Chapter III

PROCEDURE

This chapter includes the procedure adopted for selection of subjects, selection of variables, reliability of data, collection of data and statistical techniques employed to analyse the data.

Selection of Subjects

For the purpose of this study two hundred college students acted as the subjects. Out of a total of two hundred, one hundred students constituted sportsmen group and the other one hundred represented the non-sportsmen group. The sportsmen group comprised of students from Lakshmibai National College of Physical Education, Gwalior, who had participated in the All India Inter-University Competitions during the years 1985-86 and 1986-87 in selected sports, i.e., basketball, cricket, football, hockey and volleyball. Each selected sport was represented by twenty subjects.

Lakshmibai National College of Physical Education, Gwalior, being a professional training college where student's admission was based upon physical fitness and
a satisfactory level of sport performance, it was practically impossible to get a non-sportsmen group from this college. To select a group of non-sportsmen, therefore, an equal number of subjects was randomly drawn from Arts Colleges of greater Gwalior representing the same age (ranging from eighteen to twenty four years), class and socio-economic groups. It was ensured that subjects who had participated at any level of competition were not included in this group. The break up of the students, belonging to non-sportsmen group and colleges from which they were drawn are presented in Table 1.

<table>
<thead>
<tr>
<th>Name of College</th>
<th>Number of subjects in Selected Sports</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Basketball</td>
<td>Cricket</td>
</tr>
<tr>
<td>MLB Arts &amp; Commerce College,</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Gwalior. INDIA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLP Govt. College, Morar,</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Gwalior. INDIA.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>University Teaching</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Department, Jiwaji University,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gwalior. INDIA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>
Selection of Variables

Proficiency in any sport requires the ideal combination and interaction of numerous abilities developed to an ideal degree. Performance is not only dependent upon the athlete's motor abilities and physical characteristics but upon the cognitive and perceptual abilities as well.

Kinesthetic perception involves organization and interpretation of the speed, extent, and duration of movement (Coan\(^1\), Scott\(^2\)). This ability is closely related to visual process (Smith\(^3\), Thruston\(^4\)) and judgement ability of time intervals (Olsen\(^5\), Weber\(^6\)). Obviously

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\(^2\)Scott, Research Quarterly: 324.


the activities which involve catching, throwing, kicking and striking the ball are heavily loaded with perceptual factors.

The accurately perceived relative position of objects to each other and the athlete to the objects enable him to execute appropriate responses. Over a long period of research Fleishman had identified dimensions underlying human performance in two categories: the physical proficiency area and psychomotor area.

It was, therefore, considered reasonable to select kinesthetic perception, depth perception and time sense as psychomotor components for the present study.

The motor fitness components chosen for the study were speed, agility and co-ordination. The reason behind this choice was that the tests of speed and agility involved total body movements which were quite similar to the actual game situations in basketball, cricket, hockey, football and volleyball. Testing of two hand coordination component involved bodily movement which was

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more of a neural function, therefore, the similarity with psycho-motor components guided the selection of this component.

Reliability of Data

The research scholar established the instrument reliability, tester's competency and reliability of tests which in-true assured the reliability of data.

Instrument Reliability

All the instruments used in this research investigation were found to be quite precise and reliable.

Depth Perception Apparatus was quite reliable to measure the depth perception ability of the subjects as it was manufactured and supplied by a competent firm, Biological Concern, Calcutta.

The accuracy of Electronic Time Sense Apparatus and Electrical Two Hand Coordination Apparatus was guaranteed by Anand Agencies, Pune.

Bicycle Ergometer was used to induce physical fatigue in the subjects. The ergometer manufacturers guaranteed the precision and accuracy of this bicycle.
Simple stethoscopes were used to assess the pulse rate of the subjects in relation to the inducement of physical fatigue. All the stop-watches utilised to administer physical fatigue and to measure time in 50 yards Run Test, SEMO Agility Test and Two Hand Co-ordination Test were Swiss Made. The suppliers, Krishna Watch Company, Bombay, assured the accurate calibration of their watches.

A calibrated steel tape of superior quality and with ISI mark was used to mark the requirement of various tests.

Thus the instrument reliability was assumed.

