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5.1. Variables of the study

The purpose of this investigation is to examine the effects of state and trait anxiety and intelligence on perceptual-motor and cognitive task performance. The investigator has, therefore, selected the following three independent organismic variables:

1. Intelligence
2. Trait Anxiety and
3. State Anxiety

The dependent variables of the study are:

1. Perceptual-motor performance and

5.2 Tools used

The study is carried out on the X, XI and XII standard students. Some of them coming from the Higher Secondary Schools and some from Junior Colleges located in Pune. The schools, selected for study are Central School (Aundh) and Nandadeep High School (Laxminagar) and the colleges are Fergusson, Modern and Garware College.
This being an experimental work to be carried out in the laboratory, the researcher could achieve finer control over the measures of performance in this study. The selection of the sample is also done by using the Indian Adaptation of the Standardized American Tests.

5.2.1 State-Trait Anxiety Inventory (STAI)

The State-Trait Anxiety Inventory (STAI) provides reliable, relatively brief, self-report measures of State and Trait anxiety. Spielberger, Gorsuch and Lushene developed STAI in 1970. The A-State Scale of STAI consists of 20 statements, which ask people to respond how they feel at a particular moment or time. The responses are scored by the weighted scoring system, indicating the intensity of state anxiety. The A-Trait Scale of STAI included 20 statements which ask people to respond how they generally feel. In this scale also, the responses are scored by the weighted scoring system indicating the frequency of occurrence of anxiety in their life.

The investigator used Marathi translation of STAI developed by Deshpande and Aljapurkar (1988). An effort was made in Marathi translation by the authors to retain the essential content of the original items. The feeling connotations of the English expressions rather than the literal meaning of the words were maintained.

The Marathi A-Trait Scale was correlated by the authors with Manifest Anxiety Scale (MAS) and the correlation reported between the two on the Junior College students was high positive ($r = .64$).
Alpha reliability for A-Trait was .80 and for A-State was .83. Instead of using the American norms developed by Spielberger et al (1970) or the norms on the North Indian Hindi population by Sagar Sharma (1973), the percentile norms of the Marathi STAI are used by the investigator for selecting High and Low anxious groups. The Marathi STAI is enclosed in the Appendix.

5.2.2 Kuhlman-Anderson Test of Intelligence

Kuhlman-Anderson Test of intelligence (1927) serves the purpose of assessing the verbal and non-verbal functions. It can be used from the 1st grade through Grade IX to maturity and enables both vertical and horizontal comparisons. At lower levels, it is loaded by persistence and at higher levels, it is more loaded by vertical functions. The scale included 89 subtests, 10 for each grade level.

The Marathi Adaptation of Kuhlman-Anderson Test is done at Dnya Prabodhinee, Pune (1979). The subtests prepared for standard 9th, 10th and 11th are used to select the High and Low Intelligent groups.

This test can be administered to a single individual or to a group of individuals at a time. The correlational analysis reveals that the reliability co-efficients vary from .56 to .90. The predictive validity was found to be very low (0.16). The subtests are enclosed in the appendix.
5.2.3 Chronoscope-Counter: An apparatus for measuring performance:

Chronoscope counter is a unique instrument specially designed for use in psychology laboratory. It provides means of accurate measurement of time up to 60 minutes and with accuracy of microsecond. Minimum unit of time displayed is millisecond. Bright seven segment light illuminating display (LED) is used to show milliseconds, seconds and minutes. This instrument also has 6 digit counter which can count the events electrically detected by incoming contacts. Counter can be independently reset to zero. Same LED facility is used for indicating the count as well as time by simple selection switch. The timer can be set to zero by reset button. It can be started by pressing 'start' button and stopped by pushing 'stop' button. These start-stop operations are also activated by incoming signals for use as automatic chronometric applications.

For operating timer there are three switches on the left. The GREEN switch is for starting timer, the RED one is for stopping and the BLACK is for resetting the timer to zero. In addition to these switches, two more points on the back panel are brought out for connecting it or operating it from the external devices. There are three terminals on the back panel. GREEN terminal is for starting the timer. RED for stopping it and the third one is used in the counter mode. The start-stop functions can be actuated by making these points logically low i.e. connecting them to GND (0V) which is provided on front panel and named as stylus.
For operating counter the count input terminal is provided on the black panel (Black coloured binding post), this also gets activated by making it logically low. This counter counts the logic-low states. Two more switches are provided on the front panel on the right side, one named RESET which is for setting the counter to zero and the other one is for enabling or disabling the counter to count input logical low states. An audio feedback is also provided. Whenever the count input is held at logic-low, the buzzer gets on and produces sound.

This instrument works on 230 V 50 Hz. Ac. input, a power input socket and an on/off switch is provided on the back panel. A fuse for protection is also built in the socket which can be replaced in case of problems.

