CHAPTER VII

BEHAVIOURAL AND ENVIRONMENTAL CORRELATES OF ACADEMIC ACHIEVEMENT AND OVER- & UNDER-ACHIEVEMENT: A MULTIVARIATE CORRELATIONAL APPROACH
BEHAVIOURAL AND ENVIRONMENTAL CORRELATES OF ACADEMIC ACHIEVEMENT AND OVER- & UNDER-ACHIEVEMENT: A MULTIVARIATE CORRELATIONAL APPROACH

This study mainly being a correlational one, aims at investigating the behavioural and environmental correlates of academic achievement in the total sample as well as over- and under-achievers separately. Besides product-moment correlations, multivariate correlational analysis was done by working out multiple correlations. Multiple regression equations were also set up to estimate the relative contribution of different independent variables in explaining achievement (CRN). The analysis in this chapter was directed to test the following hypotheses:

1. 'Significant variance towards academic achievement is contributed by major behavioural and environmental measures, that is, adjustment personality, study habits and attitudes, achievement motivation, interests and socio-economic status for the total group (TFS), overs achievers (OAs) and unders achievers (UAs).'

2. 'Behavioural and environmental measures contribute differentially to the prediction of academic achievement of the total group, overs achievers and unders achievers individually within the group, and from group to group.'

For testing the above hypotheses, fourteen models of multiple correlations are reported here. Regression analyses were designed

* The processing of the data was done on IBM-1620 computer with memory of 20 K. Partial regression coefficients and multiple R's were calculated by the method described by Croxton and Crowden (1956, pp.549-50).
and the results are presented in Table 7.1. These throw light on the predictive value of different combinations of behavioural and environmental measures in the area of school achievement. The various models are explained in brief as follows:

MODEL I. \((\text{ADJ}^*)\) was designed to indicate how much variance towards CRN is accounted for by the linear variables of adjustment for the total group (TFS) as well as the overachievers (OAs) and the underachievers (UAs).

MODEL II. \((\text{ADJ} + \text{HSPQ}^{**})\) was designed to indicate whether the addition of linear variables of HSPQ do lead to significant increase in achievement prediction over and above the one obtained by Model I.

MODEL III. \((\text{ADJ} + \text{HSPQ} + \text{ACH MOT}^{***)}\) aided in finding out the significance of adding linear measures of achievement motivation to Model II in predicting the criterion.

MODEL IV. \((\text{ADJ} + \text{HSPQ} + \text{AM} + \text{INTS}^{****})\) allowed for assessing the effectiveness of linear measures of interest in predicting academic achievement over and above the measures of Model III.

MODEL V. \((\text{ADJ} + \text{HSPQ} + \text{AM} + \text{INTS} + \text{SES})\) helped in estimating the variance contributed by socio-economic environmental measures over and above the behavioural measure studied in Model IV.

* 'ADJ' in models refers to all the five measures of adjustment (HA, SA, HEA, SCA and TA).
** 'HSPQ' refers to all the fourteen measures of personality Questionnaire.
*** 'AM' refers to all the three measures of achievement motivation.
**** 'INTS' refers to all the ten areas of interest.
MODEL VI. (ADJ + HSPQ$_{-B}$ + AM + INTS + SES) aimed at studying the effect of four behavioural measures and one environmental measure when Factor $B$ (crystallized intelligence) of personality is taken out of HSPQ factors.

MODEL VII. (ADJ$_{-TA}$ + HSPQ$_{-B}$ + AM$_{-S_1AM}$ + AM$_{-S_2AM}$ + INTS + SES) was designed with the aim of finding out whether the total score ($TA$) of four areas of adjustment ($HA + SA + HEA + SCA$) and the achievement motivation as it is represented through two sub-scores ($S_1AM$ and $S_2AM$), when partialled out from Model VI, do effect significantly in reducing the variance contributed by these. This model studied the combined contribution of linear behavioural and environmental measures of academic achievement, minus intelligence (Factor $B$), total adjustment scores and two sub-parts of the total achievement motivation scores.

MODEL VIII. (ADJ$_{-TA}$ + HSPQ + AM$_{-S_1AM}$ + AM$_{-S_2AM}$ + INTS + SES) showed the effectiveness of adding personality Factor 'B' to the VII Model. Thus it aimed at studying the linear behavioural and environmental measures, minus total adjustment score and sub-scores of achievement motivation ($V_3$, $V_{22}$ and $V_{23}$).

MODEL IX. (ADJ + HSPQ$_{-B}$ + AM + INTS + SES + SHA) studied the joint effect of non-intellectual linear variables, plus one non-linear measure of study habits and attitudes. This model consists of Model VI + SHA to see the effect of study habits and attitudes.
MODEL X. (ADJ + HSPO + SHA + AM + INTS + SES 'Full Model') was designed to indicate the precision in prediction of achievement by all the thirty-four measures. This model is a 'Full Model' studying all the thirty-four linear as well as non-linear behavioural and environmental measures.

MODEL XI. (ADJ + TA + HSPO + SES + SHA + AM + S1AM + S2AM + INTS) indicated the effect of taking out TA, S1AM and S2AM (V5, V22 and V23) from Model X so as to see whether these variables significantly reduced the R² as obtained in Model X.