Tester's Competency and Reliability of Data

Test-Retest Method was employed to establish the reliability of tests as well as the tester's competency. For this purpose five subjects from each group, i.e., sportsmen and non-sportsmen, were selected randomly. Testing and re-testing was administered by the same tester on the same ten subjects with one day's gap in-between under utmost similar conditions on the tests of depth perception, time sense, kinesthetic-perception, running speed and two-hand coordination.
SEMO's Agility Test was considered to be fairly reliable to measure agility of the subjects on the basis of it's co-efficient of reliability being 0.88 as reported by Johnson and Nelson. This reliability co-efficient, therefore, was accepted for the purpose of this study.

The obtained Pearson's Product Moment Correlation co-efficients were found to be statistically significant at .01 level of confidence (Table 2).

**TABLE 2**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Tests</th>
<th>Co-efficient of Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Depth Perception Test</td>
<td>0.88</td>
</tr>
<tr>
<td>2.</td>
<td>Time Sense Test</td>
<td>0.85</td>
</tr>
<tr>
<td>3.</td>
<td>Kinesthetic Perception Test</td>
<td>0.60</td>
</tr>
<tr>
<td>4.</td>
<td>Two Hand Co-ordination Test</td>
<td>0.81</td>
</tr>
<tr>
<td>5.</td>
<td>50 Yards Run Test</td>
<td>0.91</td>
</tr>
</tbody>
</table>

Therefore, the tests selected for the purpose

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of the study were highly reliable and tester proved to be competent to administer these tests.

Pilot Study

As per the requirements of the study the physical fatigue was induced with the help of bicycle ergometer. Three different fatigue levels were selected in order to study their effects on the chosen variables. The criteria to be set for each fatigue level was the pulse rate, i.e., 120-130 bpm - low level fatigue, 140-150 bpm - moderate level fatigue and 160-170 bpm - high level fatigue. In order to determine the load which would elicit a desired pulse rate for each level a pilot study was conducted.

For this purpose five subjects from each group, i.e., sportsmen and non-sportsmen were drawn randomly. Each of these ten subjects were made to pedal the bicycle ergometer (at the rate of 50-70 rpm) for the duration of five to seven minutes during which the work-load was administered systematically to meet the pre-determined criteria of pulse rate. The statistical analysis of obtained data led to the following conclusions:

1. To attain low level physical fatigue condition it was needed to pedal the bicycle ergometer at a work-load of 450-600 Kpm/min, which raised the pulse rate between
120-130 bpm.

2. To obtain moderate level physical fatigue condition the bicycle ergometer had to be pedalled at the work-load of 600-750 Kpm/min. which raised the pulse rate between 140-150 bpm.

3. To induce high level physical fatigue condition the bicycle ergometer had to be pedalled at the work-load of 750-900 Kpm/min. which raised the pulse-rate between 160-170 bpm.

Thus to induce three different levels of physical fatigue the load was regulated through intensity and not through volume. In other words in this process the time duration was constant i.e. five to seven minutes, whereas the physical work-load was subjected to specified altera-
tions.

Collection of Data

In order to acquaint the subjects with the purpose of research being conducted, all the subjects were assembled near the Human Performance Laboratory of Lakshmibai National College of Physical Education, Gwalior. All the necessary informations pertaining to the requirements of the experimental procedure of adminis-
tering selected tests were imparted to them. To make
the research findings more authentic, positive attitude towards performing the tests to their best ability was emphasised.

Professionally trained colleagues assisted the research scholar in collecting data on selected tests. The tests on depth perception, time sense and two hand co-ordination were conducted in the Human Performance Laboratory, whereas, the testing on kinesthetic perception, running speed and agility was conducted on the field adjoining that laboratory.

In order to induce the varying levels of physical fatigue the subjects were made to pedal bicycle ergometer where the work-load could be automatically set to attain the desired pulse rate. Three different levels of physical fatigue were induced in the subjects. This was carried out in the same laboratory. The four sets of the scores were obtained on each of the selected psychomotor and motor ability components, i.e. under normal condition, after low level fatigue, after moderate level fatigue and after high level fatigue.

After inducement of one particular level of physical fatigue at a time only one test was administered so that the influence of fatigue could be correctly
assessed. Further, adequate rest period of minimum twenty four hours was provided to each subject to ensure complete recovery from fatigue before administering the next desired level of physical fatigue. The subject was advised complete rest during the days of actual testing so that the influence of fatigue condition resulting from such participation could be eliminated.

**Administration of Tests**

**Depth Perception Test**

**Purpose**

To measure the ability of subjects to judge the distance of objects or relative distances.