The chronoscope-counter can be electrically attached to a number of apparatus which measures performance in motor, perceptual-motor or psycho-motor tasks. It is tested in the experimental psychology laboratory on the following apparatus:

1. Bolt-head maze
2. Mirror-drawing apparatus and
3. Two-hand co-ordination apparatus.

A minor adjustment is to be made in the above mentioned apparatus before chronoscope-counter is attached to them. Audio feedback for errors is also available in this instrument.

A primary concern in the design of the apparatus was high reliability of performance. This has been achieved. Chronoscope-counter
has been used by the researchers and it has given fairly accurate measures of performance.

5.3. Sample Selection

The investigator administered the Marathi A-Trait Scale to a group of 30 students at a time, covering about 670 students from different Higher Secondary Schools and Junior Colleges of Pune City. The test required about 20 minutes to administer. After the administration, scoring was done according to instructions given in the manual. The students who scored more than 46 (Q 3+) and less than 36 (Q 1-) were sorted out. The former was labelled as High Anxious (HA) and the latter Low Anxious (LA). In the HA group, there were 185 students and in the LA group, 170 students. These 355 students (185 + 170) were again contacted for testing of intelligence.

The Marathi adaptation of Kuhlman-Anderson Test of intelligence was administered to these 355 students using each time a group of 20. The ten subtests were administered one after the other, giving instructions for each subtest at a time from the manual. The actual time for all the 10 subtests was 27 minutes but with the instructions of the tests it took about 40 minutes.

After all the 355 students have taken these subtests, scoring was done according to the instructions given in the manual. The scores were then subjected to statistical treatment. The Q 3 and Q 1 values were calculated and those who scored more than 60 (Q 3+) and less
than 40' (Q = 1 - ) were sorted out. 97 students fell into 1st group i.e. High Intelligent and 93 students were in the second group viz. Low Intelligent.

After the administration and scoring of the test of anxiety and intelligence, the following sample was available for the experimental work.

High Anxious and High Intelligent \(-\) \(N = 53\)
High Anxious and Low Intelligent \(-\) \(N = 47\)
Low Anxious and High Intelligent \(-\) \(N = 44\)
Low Anxious and Low Intelligent \(-\) \(N = 46\)
\[N = 190\]

5.4.  Experimental Design

The experimenter has selected the High Intelligent and Low Intelligent subjects on the basis of the Kuhlman-Anderson Test. This Independent variable has two levels (High and low). The trait anxiety also has two levels, viz. high and low. The design of the experiment is, therefore, 2 x 2 factorial, with 20 subjects per cell. 80 subjects from the above were chosen randomly for the perceptual-motor task.

Similarly, the 2 x 2 factorial design was used with the same Independent variables. Other 80 subjects were randomly selected for the cognitive task with 20 subjects per cell.
5.5. Experimental task:

5.5.1 Perceptual-motor task: Two-Hand

Co-ordination Test:

This test, devised by Thurstone, requires the subject to do two things simultaneously and has a perceptual component. The test is given with the simple equipment in figure 5.1, 2, 3. It consists of two styluses, one for each hand and the two circular plates on a board 25 cms. by 45 cms. Each of the two circular plates is divided into four sections as shown in figure 5.1, 2, 3. The four sections are numbered as 1, 2, 3 and 4 on each plate. The diameter of the circular pattern is 52 cms. The board is viewed so that each contact of the stylus with one of the four sections can operate the Chronoscope-counts attached to it.

The test is given in three parts:

1. The right hand alone on the right circular pattern.
2. The left hand alone on the left circular pattern and
3. Both hands simultaneously on the two circular patterns.

The subject is asked to tap with a stylus on the sectors numbered 1, 2, 3 and 4 in rotation as fast as possible. The experimenter controls the 30 second time interval on the Chronoscope-counter. The total number of correct taps in 30 sections is recorded.

Doing the test either by left or right hand is not difficult for the subject but because of the lack of symmetry in the four corresponding pairs of sectors, many subjects find it extremely
TWO HAND COORDINATION TASK (RIGHT HAND)

FIG. 5.1
TWO HAND COORDINATION TASK (LEFT HAND)

FIG. 5.2
difficult in doing the task simultaneously by both hands. This motor test is related somehow to other more sensory tasks which also involve a breakdown of a perceptual configurations into distinct parts.

5.5.2 Cognitive task: Letter Transformation:

The other task used was a letter transformation task first described by Hamilton, Hockey and Rejman (1977). The task involves transforming between 1 to 4 letters by moving a given distance through the alphabet and then producing the results of the transformation as the response. For example, the answer to the one letter problem 'D + 2' is 'F' and the answer to the four letter problem 'RDGE + 4' is 'VHKT'. All the letters must be transformed before the answer is given.

Eight versions of the letter-transformations-task were used in this study. The number of letters was 1, 2, 3 or 4 and the size of the transformations was either 2 or 4. The task was so prepared that the same alphabet never appeared in the problem. The letters were selected at random from the letters A-V. The investigator prepared five blocks of letters, in each block, there were four combinations of letters, namely 1 letter, 2 letters, 3 letters and 4 letters. The total combinations in five blocks, therefore, were 20 (4 \times 5 = 20). A block of trial consisted of only four combinations of letters with the size of transformation two and four letters. The investigator wrote these combinations on the paper and kept them ready for presentation to the subjects. The subject was supposed to speak out the answer immediately.
5.6. Actual Procedure

5.6.1 Two hand coordination experiment:

The experimenter prepared the list of the students selected for the experimental work. She invited a batch of 20 students per day for the experiment on two-hand co-ordination. The experiment was conducted in the psychology laboratories of Fergusson, Modern and Garware Colleges.

