THE SUCCESS OF TECHNICAL COLLEGE STUDENTS IN RELATION TO SCORES ON ATTITUDE, PERSONALITY AND INTELLIGENCE TESTS.

by

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Summary

A representative sample of the students of an area technical college completed an intelligence test, a personality questionnaire, a biographical questionnaire and an attitude record constructed by the semantic differential technique. Interviews were conducted with a third of the sample.

The intelligence scores showed the expected non-verbal bias, mean scores on the non-verbal part of the test being at about the level reported for university students while the verbal/numerical scores were much lower. The personality profile was nearer to that of American students than to that published for British university students. Attitudes to the college and related topics, when analysed by factor analysis, had a three-dimensional structure.

The marks awarded in each examination were standardised, and the mean of the standardised marks of each student used as a criterion of relative academic performance. This criterion score was not related to the intelligence scores, and the association with personality traits was marginal.

Two subsamples of successful students were studied, the first selected on the basis of the criterion score alone and the second by their self-rating in the biographical questionnaire as extremely hard workers. The latter subsample also had high criterion scores, and their personality profile contrasted with that of the students who left their courses without completing their examinations. Both

subsamples of successful students had more favourable attitudes than the majority to certain of the more arduous college activities, amd the method of attitude analysis used is considered worthy of further development.

The case histories and test scores of the successful students showed great diversity, including extremes of intelligence and of introversion and extraversion, and varied backgrounds. It is concluded that any improvement in students' achievement is more likely to follow from greater individual attention to their motivation than from more rigid application of selection criteria.

Acknowledgments

This research was inspired and supervised throughout by Lady Venables. It was begun in the Department of Applied Psychology under Professor W. T. Singleton, and transferred to the Department of Education when the latter was inaugurated under Professor A. G. Joselin. It has been encouraged by Mr B. C. Whitehouse, then Principal of South Birmingham Technical College, and the City of Birmingham Education Committee who granted a reduction in teaching commitments. My wife has spent many hours patiently helping with scoring, and the staff and students of the college have been generous in giving their time and encouragement. I am very grateful.

Contents

1. The problem and some related literature

A teacher's satisfaction when some of his students succeed in their examinations is frequently marred by the knowledge that others of apparently similar ability have not succeeded. Problems of underachievement exist throughout education, but the writer's interest is mainly in technical education, and it was in this field that the research was proposed.

At the time of the investigation, the college at which the work was carried out was an Area College, intermediate in function between the local colleges, which offer courses up to Ordinary National Certificate or the G.C.E. "A" level, and the universities. At that time, however, the student population was unusually varied because some local college work was also undertaken.

The term "underachievement" implies limitation of attainment by factors other than ability. Studies of student "wastage" which have sought to evaluate the causes of failure by analysis of the characteristics of the "dropouts" have produced evidence of the importance of personal and social factors. Such information, however, does not completely solve the problem of the teacher. He can hardly tell his unsuccessful students that they ought to have come from better homes. Further, it is not uncommon to meet people who have surmounted obstacles which prove too great for others.

In the investigation of success it is expected that those who succeed may include the brilliant and those whose circumstances have conferred advantages by which they have been able to develop their potentiality; but also they include those whose qualities have enabled

them to overcome their difficulties, and the nature of these qualities is an important field of investigation. In this research the problem was as far as possible to identify and to evaluate some factors associated with high achievement. Possible factors were considered under the three headings, intelligence, personality and attitudes.

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The importance of intellectual ability has been recognised for so long that it now seems self-evident. In 1892 Sir Francis Galton (1) wrote, "There can hardly be a surer evidence of the enormous difference between the intellectual capacity of men than the prodigious differences in the numbers of marks obtained by those who gain mathematical honours at Cambridge....." Since that date students have been more rigorously selected and it is now rare to find a high correlation between examination results and scores on the group tests of intelligence designed to measure intellectual capabilities. Although "intellectual capacity" is sometimes assumed to be the only factor of consequence in academic performance, evidence from the selected populations of technical colleges and universities shows that its importance can be overestimated.

The highest of the correlations obtained have been from highly motivated students. A coefficient of 0.800 was reported by Montgomery (2) between an arithmetic/maths attainment test and an eight-point scale of "Technical Theory Qualification" in a situation in which the students were highly motivated. In the same study, correlations with non-verbal intelligence and space perception were 0.580 and 0.576 respectively. P.E.Vernon (3) wrote that in selected grammar school groups the correlation between combined selection tests and later

school grades is normally around 0.4 to 0.5. In further education, however, smaller correlations have been reported. Lady Venables (4) in a series of investigations with City and Guilds and Ordinary National Certificate students in local colleges found product moment correlations between 0.2 and 0.4. The best predictors of success in the examinations were mathematical attainment, non-verbal reasoning and space perception. Traditional verbal reasoning was predictive only for members of craft courses, at the lowest academic level investigated.