**Equipment**

Depth Perception Box\(^9\)

**Procedure**

Depth perception box was a hollow wooden box which had a metric scale on its top. This scale had the zero-point at its middle and it was calibrated into

\(^9\)Manual of Depth Perception Box (Calcutta: Biological Concern).
fifty centimeters at each side of the zero-point. There was a slit at one end of the box and an illuminated white background at the other end. Inside the box there were three still rods of same dimensions which could be seen through the slit. Two outer rods were fixed whereas the middle one was movable either away or towards the slit-end. There was a plastic handle on the top of the box with the help of which the middle rod could be moved. At the slit-end an iron plate was fixed in such a way that the subject could not see the calibrated scale.

The subject was seated on a stool at the slit-end. The height of the stool should be adjusted in such a way that when seated on it, the subject's eyes should be at level with the observational slit seeing the rods against the illuminated background (Fig. 1).

The tester stood at the right side of the box and moved the middle rod from the illuminated end of the box towards the middle of the box. The subject was instructed to immediately indicate the moment he could see the middle rod to be in line with those two fixed rods. The deviation from the mid zero-point was recorded from the metric scale. The same procedure was repeated
Fig. 1. Depth Perception Test
while moving the movable rod from the slit end towards the middle of the box.

**Scoring**

Three trials were provided to each subject in each direction. The minimum score was obtained out of three trials and was rounded off to the nearest centimeter. Thus two sets of score were obtained, i.e. while moving rod from illuminated end and slit end towards the middle of the box. Co-relation was computed between these two sets of scores and on the basis of high correlation co-efficient any one of the set of scores was taken as depth perception score of the subjects.

**Kinesthetic Obstacle Test**

**Purpose**

To assess the ability of the subjects to predict position during movement without using eyes.

**Equipments**

Twelve chairs or similar objects, material for blind folding, chalk markers and tape measures.

**Procedure**

An area of forty feet long and three feet nine inches
in width was marked on the floor. Twelve chairs or similar objects were arranged in the particular pattern as indicated in the literature.¹⁰ (Fig. 2).

Each performer was allowed one practice trial walk through the course without a blindfold and one walk through the course blindfolded for a score.

**Scoring**

The performer scored ten points for clearing each station successfully without touching. There were ten stations for a maximum score of 100 points.

For touching one station there was a penalty of ten points and in such a case the performer was directed to the centre line one step ahead of the station where the penalty occurred. There was a five-point penalty for each occurrence of getting outside the line or pattern of chairs and then the performer was directed back into the centre of the pattern at the nearest pattern from which he went astray.

FIG. 2 KINESTHETIC OBSTACLE TEST
Time Sense Test

Purpose

To measure the ability to judge the time period elapsing between on-set and cessation of stimuli.

Equipment

Electronic Time Sense Apparatus.

Procedure

Time Sense Apparatus\textsuperscript{11} was an electronic device to measure the time sense ability of an individual. This apparatus has been shown in the figure 3. On the left side of the front surface, there were nine knobs arranged in three horizontal rows and through these the apparatus could be set at desired time periods or intervals. On the right side there was a switch to put the apparatus electrically on or off. Also, there were certain more switches to provide particular types (empty or filled) of auditory stimulus.

In this study the apparatus was set at the time periods of 5.0 seconds, 10.0 seconds and 15.0 seconds at

\textsuperscript{11}Manual of Electronic Time Sense Apparatus (Pune: Anand Agencies).
Fig. 3. Time Sense Test
a time. The stimulus was of an empty type or in other words a sound was made and it reappeared at the end of 5th second or whatever the time period was set. The subject was seated on a stool with his back towards the apparatus and the tester operated the instrument as discussed above. The subject was instructed to sense the time elapsing between the on-set and cessation of the stimulus and to tell it to the tester which was recorded by the tester. A practice trial was given to each subject before the actual testing.

**Scoring**

As the apparatus was set at three different time periods, (5.0 seconds, 10.0 seconds and 15.0 seconds) each subject was given three trials on each of these time settings. This was deducted from the seconds on which the apparatus was set. Mathematical sign was not considered. Best of the three trials was considered as time sense score of the subject. Thus three sets of scores were obtained for the subject as the apparatus was set at three different time periods. These three scores were added up together to provide a single score on time sense of the subject in seconds.
SEMO'S Agility Test

Purpose

To measure general agility of the body in maneuvering forward, backward, and sideward.