MODEL XII. (SCA + TA + P + O3 + SES + SHA + S1AM + S2AM + TAM + FA + HH) is a 'Reduced Model' for all the three groups of total final sample, overachievers and underachievers. It was designed to see the contribution of a few variables which were found to be 'common correlates' of all the three groups (vide Chapter VI, Table 6.1) that is, they were significantly correlated with the criterion measure of all the three groups. However, 'Reduced Model' of common correlates is restricted to only those correlates which were common to all the three groups. This was done with the aim of getting a Reduced Model Regression Equation and to know the variance contributed by the above eleven common correlates for predicting the academic achievement of the total sample, overachievers and underachievers for all practical purposes.
MODEL XIII. (SCA + B + SES + SHA + TAM + HH) is a 'Mini Model' of the Reduced Model where the most predictive set of six variables was picked up out of the eleven common correlates. Those variables which contributed insignificantly or negatively, were screened out. Thus, ultimately, six variables, each representing the principal behavioural or environmental domain were selected and the combination of these was studied and is represented through Model XIII.

MODEL XIV. (B + SES + SHA + TAM + HH) was constructed with a specific aim of studying the contribution of 'adjustment' that is, to compare Model XIII and XIV and to see if the measure of adjustment (SCA) is screened out, whether it significantly reduces the variance or not. Another specific aim of this model was to see whether the variance which was accounted for by study habits and attitudes in Model XIII is increased in Model XIV or not. This was done because school adjustment had high intercorrelation with study habits and attitudes. So the object of this model was to find out that if intercorrelated variable is taken away, will it significantly affect the contribution of variance towards the criterion measure or not?

The results of these models are summarized in Table 7.1. This shows nineteen columns. The first column represents the model number studied; the second column represents the variables that were combined to study the variance contributed by them towards the estimation of the criterion; the third column shows the serial

* 'Mini-Model' is a miniature model of the 'Reduced Model'.
<table>
<thead>
<tr>
<th>Models</th>
<th>Variables Combined</th>
<th>S.No. of VS considered</th>
<th>Number of VS taken into account from 'A'</th>
<th>S.No. of VS excluded from 'A'</th>
<th>$R^2$</th>
<th>$R^2***$</th>
<th>F-values</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>ADJ</td>
<td>1 to 5</td>
<td>3</td>
<td>5</td>
<td>1,4*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1,4*</td>
<td>9*,17*</td>
<td></td>
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<tr>
<td>II</td>
<td>ADJ+HSPO</td>
<td>1 to 9</td>
<td>9*</td>
<td>17*</td>
<td>1*</td>
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<td>1 to 9</td>
<td>9,17*</td>
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<td>ADJ+HSPO+AM+INTS</td>
<td>1 to 9</td>
<td>9,17*</td>
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<td>1 to 9</td>
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<td>9,17*</td>
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</table>

**Linear + Non-linear Variables**

| IX    | ADJ+HSPO+AM+INTS | 1* to 9                 | 9,17*                                 |                               |        |          |          |
|       |                   |                        | 9,17*                                 |                               |        |          |          |

**Reduced Model (Common Correlates)**

| X     | ADJ+HSPO+AM+INTS | 1 to 9                 | 9,17*                                 |                               |        |          |          |
|       |                   |                        | 9,17*                                 |                               |        |          |          |

**Mini Model**

| XI    | ADJ+HSPO+AM+INTS | 1 to 9                 | 9,17*                                 |                               |        |          |          |
|       |                   |                        | 9,17*                                 |                               |        |          |          |

**Models**

- Reduced Model
- Common Correlates
- Mini Model

**Variables Taken into Account**

- $TFS$, $OAs$, $UAs$, $TFS$, $OAs$, $UAs$, $TFS$, $OAs$, $UAs$, $TFS$, $OAs$, $UAs$, $TFS$, $OAs$, $UAs$

**F-values**

- $R^2$, $R^2***$
<table>
<thead>
<tr>
<th>Year</th>
<th>ADHS/NS-PHINT</th>
<th>SES</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
<th>XI</th>
<th>XII</th>
<th>XIII</th>
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<td>1.209</td>
<td>1.490</td>
<td>0.689</td>
<td>0.869</td>
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<td>1.131</td>
<td>1.243</td>
<td>1.204</td>
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<tr>
<td>1973</td>
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<td>1.209</td>
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<td>0.689</td>
<td>1.131</td>
<td>1.169</td>
<td>1.204</td>
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<td>1.243</td>
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<td>1.250</td>
<td>1.243</td>
<td>1.204</td>
<td>1.250</td>
<td>1.243</td>
</tr>
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</table>

N.B.: VS rotor to A D S rotors to HSPQ rotors to SHA refers to.

Linear variable:
P < .01 level
P < .05 level, All R's are significant beyond .01 level

DTS refers to ten areas of interest (1 to 10).

HSPQ refers to fourteen measures of personality (Q) as also

SES refers to one measure of study habits and attitudes.

N.B.: All R's refer to four measures of achievement adjustments (1 to 4).

(1) Non-linear variables

(2) All R's refer to four measures of achievement adjustments (1 to 4).

(3) SES refers to one measure of study habits and attitudes.

(4) All R's refer to four measures of achievement adjustments (1 to 4).
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Variables</th>
<th>Full Model</th>
<th>Reduced Model</th>
<th>Mini Model</th>
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<td>No. (Code)</td>
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<td>7.</td>
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<td>0.2030</td>
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<tr>
<td>28.</td>
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<td>0.2030</td>
<td>0.0158</td>
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<td>29.</td>
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<td>0.0176</td>
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<td></td>
<td>R</td>
<td>0.4558</td>
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linear adjustment variables \((V_2, V_3, \text{ and } V_5)\) of the total final sample contribute 20.70 per cent of the total variance, that is, 20.70 per cent of the individual differences in the total group (TFS) in school achievement can be attributed to the differences in the variables of social, health and emotional and total adjustment (SA, HEA and TA). These findings are in line with the findings of Altus (1947), Dana and Baker (1961), Pittall (1962) and many others.