At university level, validation studies of the intelligence test AH5 (5) produced correlations of similar magnitude with examination marks (r was between 0.27 and 0.40). Pilkington and Harrison (6) however, found much lower correlations between AH5 and examination results of psychology students. (Correlations of 0.11 with mean first examination mark, and 0.18 with degree class)

It is interesting to observe the variation in correlation coefficients between one study and another. The results suggest that in some courses the students are so selected that their level of intelligence is sufficient for their work. Nevertheless in the investigation of factors which might have a general effect on academic performance of selected students the salient observation is a negative one, that it is unusual for intelligence scores to account for more than about 16% of the variance of examination marks. No doubt P. E. Vernon had this in mind when in connection with university expansion he expressed his reservation "whether so many children or students have the attitudes and character qualities, rather than the abilities, required for worth-while higher education." (7)

Some of these "qualities of character" have been related to academic attainment by using personality questionnaires. In this

country, Lady Venables' studies of technical college students showed that high achievement was associated with personality scores towards the anxious and introverted ends of the M.P.I. scales. Similar results have been obtained in universities (8,9).

The specification equation for "general progress in school" published by Cattell and Eber (10) lists eleven of the sixteen primary personality traits measured by the 16PF questionnaire, together with their weightings, so that to obtain the best estimate of performance the factor scores may be multiplied by the appropriate fractional weights, positive or negative, and added. The scores of British students have been found to differ from those of American students on this questionnaire (Cattell and Warburton, 11) and if a similar equation were written for British students the factor weightings would not neccessarily be the same, but some association could be expected. The validity of this questionnaire in the prediction of behaviour in a college is therefore open to verification.

The general response tendencies represented by personality scores, however, are not sufficient to describe or to predict all the actions of any individual in particular circumstances. Active learning requires a sense of purpose, and the existence and nature of this purpose may be influenced by circumstances which do not necessarily affect the whole personality. In J. A. Wankowski's studies at Birmingham University of the performance of undergraduate students, achievement was related to goal orientation as well as to factors of personality. Frequency of attendance at the University Health Centre (Index of stress), difficulty in study and lack of interest in studies were coupled with uncertainty about short- and long-range goals and with entry to university as the result of persuasion rather than the student's own wish. (12)

These observations, and observations in the classroom of apathy, recalcitrance or enthusiasm, for example, lead to the assumption that an unfavourable or favourable attitude to studying has been acquired as a result of previous experience. Such attitudes appear to find expression by exerting an influence on the students' responses to the stimulation offered during the course, so that different students respond in different ways. The influence of say, a parent or training officer on the academic progress of a student is exerted by a two-stage process, the first stage being the modification of an attitude which in the second stage mediates in the formation of his response to the demands of the work.

Various socioeconomic factors have been shown to be related to educational performance. The Robbins report (13) for example, included evidence of the disproportionate numbers of university students whose fathers had themselves enjoyed some form of higher education. This result can be interpreted partly by the greater opportunities offered to the child in a professional home in the form of reading matter, conversation and activities through which abilities can be developed; but the child's attitude, influencing the way in which he responds to this stimulation and to the opportunity of formal education, is influenced by the values and aspirations of the family and other social groups surrounding him. Armstrong (14) in a follow-up study of children admitted to West Riding grammar schools with I.Q's of 135 and above, found that although there was no difference in the number of passes in G.C.E. examinations between the children of working class homes and those from higher professional homes, the proportion proceeding to higher education was twice as great in the latter group as in the former.

In technical colleges, Lady Venables' work with young apprentices

showed that "their success rate.....appears to depend at least as much on their individual motivation as on their ability as measured by test scores", (15) and "The results suggest that social factors have some bearing on underachievement, and in so far as this is indicative of poor motivation it would seem that the secondary modern school leaver and the child of the semi- and unskilled manual worker tends to take his chance of further education at the local technical college more seriously than his classmate from the Grammar School or from a superior social class."

The apparent contradiction between these two findings is presumably due to differences in tne students' perceptions of their respective educational institutions and the careers to which their courses led, and therefore in the attitudes formed. The reports agree on the effects of these attitudes on academic performance.

The family and social class are by no means the only agencies by which the attitudes of an individual are moulded. Lady Venables has isolated one of the effects of the circumstances of employment in her finding (16) that students from firms with more than 1000 employees had a higher proportion of certificates in three or four years, and a lower proportion of students abandoning their courses before taking the examinations. In this case, the attitudes of the students were apparently influenced by those of their employers, academic qualifications having less career value in a small firm than in a large one where, in addition, the larger body of peers gives rise to greater competition.

The formation of a particular attitude, however, is not by any means a necessary consequence of a particular pattern of life experience. The researches mentioned above show only the statistical probability

of the associations described, and the lack of an expected association in a particular instance may be more revealing than the association itself. Bettelheim and Janowitz (17), investigating an hypothesis that soldiers who experienced hardship in war (while fighting against another nation) developed "ethnic hostility", found that this ethnic hostility was related, not to the experience of hardship but to unfavourable perception of it. Retrospective evaluation of army experience was largely independent of actual privation, and those who suffered great hardship without becoming embittered showed less racial prejudice than those who complained loudly of relatively trivial inconvenience. Similarly we should not expect to find students' origins and life experiences necessarily reflected in their attitudes.