Equipments

A smooth area of 12 by 19 feet with adequate running space around it, four plastic cones (9 inch by 9 inch base with 12 inch height) and stop watches.

Procedure

The area was marked according to the instructions in the literature and as depicted in the figure 4.

The subject stood outside the marked area at A with his back to the area. On the command "Ready, Go" he side-stepped from A to B and passed outside the corner cone. Then he back pedalled from B to D and passed to the inside of the corner-cone. He had to sprint from D to A and to pass outside the corner cone. He then back pedalled from A to C and passed to the inside of the corner cone.

FIG. 4. SEMO AGILITY TEST
He then sprinted from C to B and passed outside of the corner cone. He then side-stepped from B to the finish line at A.

**Scoring**

The elapsed time from the starting signal till the runner crossed the finish line was recorded to the nearest 1/10th of a second.

**Fifty Yard Dash**

**Purpose**

To measure speed of the subject.

**Equipments**

Stop watches and an levelled area of more than fifty yards.

**Procedure**

The subject positioned behind the starting line. The tester commanded, "Are you Ready" and "Go" which was accompanied by a downward drop of his arm so that the timers at the finish line could start the watch. The subject had to run as fast as possible across the finish
Scoring

The elapsed time from the starting signal until the runner crossed the finish line was measured to the nearest one tenth of a second.

Two Hand Co-ordination Test

Purpose

To measure two hand co-ordination ability.

Equipments

Electrical Two-Hand Coordination Apparatus which was a modified form of the original Lathe Test of C.L. Null, chronoscopes and stop watches.

Procedure

The Two-Hand Co-ordination Apparatus\(^{14}\) was an electrical apparatus consisting of a hollow wooden box.


The top surface of the box was metallic which had a particular pattern extending horizontally originating at one end and ending at the other. A movable metallic pointer was arranged inside the box which could be manipulated vertically and horizontally with the help of two handles. This pointer was used to trace the pattern which existed on the upper surface of the box. The box was attached to a chronoscope (Figure 5).

The apparatus was arranged on the table and the subject was seated on a stool. The subject was instructed not to sit in a position from where he could see the base of the pointer inside the box. A practice trial was permitted. For testing, the subject was instructed to trace the pattern in shortest possible time and also with minimum errors. Here, the error meant touching the sides of the pathway by the pointer. As long as the pointer remained in contact with the sides of the pattern, the time period was recorded by the chronoscope as error time of the subject.

The subject had to control the pointer with the help of two handles manipulated by the co-ordinative abilities of both the hands.
Fig. 5. Two Hand Coordination Test
Scoring

The time taken to trace the complete pattern was recorded by the stop watch. The time which was recorded by the chronoscope as error-time, it was added to the time recorded by the stop watch. The time in seconds was the subject's score on two hand co-ordination component.

Experimental Variable

In order to study the effect of physical fatigue on selected psychomotor and motor ability components of sportsmen and non-sportsmen, the experimental variable was the physical fatigue.

The three levels of physical fatigue were induced by pedalling a bicycle ergometer at particular work-loads for specific duration of time to elicit the required pulse-rate (set through a pilot study). These levels were as followed:

a) Low level physical fatigue (120-130 bpm) induced by pedalling the bicycle ergometer for 5.0 to 7.0 minutes work load of 450-600 Kpm/min.

b) Moderate level physical fatigue (140-150 bpm) induced by pedalling bicycle ergometer from 5.0 to 7.0 minutes at the work load of 600-750 Kpm/min.
c) High level physical fatigue (160-170 bpm) induced by pedalling the bicycle ergometer from 5.0 to 7.0 minute at the work load of 750-900 Kpm/min.

As soon as a particular level of physical fatigue was induced the subject was tested on one of the selected psychomotor and motor ability components.

Statistical Techniques Employed to Analyse Data

To analyse the effects of varying levels of physical fatigue (normal condition, low level fatigue, moderate level fatigue and high level fatigue) on each of the selected psychomotor and motor ability components of sportsmen and non-sportsmen groups Two way of Analysis Variance\textsuperscript{13} was employed.

To test the significance of the post hoc differences between means, if any, Scheffe's Test\textsuperscript{14} was applied. The hypothesis was tested at a set level of .05 level of confidence.


\textsuperscript{14} Ibid., p. 26.