It may be mentioned that through skin resistance (in terms of raw ohms) is technically easier to measure and there is evidence that conductance is a better measure. Skin resistance is one of the psycho-physiological measures. The basis principle underlying this technique is that a constant current is passed through the subject via two electrodes and the voltage engendered across the skin is recorded. According to Ohms’ law (V = IR) where, his constant and V is proportionate to R (V stands for voltage and R for Resistance). In the present study the technique of Lader and Wing⁶ (1966) has been employed. In the present study the right thumb of the player was chosen as the “active” SR site, as it is a flatter

---

and more extensive surface than the other fingers. The site of inactive electrode is immaterial and the lateral surface of the right fore arm about 10 cm below the lateral epicondyle of the humerus was used.

Grease solvent, such as Carbon tetrachloride has been used by many researchers to prepare the skin under the active electrode. Solvents may have a deleterious action on the semi-permeable membranes of the sweat glands. In the present experiment the selected site of the thumb was wiped dry with a cotton wool swab, as was recommended by previous investigators.

**Procedure:**

The experiment was conducted in a room where recording instrument was kept by the side of the players bed. Long cables joined the connectors and the appropriate pre-amplifiers of the recording.

The procedure employed for collection of the skin resistance data may broadly be divided into the following steps.
Step-1 : On arrival, the nature of the experiment was explained to each player and any procedural questions answered.

Step-2 : The subject was then prepared for the experiment i.e., SR recording Electrode were applied in appropriate places and positioned properly.

Step – 3 : Amplifier was calibrated and all necessary arrangements were made for recording the skin resistance measure.

Step – 4 : At this stage the subject was given the instruction “Please lie down on bed comfortably and relax as much as possible. Be sure that your arms are in comfortable position. Please try to keep them without any movement. You will relax keeping your eyes closed. During the experiment if you experience any difficulty please let me know.

Step – 5 : The main light of the room was switched off leaving the illuminated by shaded wall lamp in a corner.
Step – 6 : Both the electrodes were plugged in and the SR instrument was calibrated. Then the instrument was switched to the player and a constant current of 14 amp/cm² was passed through the electrodes and the voltage across the player was balanced. The sensitivity was increased usually 20 to 50 Kilo Ohms if necessary. Re-adjustments were necessary during the recording session if the player’s SR altered much in either direction, or if the sensitivity was found to be inappropriate to the size of the responses. After the instrument was switched on the recorded of the psycho-physiological measure on the subject started, and it continued for 5 minutes, hereafter called “basal recording” in resting condition.

Step – 7 : The electrodes were removed from the subject and was asked informally if subject felt any disturbance during the testing session.

Scoring :

The psycho-galvanic reflex has been measured in many units including change in resistance, change in conductance,
change in log conductance and various ratios of change score to background level are raw resistance unit (Kilo Ohms) and response with log change in conductance (Micro Ohms) as also reasonably satisfactory for the responses.

SR level were read off at 15 sec interval for a period of 5 minutes. Each recording was converted into log conductance values (in Micro Ohms). The average of all the readings was calculated and noted as score for a given player. Low skin conductance score means low ANS arousal and high skin conductance means high ANS arousal.

**Statistical Techniques for Analysis of Data**

Every form of descriptive statistics were used to describe the profile on selected psycho-physiological parameters of National Table Tennis players, which included mean, standard deviation, skewness, kurtosis, range of score, highest and lowest score, coefficient of variance. The level of significance was set at .05 level of confidence.