The existence and nature of a student's attitudes are inferred from his behaviour, i.e. from his tendency to respond consistently in his own way to the stimuli of a particular object or situation. In definitions of attitude, the psychological object is frequently referred to. L. L. Thurstone, quoted by A. L. Edwards (18) defines an attitude as "the degree of positive or negative affect associated with some psychological object." The examples of such objects which follow include the Negro, steak, a state legislative bill, symphonic music, and the task of washing dishes. An attitude is thus distinguished from a personality trait; and if a single unitary psychological object can be identified, a scale of attitude to this object can be constructed.

In the application of attitude scaling to the problem of gaining understanding of student behaviour, the identification of single unitary objects of attitude related to performance presents some difficulty. There is a multiplicity of interrelated attitudes

which may be expected to have an influence. Not only is there a variety of objects, such as each subject of the curriculum, each teacher, the self, the vocational value of the course and the qualification to be awarded at the end, authority, and so on; but for each individual, attitudes to these objects will have different weightings in their effects on his responses. Even the existence of an attitude, regardless of its direction or magnitude, may indicate awareness of the issue and a maturity making for success. The ideal investigation would take into account not only the nature, direction and magnitude of each attitude vector but the whole organisation of the attitude system of each individual and relate these attitudes as well as abilities and personality to academic achievement.

For the assessment of academic attainment in technical colleges, examinations are almost invariably used. As a measuring instrument the traditional examination leaves much to be desired, (19, 20), but whatever its defects the course of many students' careers are in fact determined by the numbers of marks gained, and so part of the research problem was to find a way of using examination marks among a diverse sample of students and courses as the dependent variable.

2. The research plan

In planning this investigation the primary aim was to measure the attitudes of the students of South Birmingham Technical College to the college and academic work, and to relate these attitudes to achievement in examinations. The choice of a method of attitude measurement was governed by two requirements, that it should measure reliably as many as possible of the attitudes which might be expected to influence academic performance, and that it should do so without projecting the ideas of the experimenter. For this purpose, the semantic differential technique of Osgood et al. (21) was chosen after trials of other methods.

There was no reason to expect any variation in the relationship between attitude scores and examination marks from one discipline to another, or from one academic level to another. If favourable attitudes to studying could be shown to be associated with high marks in examinations, this result might be expected to be widely applicable; and while the author was not in a position to extend the research outside the one college, it was possible to choose the sample so as to represent varied courses within the college.

The choice of a varied sample of students made difficult the choice of a criterion of achievement, since the examinations were not directly comparable with each other. By standardising the marks of each class in each paper to the same mean and standard deviation and taking a mean of these standardised marks for each student, a score was obtained which represented examination achievement in relation to the performance of the class. Although this procedure ignores the difference in attainment between one class and another, it tests the hypothesis that an effect of attitudes on examination performance

occurs irrespective of academic level. The calculation of standard scores also offered an opportunity to record the mean and standard deviation of each set of raw marks.

In order to place the effect of attitudes in perspective, the plan included the use of standard tests of intelligence and of personality, which might also be expected to be related to the criteron score. The descriptive data obtained by the use of these standard tests might be of some intrinsic value, particularly as the student population of the college, ranking in intellectual attainment immediately below those of universities, is of interest in view of the current expansion of higher education. The collection and presentation of intelligence and personality scores and of examination marks was therefore a subsidiary aim of the research.

For the investigation of the relationships between the examination achievement score and its possible correlates, two strategies were proposed. The first, a straightforward application of statistical methods to the analysis of the numerical data, was expected to provide an expression of each relationship in mathematical form. The second strategy was to construct profiles of selected subsamples and of individuals, to confirm and extend the results of the statistical analysis and to allow the use of biographical and anecdotal material which might add further meaning to the numerical results. (In the event, the attitude data were used only in the profiles.)

Details of the sample of students chosen for the research and the methods used, together with the results of the pilot trials which led to their choice, are given in the next section.

3. Preparatory work

This section includes details of the sample of students chosen and of the methods used, together with results of the pilot studies which led to the choice of instruments.

The sample of students

At the time of the investigation, the three Departments of the college were Electrical Engineering and Science, Mechanical and Production Engineering, and Building and Civil Engineering. This college was built as an Area College to fulfil a function intermediate between those of the local colleges and the then College of Advanced Technology, and it has now been proposed that it should form part of the Birmingham Polytechnic. In order to make full use of the facilities until the numbers built up to the expected levels in courses which were regarded as proper to an area college, some local college work was also undertaken during the early years.

The majority of the students were in full-time employment, and were released by their employers to take day release courses. They attended on one day a week plus one evening. There were also some block release and sandwich courses, which required periods of full-time attendance. In order to make the sample as representative as possible, four courses were chosen in such a way as to include members of all departments, all academic levels and all modes of attendance. Two classes were then taken from each of these courses, as described in Table 3.1, below.