The experimenter arranged the two-hand co-ordination apparatus, with its electrical connection to chronoscope-counter, the instrument for measuring the taps in a specified time. Before starting the experiment, the subject was administered Marathi State Anxiety Inventory. The instructions as per the manual were given to the subjects for the test. After the test was over, the experimenter scored the responses and labelled the subjects as high and low anxious as per the Indian norms of this Inventory. Then two-hand co-ordination experiment was performed on the subject and given the following instructions:

"This is an apparatus in which there are four sectors numbered 1, 2, 3 and 4. You will be given a stylus. Hold it with your right hand. You have to tap on all the four sectors in rotation as fast as possible for 30 seconds. Your taps are going to be recorded. You will be given a few preliminary trials for familiarizing with the task. If you have any question, please feel free to ask me."

The subject did this task for 30 seconds and the experimenter recorded the taps for both the hands which was his score for double task. In the two-hand co-ordination experiment, the experimenter obtained three scores: i.e. (1) Right hand performance, (2) Left hand performance, (3) From two hands together i.e. double task performance.

In case of all the 80 subjects, the experimenter recorded the number of taps, they have correctly made in 30 seconds.

The investigator invited the selected subjects in a batch of 20 per day. Each subject was given the Marathi Adaptation of State Anxiety Inventory and his responses were scored according to the manual of STAI and the subject was labelled as high or low state anxious.

5.6.2 Letter transformation experiment

The subject was given the following instructions for the letter-transformation task:

"I shall write on the black-board a single letter or the combination of letters and will be shown to you only for 20 seconds. You have to concentrate your attention on these letters. After 20 seconds, these letters will be rubbed and I will tell you the size of transformation, i.e. 2 or 4 letters. If I say "2" and if the letter is "D" then you will have to speak out loudly the letter which would come after two places after "D" i.e. "G". Similarly, if a two letter combination, i.e. "FT" is given and the size of transformation is 2, then you will have to speak
out "IW". The same procedure is to be followed for the size of transformation of 4. You will be given 10 seconds time to give the required transformed letters."

The subject was given some letter combinations as a practice trial and was asked to reproduce the correct transformed letters. The experimenter confirmed that the subject has followed the instructions and then the actual experiment started.

Each subject from the following four groups:

1. High Anxious and High Intelligent
2. High Anxious and Low Intelligent
3. Low Anxious and High Intelligent
4. Low Anxious and Low Intelligent.

was given five blocks of trials, each consisting of 4 different letter combinations with two sizes of transformations \((5 \times 4 \times 2 = 40)\). The experimenter then checked the accuracy of responses and correct score was recorded for each subject. This was the score of subject for his cognitive task performance.

From the experimental work the investigator obtained the following scores:

1. Perceptual-motor performance (single task) 80 scores for right hand and 80 scores for left hand.
2. Perceptual-motor performance (Double task) 80 scores.
3. Cognitive task - 80 scores.
When the subject followed all the instructions, he was given two preliminary trials. The experimenter confirmed that the subject has followed the instructions. Then the actual experiment began with the right hand for a trial of 30 seconds. After the trial was over the experimenter recorded number of taps from the Chronoscope-counter.

In the second part of the experiment, the subject was asked to do the same task with the stylus in his left hand. The number of taps made by the subject in a circular pattern in 30 seconds were recorded by the experimenter from the Chromoscope-counter.

In the third part of the experiment, the subject was provided with two styluses, one for the left and the other for right. He was instructed to tap the corresponding pairs of plates in numerical order as rapidly and as accurately as possible by two styluses.

The experimenter first demonstrated the nature of this double task and subject was allowed to do two preliminary trials. When the experimenter was satisfied that the subject followed the task, he instructed the subject to tap the two number-plates simultaneously in its order. He should not use one hand at a time but both the hands simultaneously. The necessary electrical connection was made so that the Chronoscope-counter was operated only when one stylus touches the sector on right side and sector two on the left side and similarly the other pair of sectors.
The above scores were for 2 x 2 factorial design for Trait Anxiety and Intelligence as independent variables.

When the state anxiety scores of the subjects were tested against the norms, the experimenter got the following groups, when combined with their scores on intelligence test:

1. High State Anxious - High Intelligent = 16
2. Low State Anxious - High Intelligent = 24
3. High State Anxious - Low Intelligent = 24
4. Low State Anxious - Low Intelligent = 16.

The experimenter obtained three scores from the subjects on perceptual-motor task and one score cognitie task, for all the 80 subjects belonging to different groups mentioned above. These scores were put to computer for further analysis.