Values in columns 11 and 12 of the Table 7.1 show that Model I accounts for 17.92 per cent and 8.58 per cent of the total variance in achievement of the overachieving and the underachieving groups respectively. In both the groups, all the five measures of adjustment (HA, SA, HEA, SCA and TA) were combined together as all of them were linear in these groups.

As regards Model II, entries in columns 10th, 11th and 12th show that when linear personality variables were added to adjustment variables, coefficients of multiple determination \((R^2)\) obtained were .2804, .3050 and .1752 for the total final sample, the overachievers and the underachievers respectively. Despite the fact that two of the non-linear personality variables \((V_9 \text{ and } V_{17})\) were excluded from the overachieving group personality variables added more to the prediction of academic achievement of the overachievers \((R^2\) increased from .1792 to .3050) than the total group (TFS) or the underachievers. Many investigators (Cattell et al., 1961, 1972; Butche et al., 1963; Cattell and Sealy, 1965; Cattell and Sweney, 1966; Barton et al., 1971, 1972a, 1972b) have expressed similar hope that personality estimates can significantly add to the prediction weights of academic achievement.
As regards Model III, adding of linear variables of achievement motivation to adjustment and personality led to an increase in the obtained $R^2$ for all the three groups, that is the total group, overachievers and underachievers ($R^2 = .3231, .3818$ and $.2447$ respectively). Here again, adding of the behavioural measures of $n$-Ach have led to a greater increase in variance accounted for by these variables for the overachieving group as compared to the total group or the underachieving group.

Model IV shows that increase in $R^2$ by adding linear behavioural measures of interest, has led to almost equal increase in $R^2$ in all the three groups, that is approximately 4 to 5 per cent increase in variance was there due to the adding of interest variables ($R^2's = .3630, .4347$ and $.2963$ for TFS, OAs and UAs respectively).

Model V shows the effect of adding of the socio-economic environmental measure to the behavioural measures of adjustment, personality, achievement motivation and interests included in Model IV. Increase in proportion of variance accounted for by socio-economic status scores was observed in all the three groups, that is, the total group, overachievers and the underachievers. Table 7.1 shows that $R^2's$ of Model IV increased from $.3630$, $.4347$ and $.2963$ to $.4261$, $.4629$ and $.3001$ for the total sample, overachievers and underachievers respectively.
Increase in proportion of variance was, thus 6.3, 2.8 and .4 per cent for the total group, overachievers and underachievers respectively.

Model VI is Model V minus intelligence. Comparison of these two Models shows the effective value of personality Factor 'B' (crystallized intelligence) as it contributes to variance in achievement. When Factor 'F' of intelligence was taken out $R^2$s of .4261, .4629 and .3001 (vide Model VI) for the total group, overachievers and underachievers were reduced .4167, .4323 and .2926 for each of the three groups respectively.

It was thought that, perhaps, total score of four areas of adjustment ($V_5$) and two sub-scores of total achievement motivation ($V_{22}$ and $V_{23}$) were an unnecessary addition and could be avoided in the study. So to see whether these three variables were useful in increasing the variance or were useless additions, Model VII was studied. This led to reduction of $R^2$s from .4167, .4523 and .2926 for the total group, overachievers and underachievers to .3104, .3692 and .2778 respectively. Significant decrease in two out of the three $R^2$s led to the decision that these variables should be added in the study and they play their own significant role in increasing the variance in achievement.
In Model VIII, again the independent effect of personality factor 'B' of intelligence (V_p) was studied and measure of intelligence was added to all the measures of Model VII. This led to increase in $R^2$ from .3104, .3692 and .2778 for the total final sample, overachievers and underachievers to .3250, .3955 and .2873 respectively. Intelligence contributed maximum of variance in achievement of the overachieving group. Barton et al. (1971) also showed the effectiveness of adding Factor 'B' for prediction of achievement.

In Model IX, all the linear variables of the three different groups minus intelligence, plus variable of study habits and attitudes which was non-linear for all the three groups (Model VI + SHA) were studied and the combined $R^2$'s of the three groups were .4337, .4596 and .3227 for the total final sample, the overachievers and the underachievers respectively. These $R^2$'s show that study habits and attitudes significantly increased the multiple $R^2$ for the total final sample as well as the underachieving groups, that is, the proportion of variance contributed by the set of variables included in this model increased significantly due to the addition of the measure of study habits and attitudes (SHA) for two out of three groups. The reason is not far too difficult to seek. Comparison of Model VI and IX shows, that study habits and attitudes did not add significantly to the explained variance in achievement of the overachieving group.

Model X is a 'Full Model' taking into consideration all the thirty four behavioural and environmental measures (linear as well as non-linear). Inclusion of all the measures led to the

* Explanation given ahead...
obtaining of $R^2$'s of .4558, .4698 and .3333 for the total final sample, overachievers and underachievers respectively.

Model XI, again, is studied to see the effect of total adjustment scores, and two sub-scores of the total achievement motivation scores ($TA$, $S_1^{AM}$ and $S_2^{AM}$) in the full model. This led to decrease in $R^2$'s from .4558, .4698 and .3333 to .4444, .4586 and .3190 for the total sample, overachievers and underachievers respectively.