Table 3.1

Composition of the research sample

Class	Course	Year	Attendance	Department	N
I	C & G Technicians	3rd	Day release	M & P Eng.	14
II	"	"	"	"	14
III	Ord. Nat. Cert.	1st	Block release	Elec. Eng	39
IV	"	"	"	"	16
V	Higher Nat. Cert.	"	Day release	Bdg & C. Eng	17
VI	"	"	"	"	21
VII	Higher Nat. Dip.	2nd	Sandwich	M.& P Eng.	20
VIII	"	3rd	"	"	28
				Total	169

In addition to the above sample, the first year class of the Higher National Diploma course was included for the standard group tests only, and other classes took part in pilot trials of the tests used. These latter were selected on grounds of availability only and are mentioned where appropriate in the text.

The following abbreviations are used to refer to the above courses:

MT3 Mechanical Technicians, 3rd year;

EE01 Electrical Engineering, Ordinary National Certificate, first year;

Bdg A1 Building and Civil Engineering, Higher National Cert., first year;

HND M&P Higher National Diploma in Mechanical and Production Engineering.

The choice of methods

a) The criterion score

The examination marks available for the research were from examinations of traditional form, in which candidates are required to attempt five or six questions in three hours with some choice of questions. All were vocationally orientated. The final year H.N.D. examinations lead directly to the award of the Diploma, while the remainder of the examinations taken by classes of the research sample lead to the next year of the course. Satisfactory course work marks and attendance are also required, but the examination is the main hurdle and examination marks alone were chosen as data for calculation of the criterion score.

The choice of a score representing the examination achievement of each student in relation to his peers in the same class, rather than to the research sample as a whole, was dictated by the decision to take a sample representing the whole college population of students, as described above. A mark in one examination could not be equated with the same mark in another examination in the sense of representing equal academic attainment, even after standardisation, but by standardising the marks to the same mean and standard deviation irrespective of academic level, the achievement of each student could be related to that of the class of which he was a member. For each paper for each class, a mean of 100 and standard deviation of 15 were chosen, because t scores are close enough to raw examination marks to cause confusion.

In taking a mean examination score some information is lost. On the other hand, by regarding the various subject examinations as replicate trials of general attainment in relation to peers the

unreliability of examinations could to some extent be counteracted. (An aggregate score was unsuitable because the number of papers taken varied from one class to another.) The criterion score of each student was therefore calculated by taking the mean of his standardised marks in each of the written papers taken by his class. For these computations, and others mentioned elsewhere in this thesis, a series of programs was written by the author for the university computer and these are presented in Appendices A to E.

b) The intelligence test

For the purpose of estimating the contribution of intelligence to the variance of examination achievement scores, over a wide range of examinations, a test was required which could measure general ability rather than any group or specific ability, and which was of a standard of difficulty to suit the students of the sample.

In addition, since Lady Venables' results (22) showed a non-verbal bias of ability in young engineering apprentices, which from subjective impressions in the classroom was also expected in the research sample, it was desirable to use a test which could give both verbal and non-verbal scores in order to test this finding at the higher level of ability expected in an area college.

The 16PF questionnaire includes a factor of intelligence, (Factor B), described as "scholastic mental capacity". This however, contains only thirteen items all of the verbal type, and does not discriminate between members of a highly selected sample to an extent which would be adequate for this research.

Test AH4 is intended "for use with a cross section of the adult

population". (23) It includes verbal and non-verbal sections, and has been validated by comparison with examination results from school and university as well as other criteria. Norms are available for university and technical college students, with whom the South Birmingham sample could be compared directly. However its main disadvantage with an intelligent population is that differences in score are likely to be based on speed rather than power. (24)

Test AH5 was designed on the same lines as AH4, giving verbal, non-verbal and total scores, but for a higher level of ability. Some of the questions require a vocabulary beyond that of many technical college students and for this reason scores on Part I, which contains a high proportion of verbal reasoning items, were likely to be largely influenced by knowledge of vocabulary as well as by verbal reasoning ability; but there was no reason to suppose that this knowledge is unrelated to academic progress.

A pilot sample of students drawn from four classes took test AH4 (total number of students was 69) including fifth year electrical technicians, first-year O.N.C. students in Science and in Electrical Engineering, and G.C.E. "A" level students. The resulting spread of scores was within the range quoted in the Manual for university students. The distribution of scores on the two parts of the test showed the expected bias in favour of the non-verbal, as shown in Table 3.2. Three classes (81 students) took test AH5, this time including the same O.N.C. students plus a second-year class from the same course. The scores on the two parts of the test are shown in Table 3.3.

Table 3.2

Frequencies of pilot AH4 scores

(N = 69)

Score	Part I	Part II
28 - 31	2	2
32 - 35	11	6
36 - 39	23	5
40 - 43	21	13
44 - 47	8	16
48 - 51	6	14
52 - 55	1	6
56 - 59		7
60 - 63		5

(Max. 65 each Part)

Table 3.3

Frequencies of pilot AH5 scores

(N = 81)

Score	Part I	Part II
6 - 8	1	
9 - 11	14	2
12 - 14	24	9
15 - 17	26	14
18 - 20	15	18
21 - 23	1	21
24 - 26		14
27 - 29		2

(Max. 36 each Part)