Model XII is a 'Reduced Model' and deals with calculation of coefficients of multiple determination and multiple correlation for only eleven common correlates of the three groups (TFS, OAs and UAs). Comparing this model with 'Full Model' (Model X) shows that whereas in Full Model $R^2$'s obtained were .4558, .4698 and .3333 for the total final sample, overachievers and underachievers respectively, these values were reduced to .4169, .3800 and .2536 for the corresponding groups in 'Reduced Model'. Column of F-values show that the reduction in value of $R^2$ was significant for all the three groups, yet it is a matter of great consolation that the reduction was (as expected) much less as compared to reduction in number of variables (from 34 to 11). Loss of variance explained was less in the total final sample (approximately 4%) as compared to the over-achievers (approximately 9%) or the underachievers (approximately 8%).

Model XIII is a 'Mini Model' which further represents reduction of the 'Reduced Model'. Here only six measures, that is, one measure from each of the six broad areas of behavioural
and environment measures was taken. Thus, from the five measures of adjustment, only school adjustment was taken. From fourteen measures of personality, Factor 'B' (intelligence) was selected. Since there was only one composite measure for socio-economic status and one composite measure for study habits and attitudes, both were taken in the model. Then, out of the three measures of achievement motivation, only total scores of achievement motivation were considered. Lastly, out of the ten areas of interest, only interest in house-hold activities was combined in this particular model. The reason for selection of these six measures has already been explained earlier in this chapter.

The coefficients of multiple determination obtained in this model were .3953, .3539 and .2297 for the total final sample, overachievers and underachievers respectively. Comparing these values with the values of $R^2$'s of 'Reduced Model' show that there was reduction in explained variance from 'Reduced Model' to 'Mini Model' by approximately 2.3 and 2 per cent for the total final sample, overachievers and underachievers respectively, yet the reduction was not dramatic as compared to shrinkage of five measures that is, from eleven measures to six measures only.

Model XIV is an evident proof that taking away of the measure of school adjustment resulted in significant decrease in prediction in all the three groups. Details of percentage contribution of study habits and attitudes was increased in this model as compared to Model XIII for all the three groups. This means, that adjustment and study habits and attitudes, which are significantly correlated (Jamaner, 1961; Daftuar, 1967) if taken together, explain the variance of one another to some extent as compared to the set of variables where they are taken singly.
FIG. 7.1
CHANGE IN PROPORTION OF VARIANCE ($R^2$) FROM MODEL I THROUGH XIV FOR TFS, OAs & UAs
Change in proportion of variance explained from Model I through XIV for all the three groups has also been represented by Figure 7.1.

Columns 13th, 14th and 15th of Table 7.1 indicate that all the R's for all the three groups and for all the fourteen models were statistically significant beyond .01 level of significance. Figure 7.2 pictorially explains the change in the values of R for all the three groups from Model I through XIV. Values of R in all the Models and for all the three groups are greater than any of the zero-order rs with different variables in the particular combination of variables. Hence, the calculation of multiple R's is justified.

F-ratios as they are represented in columns 17th, 18th and 19th of Table 7.1 help in indicating whether the addition or subtraction of one or a few variables led to significant increase or decrease in the value of $R^2$ between the two models. F-ratios between Models I and II show that whereas addition of personality measures along with adjustment measures significantly increases coefficient of multiple determination (beyond .01 level) of the total final sample as well as the overachieving group, yet it does not significantly increase the $R^2$ of the underachieving group.

Adding of achievement motivation to adjustment and personality measures significantly increases $R^2$ of all the three groups, F-values being 23.372, 10.063 and 6.042 (significant beyond .01 level) for the total final sample, overachievers and underachievers respectively.
FIG. 7.2

CHANGE IN 'R' BETWEEN 'ACH' AND WEIGHTED COMBINATION OF DIFFERENT VARIABLES INCLUDED IN MODEL I THROUGH XEZ FOR TFS, OAs & UAfs.

MODELS

I II III IV V VI VII VIII IX X XI XII XIII XIV

R

0.10 0.20 0.30 0.40 0.50 0.60 0.70
Adding of interest measures to adjustment, personality and achievement motivation led to highly significant increase in $R^2$ of the total final sample, beyond .01 level; increase in $R^2$ of the overachieving group, beyond .05 level; and no significant increase in $R^2$ of the underachieving group. These findings are partially in line with the findings of Chatterji and Mukherjee (1963).

The addition of environmental measure of socio-economic status to the behavioural measures studied in Model IV, led to significant boosting of $R^2$ (at .01 level) in the total final sample as well as the overachieving group, their $F$ values being 80.592 and 12.181 respectively. All results were obtained by Jamuar, 1963; Rao, 1963, 1965; Curry, 1964; Vane, 1966. This measure, however, did not significantly add to variance in achievement of the underachieving group.

Comparison of models V and VI indicates whether personality factor 'B' (intelligence) led to significant increase of variance in achievement. The three $F$-values obtained were 12.005, 4.578 and 2.014 for the total final sample, the overachievers and the the underachievers respectively. This factor significantly (at .01 level) increased the variance in achievement of the total final sample as well as the overachieving group. No significant increase, however, was noted in the underachieving group.

Comparison of Models VI and VII helped in the assessment of role played by the total adjustment score (TA) and the two sub-scores ($S_1$AM and $S_2$AM) of the total achievement motivation. Results show that these three variables contributed significantly
in explaining the variance in achievement of the total final sample as well as the overachieving group (F = 44.588 and 11.784 respectively). These variables did not significantly add to the explained variance by other measures of model VI for the underachieving group.

Comparison of Models VI and IX show whether the measure of study habits and attitudes (SHA) did significantly add to the explained variance in achievement by measures of Adjustment personality (excluding Factor 'B'), achievement motivation, interests, socio-economic status, for all the three groups (TFS, OAs and UAs). F-values of 22.004 and 8.355 for the total group, and underachieving group show that study habits and attitudes (SHA) added significantly to the variance in achievement of these groups. However, low and insignificant F-value of 3.134 for the overachieving group means that this measure did not add significantly to the variance in achievement of this particular group.

The above findings for the total sample as well as underachievers are in agreement with the findings of Carter (1950); Brown and Farquhar (1954) and Palsen (1963) who have stressed the important contribution of study habits and attitudes for the prediction of academic achievement. Entwistle and Entwistle (1970) also found positive, though low relationship of study habits and attitudes and academic achievement. Ahman (1968), however, in his study found that study habits and attitudes did not add significantly to multiple R. Similar results like those of Ahman were obtained by Gordon (1941) and Daniel (1971). In overachieving group, alike results were obtained.
Comparison of models X and XI show that if the three measures, that is, total adjustment scores, and two sub-scores (TA, S1AM and S2AM) are taken away from the 'Full Model' where all the thirty four independent measures are studied, $R^2$ is significantly reduced in two of the three groups, that is, the total final and the underachievers (F-values being 6.403 and 37.392 respectively).

Again, comparison of Model VIII with Model XI shows whether adding of non-linear variables in the set of linear variables (Vs 5th, 22nd and 23rd excluded) did significantly add to the variance in explaining academic achievement. F-values of 22.380, 6.760 and 2.176 for the total final sample, over-achievers and the underachievers respectively, show that there is a significant difference (beyond .01 level) between the two models for the total group (TFS) as well as over-achievers (OAs). Difference, however, is not significant for underachievers (UAs).

F-values obtained by comparing Models XI and XII show that factor 'B' (intelligence) added significantly to variance in achievement of the over-achieving group only. Thus the measure of intelligence in this particular set did not significantly increase $R^2$ of the total final sample as well as underachieving group.

Comparing the F-values of Models X and XII, reveals the fact that the difference between the two models is significant at .01 and .05 levels for the total final sample and the over-achieving group. Non-significant F-value ($F = .956$) for the underachieving group indicates that the two models do not differ significantly in this group. Thus, 'Reduced Model' from thirty
four measures to only eleven 'common correlates' led to significant decrease in contribution of variance in achievement of the total final sample and the oversachieving group, yet it did not lead to any significant decrease in the underachievers. So 'Reduced Model' is as good as the 'Full Model', particularly for the underachievers.

From F-values obtained by comparing Models XII and XIII, it is apparent that these two models differed significantly for the total final sample only (F = 5.549) and that too, at .05 level. Nonsignificant F-values of 2.122 and 1.326 for the overachievers and the underachievers demonstrate that these two models did not differ at any statistically acceptable level of significance. Hence this shows that 'Mini Model' consisting of just six measures is as good as the 'Reduced Model' both for the overachievers as well as the underachievers. In the total group (TFS), however, it has led to a significant decrease (beyond .05 level) in explaining variance in achievement.

Comparison of Models XIII and XIV indicates the contribution of the measure of school adjustment. All the three F-values of 8.8779, 23.628 and 6.908 for the total final sample, overachievers and underachievers respectively are highly significant at .01 level and thus it can be safely concluded that this measure (SCA) did add significantly to the variance in achievement explained in the 'Mini Model' for all the three groups.

Table 7.2 represents three models, that is, the 'Full Model' (Model X), the 'Reduced Model', and the 'Mini Model' for

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* For limitations of space and keeping in view the purpose of study, details of all the models are not given except for three models.
all the three groups. This Table summarizes the results of multiple correlations of these models. The detailed multiple regression equation and also the proportion of variance (vide Garrett, 1957, p. 419) contributed by each of the variables included in each of the three models towards the total criterion estimation and prediction is given.

Table 7.2 provides three regression equations based on score weights (regression coefficients) for analysing the weightage to be attached to each of the independent variables included in each of these models so as to maximize the predictive efficiency of the criterion. But these 'score weights' are not sufficient enough to give information about the relevant importance that should be given to each of the variables. This information is given by beta weights or beta coefficients. Here the multiple $R^2$ for each of the three groups is calculated in terms of beta weights and zero order 'rs' (vide Garrett, 1951) so as to know the exact proportion of variance in the criterion measure which is attributable to the joint action of all the independent variables as well as to know the independent contribution of each of these variables separately.

FULL MODEL REGRESSION EQUATIONS

Entries in Table 7.2 show that so far as the 'Full Model' of the total final sample is concerned, out of the thirty four measures, maximum variance in achievement is contributed by the measure of socio-economic status (12.95 per cent). Next to it

* Here non-linear variables are also combined with linear ones.
in importance is the measure of school adjustment (12.42 per cent). Total adjustment and study habits (TA and SHA) contribute positively to the extent of 4.23 and 4.04 per cent respectively. All other measures contribute less than that. In this particular group, personality factors 'A' (warmheartedness), 'C' (ego-strength), 'D' (excitability), 'E' (assertiveness), 'F' (happy-go-lucky), 'G' (super-ego-strength), 'H' (venturesomeness), 'I' (tender-mindedness), 'J' (doubting), 'O' (apprehensive), 'O_2' (self-sufficiency), 'O_3' (self-concept control) and 'O_4' (tenseness) contribute less than even .5 per cent of the variance. In this particular combination, measures of total achievement motivation (TAM), interests in fine arts, literary, scientific, medical, agricultural, technical outdoor and sports activities also contribute insignificantly towards estimating the criterion. The total proportion of variance \( R^2 \) attributable to the combined effect of all the independent measures for the total sample is .4556, that is, 45.58 per cent of the total variance in achievement is due to these behavioural and environmental measures. The equation of the 'Full Model' (vide Table 7.2) correlates .675 with academic achievement which is higher than any of the zero order 'rs' of these variables with the criterion. Hence, it justifies the combining of these moderators in predicting the criterion with the help of multiple correlation.