In each of the above distributions, the raw scores shown are the numbers of correct answers given, with a possible maximum of 65 for each part of AH4 and 36 for each part of AH5. In each distribution, the non-verbal scores are by inspection comparable with those of the university students mentioned in the Manual, but the verbal scores are appreciably lower. This finding was in accordance with expectation, and although lack of vocabulary was probably an element in the lower verbal scores, it was not so serious as to prevent the students from obtaining total scores on test AH5 which had a mean only half a standard deviation below the university mean. The AH5 test was therefore judged the more suitable for this research.

c) The personality questionnaire

The 16PF personality questionnaire was proposed for this research, rather than a shorter test, because of the comprehensive profile it offers. In addition to the second-order factors of anxiety and

extraversion, sixteen primary or source traits are measured, twelve of which have been identified with traits observed by other techniques. It "sets out to cover planfully and precisely all the main dimensions along which people can differ." (Manual of the 16PF, (10))

The raw scores obtained from this questionnaire have various maxima. Factor B scores have a maximum of 13. For factors A, G, I, L, N, Q_1, Q_2 and Q_3 the maximum is 20 and for the rest it is 26. Even with factors which have the same maximum score the distributions for the same population vary from one factor to another, and also from one form to another of the same test. This does not imply that some traits are more prominent than others in the behaviour of the individuals, only that the items in the test evoke these responses; so it is more reasonable to assume a normal distribution of each trait among the population and standardise the scores than to regard the skew or other characteristic of the raw scores as being a valid expression of personality. Cattell therefore provides tables for the conversion of raw scores to stens (or, if required, stanines), for use when factor scores are to be related to criteria.

These tables are suitable for comparing scores with those of the American population represented in each table, and indirectly with scores of other groups standardised in the same way. They also facilitate the construction of profiles, either for individuals or for groups, and the comparison of these profiles. The Manual provides a nomograph for rapid calculation of the profile similarity coefficient r_p, which resembles the product moment correlation but allows for differences in level of scores.

Pilot trials were carried out with 32 students drawn from classes

studying for G.C.E. "A" level, the City and Guilds Electrical Technicians' Certificate, and the O.N.C. in Sciences. In the table of results below these classes are labelled A, B and C respectively. Form B of the questionnaire was used, and the raw scores were standardised using the tables of stens for college men or college women, as appropriate.

Table 3.4

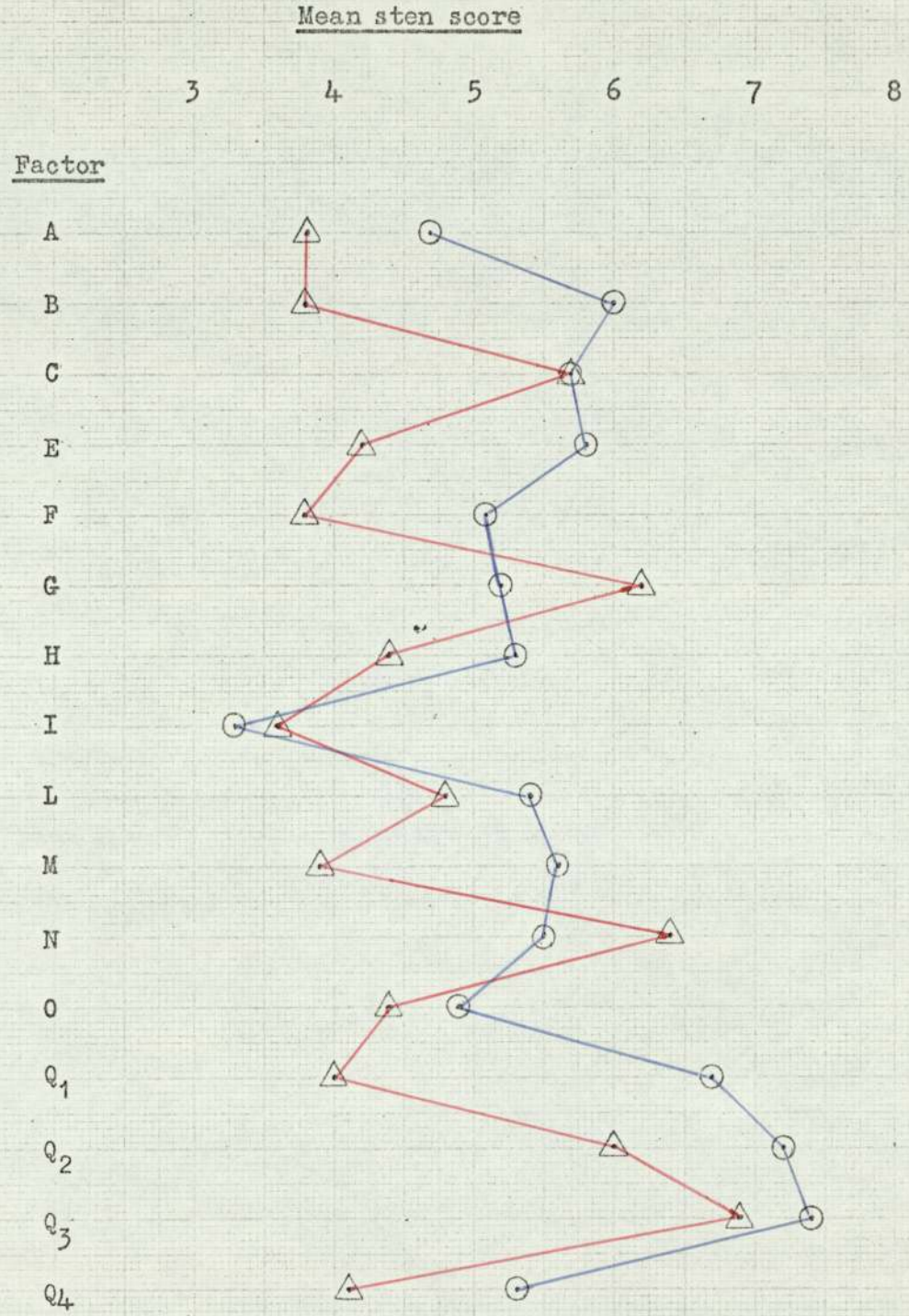
Mean 16PF pilot scores from three classes (stens)