Considering the 'Full Model' of the oversachieving group, the variable that contributes maximum (18.04 per cent) of variance in achievement in this particular set of variables is that of total adjustment. Next to it is the measure of socio-economic
status (8.88 per cent). Interest in household activities and total achievement motivation (HH and TAM) contribute positively to the extent of 3.79 and 3.07 per cent respectively. All other measures contribute less than that. In this particular group, personality factors 'C' (ego-strength), 'D' (excitability), 'E' (assertiveness), 'F' (happy-go-lucky), 'G' (super-ego strength), 'I' (tender-mindedness), 'J' (doubting), 'Q_2' (self-sufficiency) and 'Q_4' (tenseness) contribute less than even 5 per cent of the variance. In this particular combination, the measure of school adjustment (SCA), personality factors 'B' (intelligence) and 'Q_3' (self-concept control), second measure of achievement motivation (S^2AM) and interest in scientific activities also contribute to some extent towards estimating the criterion. The total proportion of variance attributable to the combined effect of all the independent measures for the total sample is .4698, that is 46.98 per cent of the total variance in achievement is due to these behavioural and environmental measures. The equation of the 'Full Model' (vide Table 7.2) correlates to the extent of .685 with academic achievement, which is higher than any of the zero order correlation values between moderators and the criterion. Hence, it justifies the combining of all of them for predicting the criterion variable.

With regard to the underachievers (UAs), total achievement motivation scores (TAM) contribute maximum proportion (34.06 per cent) of variance in academic achievement. Measures of school adjustment, interest in household activities, study habits and attitudes also contribute to a considerable magnitude
(6.53, 5.08 and 4.89 per cent). The variance that was to be explained by measures of achievement motivation ($S_1^{AM}$, $S_2^{AM}$) has been explained by total achievement motivation ($TAM$) scores and hence this led to the seemingly negative contributions of these measures in the equation.

The major portion of variance in achievement being explained by the measure of achievement motivation reminds of the findings of Taylor and Farquhar (1966) who operationally defined high and low motivated students as under- and over-achievers. Green and Farquhar (1965) obtained highly significant positive correlation between academic motivation and achievement.

The measures that did not contribute significantly (less than .5 per cent) in explaining variance towards academic achievement of the underachieving group are those of home adjustment, personality factors 'C' (ego-strength), 'F' (surgency), 'H' (venturesomeness), 'I' (tender-mindedness), 'J' (internally restrained), 'O' (guilt proneness), 'Q_3' (self-sentiment), 'Q_4' (tenseness), interest in literary, scientific, medical, agricultural, technical, crafts, outdoor and sports activities.

On the whole, out of all the three groups, the underachieving group led to the minimum precision in predicting the criterion. The total proportion of variance in achievement contributed by all the thirty-four moderators in this group was 33.33 per cent only. This combination of variables correlated to the extent of + .577 with academic achievement.
One of the basic principles of multiple correlation is that "multiple correlation usually does not increase dramatically as the number of independent variables is made larger and larger" (Nunnally, 1967, p.162). So, to select the best combination of predictors for the three groups (TFS, OAs and UAs), an effort was made to select those 'common moderators' of the three groups (TFS, OAs and UAs) which had high correlations with the criterion and low correlations among themselves, within the same group. The optimum prediction of achievement, within the 'Reduced Model' of common correlates is given by the three equations represented by Model XII. The predictive equations derived for these groups are as follows:

**Achievement (TFS)**

\[ R^2 = .4169 \]
\[ R = .6457 \]

\[ \text{Achievement (TFS)} = 13.846 + .655 \text{SCA} - .065 \text{TA} + .783B + .0840_3 \]
\[ + .315 \text{SES} + .039 \text{SHA} + .436s_1^\text{AM} + .542s_2^\text{AM} \]
\[ + .028 \text{TAM} + .007 \text{FA} + .206 \text{HH}. \]

**Achievement (OAs)**

\[ R^2 = .3800 \]
\[ R = .6165 \]

\[ \text{Achievement (OAs)} = 25.566 + .522 \text{SCA} - .063 \text{TA} + .707B + .3940_3 \]
\[ + .268 \text{SES} + .020 \text{SHA} + .106s_1^\text{AM} + .313s_2^\text{AM} \]
\[ + .272 \text{TAM} - .013 \text{FA} - .169 \text{HH}. \]

**Achievement (UAs)**

\[ R^2 = .2536 \]
\[ R = .5036 \]

\[ \text{Achievement (UAs)} = 27.356 + .216 \text{SCA} - .015 \text{TA} + .0495B + .0840_3 \]
\[ + .026 \text{SES} + .036 \text{SHA} - 1.057s_1^\text{AM} - .401s_2^\text{AM} \]
\[ +1.136 \text{TAM} - .120 \text{FA} - .120 \text{HH}. \]
The first equation for the total sample led to obtaining of $R^2$ equal to .4169. This value shows that 41.69 per cent of variance in achievement can be explained by this equation based on reduced model of eleven common correlates ($SCA$, $TA$, $B$, $O_3$, $SES$, $SHA$, $S_{1AM}$, $S_{2AM}$, $TAM$, $FA$ and $HH$). These variables correlated to the extent of .646 with academic achievement. The variance as it was explained in the Full Model when all the thirty four moderators were used, was 45.98 per cent and the correlation in the full model equation was .675. Thus, only 3.89 per cent of the total variance is explained by the rest of the twenty-three measures. Very little reduction in the value of $R$ (from .675 to .646) is observed. Hence this equation can be accepted as valid for all practical purposes for analysis and prediction of achievement for the total sample.