Factor		A	B	C	E	F	G	H	I	L	M	N	O	Q_1	Q_2	Q_3	Q_4
Class	N																
A	7	4.1	5.1	4.6	6.0	7.3	4.9	5.6	4.4	7.1	7.7	5.7	5.7	8.3	6.0	3.9	6.0
B	11	4.7	6.0	5.7	5.8	5.1	5.2	5.3	3.3	5.4	5.6	5.5	4.9	6.7	7.2	7.4	5.3
C	14	3.5	6.2	6.4	6.3	6.7	4.4	5.9	3.1	5.6	6.0	4.8	5.2	6.4	6.1	7.6	5.4
All	32	4.0	5.9	5.8	6.1	6.3	4.8	5.6	3.5	5.9	5.3	5.2	5.2	7.0	6.4	6.7	5.5

The mean sten scores in these pilot trials did not agree closely with the American means of 5.5 for each factor, four of the grand means differing by more than two stens, but with a small and highly selected sample close agreement was not expected. Some of the students in the pilot sample were known to the writer, and these gave profiles which were not inconsistent with their classroom personalities. The distribution of sten scores, by inspection, did not show any pronounced irregularities. One of the classes (Class B in Table 3.4) was of Electrical Technicians, in the fifth year of a City and Guilds course, and when the mean sten scores for this class were compared with Cattell's published means for electricians the profile similarity coefficient r_p was found to be 0.65. The profiles are shown in Figure I, page19.

Figure I

16PF profiles of American electricians and British elec. technicians



Key △—△ 16 American electricians (from Manual of the 16PFQ)

⊙—⊙ 11 C & G student electrical technicians (5th year)

These pilot results did not reveal any objection to the use of the 16PFQ with the South Birmingham population, and the same form of the test and the same standardisation tables were therefore chosen for use with the research sample.

The amount of time taken by different students to complete this questionnaire varies considerably, and after experience with the pilot sample the order in which students finished was preserved for comparison with their personality and intelligence scores and with their examination results. The profile of the "quick workers", obtained by taking a mean of the scores of the first third of each class to finish, is included in section 6.

d) The method of attitude measurement

In seeking a method for the measurement of the students' attitudes, it was assumed that the varied influences which might affect a student in his academic work could not be adequately expressed by means of a unidimensional attitude scale, even if such a scale could be constructed. In addition, it was possible that the procedure used for attitude measurement might itself cause the students to crystallise or to modify their attitudes.

To give opportunities for the free expression of attitudes, it is possible to use open-ended questions in questionnaires, interviews, or in essays. Descriptions are given below of the biographical questionnaire and interview used to collect qualitative information, but the present section describes the preliminary trials which led to the choice of the semantic differential technique for collection of data in quantitative form.

In a trial of an essay method, a first-year O.N.C. science class

was compared with a final-year H.N.D. engineering class. As the former had only recently left school and the latter had had several years experience of one or more colleges and had been selected repeatedly by examination, it was expected that differences might be observed. Each class wrote an essay on the college, and the scripts were compared by counting the number of lines written on each topic and the direction (favourable or unfavourable) of comment. Neither criterion distinguished between the two classes, and three judges felt that the students had written on whatever topics had first occurred to them instead of making a considered judgment of the most important. The method was not sufficiently valid or reliable for this research.

Attitude analysis was also attempted by constructing a questionnaire with multiple-choice responses, with the intention of using factor analysis to reveal the main factors of attitude without imposing any predetermined pattern of responses. The correlations obtained between statements were low, and the method appeared unpromising, but the analysis could not be completed with the computer facilities then available and the full results have not yet been calculated.

A form of the semantic differential of Osgood et al. (21) was then constructed, and administered to a pilot sample of students.

In this method, each of the words or phrases to be judged (the "concepts") is rated on a number of seven-point scales described by pairs of adjectives. For example, a concept such as "socialism" or "police" or "father" is rated on scales such as "pleasant-unpleasant", "powerful-weak", "hot-cold", "safe-dangerous" or whatever the experimenter chooses. The ratings are then examined by factor analysis, by means of which the many scales are reduced to a small

number of factors which can be regarded as dimensions of meaning. By measurements on these dimensions each concept is located at a point in the multidimensional semantic space, by which its meaning is defined. The dimensions of meaning thus obtained by Osgood and his fellow workers in a number of studies were found to be reproducible, the three factors "evaluative", "potency" and "activity" appearing in each analysis. These were typified by the scales "good-bad", "strong-weak" and "active-passive" respectively.

The word "attitude" is used by these authors with reference to the evaluative component of meaning only. On page 190 of "The Measurement of Meaning" they write, "In terms of the operations of measurement with the semantic differential, we have defined the meaning of a concept as its allocation to a point in the semantic space. We then define attitude toward a concept as the projection of that point onto the evaluative dimension of that space".

In the present research, the value of a college to a student was expected to be closely related to its potency and activity, and before the factor analysis it could not be assumed that the usual three factors would emerge. For the prediction of behaviour, with which this research was concerned, Osgood recommends that all the dimensions should be used, so that the isolation of the evaluative factor was not essential to the research; and the term "attitude" is here used more broadly to cover all dimensions of meaning.

The time available for the administration of the test with each class was expected to be about half an hour. This was sufficient for about two hundred item responses (scales x concepts). For the purpose of the selection of scales it was assumed that the usual three factors would be found. The identification of a proposed scale as

representing a particular factor was not always clearcut, and some of the sixteen scales eventually chosen were tentatively allocated to more than one factor. The list was as follows:

Scale number	Polar terms	Possible factors
1	Ignorant-Knowledgeable	Potency
2	Useful-useless	?Evaluative/potency
3	Boring-interesting	?Evaluative
4	Clever-stupid	Potency
5	Unpleasant-enjoyable	?Evaluative
6	Busy-resting	Activity
7	Hostile-friendly	?Evaluative/activity
8	Active-passive	Activity
9	Frustrating-rewarding	?Evaluative/activity
10	Wise-foolish	Potency
11	Obstructive-helpful	?Evaluative/activity
12	Good-bad	Evaluative
13	Lazy-hardworking	Activity
14	Successful-unsuccessful	?Potency
15	Unimportant-important	Evaluative
16	Fair-unfair	Evaluative

In the selection of concepts, the primary aim was to provide a representative list of aspects of the college and academic work in order to allow the students' expression of their feelings to be as free as possible. In addition, a number of possible concomitants of achievement in examinations were postulated, in order to serve as guides in the choice of concepts. A preference for activities involving thought and initiative might be expected to lead to more effective learning, and could be expressed by rating such concepts as "difficult calculations", "unusual problems" and perhaps "laboratory work" more favourably than more passive procedures such as instructional films,

lectures or dictated notes. Toward concepts such as these some ambivalence was to be expected and a student might be subject to several conflicting influences. Speculation as to the relationships of attitudes to aspects of college work with the self-image, vocational ambition and identification with lecturers or employers led to the choice of the following list of concepts:

1) The college as a whole
2) Difficult calculations
3) Yourself as a student
4) Instructional films
5) Lecturers
6) Your employers
7) Unusual problems
8) Dictated notes
9) Yourself as an employee
10) Laboratory work
11) College library
12) Paper qualifications
13) Homework
14) Lectures (not the same as 5)

The bracketed comment after the last concept was added during administration when the instrument was tried out for the first time, because two students misunderstood.

Answer sheets were prepared on which all the scales were marked. A sample is appended (Appendix F). Students were asked to rate each concept in turn on all the scales, by writing the number of the concept once on each line. (In this way one sheet could be used for three or four concepts.) The seven ratings were explained using the blackboard to be as follows: extremely; very; slightly; don't know or

not applicable; slightly; very; extremely. It was pointed out that interpretation might be emotional or poetic rather than strictly logical.

The item responses may be scored either 1 to 7 or +3 to -3 across the sheet. In the pilot trial the latter was used. A copy of the sheet used for scoring is appended (Appendix G).

In the pilot trial, the test was administered to thirteen members of an O.N.C. science class. The aggregate scores are shown in Table 3.5, page 26. The frequency distribution of the ratings used for each of the item responses was observed during the counting of the tally marks used in summing these responses and showed a considerable spread, frequently spanning the extremes of the scales. This indicated wide differences in response between members of the class. The scores of individuals were not seriously at variance with the subjective impressions of the author as teacher of the class, and in general the validity of the test was not called into question by these preliminary results.

An indication of internal consistency was obtained by including one scale twice. Scale 4 on the sheet was "clever-stupid" and scale 17 was "stupid-clever". On issuing the sheets the author said, as if it had occurred by mistake, "Oh, there's one item in twice, but don't worry, just carry on." Of a total of 99 responses made on scale 17 (out of a possible 182), only 15 differed from the corresponding result on scale 4. Two of these were diametric opposites, indicating carelessness, and the others differed by one or two scale units. This result suggests that most of the students took reasonable care.

Certain students tended to use extreme ratings throughout. This and other limitations of the test are discussed in section 4. Apart from the deletion of scale 17, the procedure was repeated with the research sample without modification.