The equation based on the bivariate analysis of common correlates for the overachievers explained 38.00 per cent of variance in academic achievement ($R^2 = .3800$). It implies that 38.00 per cent of variance in achievement can be explained on the basis of conjoint effect of the eleven variables ($SCA$, $TA$, $B$, $O_3$, $SES$, $SHA$, $S_{1AM}$, $S_{2AM}$, $TAM$, $FA$ and $HH$). These common correlates, thus, correlated, as high as .616 with academic achievement. Variance in achievement as it was explained in the Full Model was 46.98 percent and the equation correlated .616 with achievement. The Full Model regression correlated to the tune of .685 with the criterion. Hence the loss in explained variance from 'Full Model' to the 'Reduced Model' was 8.98 per cent. In other words 8.98 per cent of variance is explained by the rest of the twenty three measures. The loss in the $R$ (from .685 to .616) from 'Full Model' to the 'Reduced Model' is also not very conspicuous. Hence, this
equation can also be accepted as quite valid for all practical purposes for analysis and prediction of academic achievement of the overachieving group.

Three behavioural measures of the overachieving group function as suppressant variables (McNemar, 1969, p. 188), that is, though they have low zero-order correlations with academic achievement of the overachieving group, yet when they are combined in 'Full Model' they contribute to the variance in achievement. These measures are personality Factor 'O', interest in scientific, and sports activities, contributing 1.03, 2.69 and 1.11 per cent of variance respectively towards achievement in 'Full Model'. However, their contribution in 'Reduced Model' could not be studied as they were not 'common correlates' of the three groups (TFS, OAs and UAs).

The equation developed for the underachievers explains 26.15 per cent of variance in academic achievement. On the whole, this equation predicts the criterion much less effectively than the above two equations. The obtained value of \( R^2(0.2615) \) for this equation shows that 26.15 per cent of variance in academic achievement of the underachieving group can be explained on the basis of joint action of eleven common, behavioural and environmental measures (SCA, TA, B, O_3, SES, SHA, S_1AM, S_2AM, TAM, FA, and HH). The obtained, that is, weighted combination of all the eleven variables was + .504 for the underachievers (N = 219). The 'Full Model' of thirty four variables explained 33.33 per cent of variance in academic achievement whereas this model explains only 25.36 per cent of variance. Hence, the loss of 7.97 per cent of explained variance can be attributed to the rest of the twenty three measures that were not included.
in the equation. Correlation of the equation with achievement from 'Full Model' to the present model (Model XIII) is reduced from .577 to .504. On the whole, this prediction equation is not as satisfactory as the other two are (that is, one for the total sample and one for the overachievers). Comparison of the three 'Reduced Model' regression equations makes it evident that whereas there was less loss of prediction by 'Reduced Model' regression equation in the total final sample, for the prediction of overachievers or underachievers 'Reduced Model' Regression equations led to greater loss in the prediction of the criterion measure.

'MINI MODEL' REGRESSION EQUATIONS

Review of the three 'Reduced Model' regression equations makes it clear that all the eleven measures which were found to be the 'Common Correlates' in all the three groups (vide Chapter VI) did not contribute equally significantly and positively to the prediction of the criterion measure for these three groups. So 'Mini-Model' regression equations further reduced the number of common correlates from eleven to six only. The three regression equations obtained for each of the three groups are as given below:

Achievement (TFS) = 6.957 + .482SCA + .881B + .306SE
               + .040SHA + .365TAM − .196HH

\[ R^2 = .3953 \]
\[ R = .6287 \]
The first 'Mini-Model' regression equation, that is, the one predicting academic achievement of the total final sample led to the obtaining of $R^2$ equal to .3953. This equation showed the correlation of six variables equal to .629 with the criterion. Thus, comparing these values with the values of $R^2$ and $R$ of the 'Reduced Model' regression equation of the total group, it is obvious that very little loss in these values (values of $R^2$ and $R$ in 'Reduced Model' being .417 and .646 respectively) was noticed. Splitting 39.53 per cent of variance explained by this equation, 13.27, 2.57, 13.95, 4.24, 2.67 and 2.81 per cent of variance is explained by school adjustment, personality Factor 'B' (intelligence), socio-economic status, study habits and attitudes, total achievement motivation, and interest in household activities respectively. Major role out of these measures is played by school adjustment and socio-economic status.

Considering the 'Mini-Model' regression equation for the oversachieving group, the coefficient of multiple determination obtained by it was .3539. This equation indicated a
correlation of .595 with the criterion measure. Again 'Mini-Model' regression equation of this group is quite useful for all practical purposes as the loss of $R^2$, from 'Reduced Model' to 'Mini Model' was .0261 only (loss of $R^2 = .3800 - .3539$). Splitting 35.39 per cent variance as explained by this equation, 9.95, 2.71, 11.84, 2.17, 4.77 and 3.92 per cent of variance is explained by school adjustment, personality Factor 'B' (intelligence), socio-economic status, study habits and attitudes, total achievement motivation and interest in household activities respectively.

'Mini Model' regression equation for the underachieving group correlates .479 with the criterion and led to the obtaining of $R^2$ value to be .2297 only. This is the minimum value out of the three $R^2$ values of the 'Mini Model' Regression equations of the three groups. Here, also though the loss in $R^2$ from 'Reduced Model' to 'Mini Model' is not much (loss in $R^2 = .2536 -.2297 = .0239$), yet $R^2$ value in itself is quite low. The equation does not lend itself to a high degree of prediction of the criterion. However, out of 22.97 per cent of the variance explained by this equation, 4.69, 2.11, .56, 4.30, 4.58 and 6.71 per cent of variance is explained by the school adjustment, personality Factor 'B' (intelligence), socio-economic status, study habits and attitudes, total achievement motivation and interest in household activities respectively. Socio-economic measure explains major portion of variance in the total group as well as the overachieving group, yet it explains very little variance in achievement of the underachieving group. Dibble (1967), in his studies also found
that income contributed 5 per cent to the criterion variance. The present findings are in line with these findings and also the findings of Green (1971) who found that if socio-economic status of pupils is improved, the level of pupils' academic achievement would improve as well. School adjustment plays relatively significant role in all the three groups in the 'Mini Model' regression equation of these groups. The present findings match with the findings of Mittal (1962) who found measures of adjustment as highly valid in predicting academic achievement.

DISCUSSION OF RESULTS

HYPOTHESIS I

Significant F-values obtained for the total final sample between Models I and II, II and III, III and IV, IV and V, VI and IX prove that variance in achievement as explained by conjoint action of adjustment variables through Model I is increased significantly by addition of personality, achievement motivation, interests and socio-economic factors, and study habits and attitudes. Hence the hypothesis, namely significant variance in academic achievement is contributed by major behavioural and environmental measures is accepted for the total group (TFS) representing complete range of academic achievement and intelligence. Findings of Cattell et al. (1968) suggested that variance in achievement is equally divided among intelligence, motivation and personality, each of which accounts for approximately 25% of variance. The results of the present chapter stress the
significance of personality and achievement motivation, yet the magnitude of variance contributed by them is not so much as claimed by them. Importance given to achievement motivation is in line with the findings of Farquhar (1963). Present findings are also in line with the findings of Kearney (1966) who stressed the importance of study habits and attitudes more than the interest in prediction of academic achievement.

Significant values of the overachieving group between Models I and II, II and III, III and IV, IV and V, lead to the acceptance of the hypothesis for this group as well.

For the underachievers, the variance in achievement goes on increasing from Model I to II, II to III, III to IV, IV to V and VI to IX, yet that out of the five F-values between them are non-significant and thus, the hypothesis for this group can only be accepted partially. Figure 7.1 further elaborates the results diagramatically.

HYPOTHESIS II

Results summarised in Table 7.2 and discussed earlier in this chapter testify the validity of the second hypothesis, namely, certain behavioural and environmental measures within the above major areas contribute more to prediction of academic achievement of the total final sample, overachievers, and underachievers; and also that some measures predict more than the others within the same group.

Major portion of variance contributed in the total final sample out of the major behavioural and environmental measures
is by measures of socio-economic status, school adjustment, total adjustment, study habits and attitudes, interest in household activities, achievement motivation through second story (S2AM), and personality factor 'B' (intelligence). Rest of the measures are relatively less effective for prediction of achievement of this particular group.

For the overachieving group, measures of total adjustment, socio-economic status, interest in household activities, and total achievement motivation (TAM) contribute more for explaining variance in achievement of this group. In this team of variables, measures of school adjustment (5CA), personality factors 'B' (intelligence) and Q3 (self-concept control), second measure of achievement motivation (S2AM) and interest in scientific activities (9C) also explain a significant portion of variance in achievement. Rest of the measures explain very little or negligible variance in achievement.

For the underachievers, measures of total achievement motivation (TAM), school adjustment, interest in household activities, study habits and attitudes explain major portion of variance in school achievement of this group. Rest of the behavioural and environmental measures are of less or no significance in prediction of academic achievement of this particular group.

The above discussion helps in verifying and accepting the second hypothesis for all the three groups, that is, there are only a few behavioural and environmental measures out of the major measures (adjustment, personality, study habits and
attitudes, achievement motivation, interests and socio-economic status) which contribute significantly to the prediction of academic achievement. Some of these significant measures are common to all these groups and some are specific to one or two of the three groups.

Whether the behavioural and environmental measures that are significant for prediction of academic achievement are common to the three groups or they are specific to them, the weightage given to these measures differs from one group to the other and also within the same group, different measures contribute differentially in prediction of academic achievement.

The three equations of the 'Reduced Model' also prove the same thing. Take, for example, the three equations of 'Reduced Model'. The results show that there are eleven measures that are common to all of these equations, yet the score weights tell that the differences exist from one group to the other as well as from one measure to another within the same group.

Even though bivariate analysis led to identifying the above mentioned variables as common correlates of academic achievement in the three groups, yet multiple regressions indicated their differential contributions conjointly. It appears that these variables are in general, the correlates of academic achievement which run through over-achievement as well as under achievement. But their contribution is decidedly higher in the OAs than the UAs and this difference certainly has implications for understanding differences in respect of contribution made by them towards over- and under-achievement.
The three regression equations of the 'Mini Model' also explain the second hypothesis. Here, though only five behavioural measures and one environmental measure were picked up for all the three groups, yet all these measures contributed differentially to the prediction of the academic achievement of the total final sample, overachievers and underachievers, individually, within the group, and from group to group. Hence the second hypothesis of the present chapter stands verified.