Table 3.5

Aggregate semantic differential scores in pilot trial

Concept / Scale	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	-7	-14	-10	-20	-28	-15	-9	-6	-17	-10	-10	-8	-10	-19
2	+22	+12	+14	+18	+18	+9	+17	+18	+22	+22	+20	+31	+22	+20
3	-5	+3	-8	-5	+10	-1	-4	+23	-11	-17	-4	+6	+15	+7
4	+5	+6	+12	+5	+15	+16	+7	+7	+12	+10	+8	0	+7	+9
5	-2	+15	-15	+21	+3	-6	-1	+18	-8	-14	-4	-4	+17	+8
6	+7	+22	+16	-20	+3	-2	+16	+15	+4	+12	-3	-2	+28	-1
7	-9	+14	-25	-8	+2	-15	+6	+1	-23	-4	-5	+3	+14	-3
8	+1	+10	+20	-2	+8	+11	+10	+8	+10	+12	-1	+3	+10	+5
9	-2	+14	-3	-11	+3	-6	0	+14	-2	-12	-6	-15	+14	+4
10	+11	+7	+4	+7	+13	+11	+11	+6	+11	+8	+12	0	+12	+19
11	-20	-9	+12	-18	-21	+14	-13	-8	-15	-18	-19	-27	-18	-17
12	+12	+7	+14	+12	+5	+13	+11	+5	+13	+18	+14	+17	+11	+12
13	-6	-12	-7	+2	-15	-10	-5	-5	-13	-4	+2	-4	-22	-12
14	+13	+3	+9	+9	+10	+26	+10	+12	+14	+7	+13	+18	+13	+17
15	-27	-18	-7	-10	-15	-22	-19	-21	0	-21	-25	-34	-22	-23
16	-5	+2	+11	+6	0	+7	+5	+4	+10	+9	+8	-4	-3	+4

e) The biographical questionnaire

The questionnaire was designed to provide information for the selection of subsamples, and also for amplification of the numerical data in profiles of the subsamples and of individuals. Any particular circumstance having a large effect on the attitudes of a high

proportion of the students who experienced it might well be reflected in examination achievement scores and also in attitude scores on the semantic differential. The items included some self-ratings and some open-ended questions, with opportunities for free comment. The topics included previous educational experience, current employment, the family, current outside interests and the college, all of which could be expected to have influenced the students' attitudes. A copy of the questionnaire is appended (Appendix H).

f) The interview schedule

Interviews were planned for two purposes, to check the numerical results of the standard tests by following up extreme or apparently anomalous figures, and to provide additional background material for the interpretation of the test scores. The intention was to select two or three students from each class on the basis of their scores plus another two or three at random.

Five-point scales were constructed by which ratings of vocational aspiration and intellectual curiosity could be made at each interview, as follows:

Vocational aspiration scale

1) Determined to remove all obstacles
2) Glad of opportunity but not prepared to make great efforts
3) Drifting
4) Not satisfied with career prospects
5) Already arranging to change job.

Intellectual curiosity scale

1) Deep interest in theory of own subject, plus intellectual approach to outside interests
2) Interested in some aspects of course and in how things work
3) Accepts training for narrow practical ends but would not seek

understanding for its own sake

4) Doubtful of value of course or of any education. Prefers rule-of-thumb solutions

5) Bored, never reads for pleasure, entertainment entirely passive, regrets having to learn his own trade.

A flexible structure was planned for the interviews. After being shown (if they requested this) their own but not their fellows' AH5 and 16PF scores, students would be encouraged to talk about themselves in relation to these scores, and about their schools, the college, their employers and home background, in that order. The completed biographical questionnaire would be available for reference. There was no fixed interview schedule, but the following list of questions was prepared as a standby:

Was that the kind of school you really wanted to go to?

Was it a good school?

Did you have the chance to do what you wanted?

How about exam. results - were you satisfied with what you got?

How did you come to choose that job?

What chances of promotion are there?

Do they worry much about what you do at the college?

Would you change your job if you had the chance?

What do you think of the course you're on?

Do you find the classes interesting?

How do you get on with .....(lab.work, Maths, English etc.) ?

Do you find the lectures useful?

How many hours a week do you spend on homework, on average?

What takes up most of your time?

Can you settle down to homework at home?

Does anybody at home help you at all?

Is your father in the same kind of job as you are?

What do your people think of the course you're doing?

4. Descriptive data

In this section the numerical results describing the sample as a whole are presented and discussed. The examination marks, the intelligence scores, the personality factor scores, and the semantic differential ratings are considered in turn.

a) Examination Marks

Although the examination system was not itself the subject of this research, the marks used for the calculation of the criterion scores were examined for any large systematic differences between courses or between classes.

The mean and standard deviation of the examination marks of each class in each subject* were printed out by the computer during the calculation of the criterion scores, (mean standardised examination marks) using the program "Standardisation" detailed in Appendix A. In addition to the marks of the research sample, those from certain other classes were also used for comparison. These were three other (parallel) classes of third-year mechanical technicians and three of first-year Building Department H.N.C. students who were not asked to take part in the research, and also all other classes which played any part in the testing program. Altogether 105 sets of marks were used, from 24 classes. The mean marks ranged from 32.8% to 78.4%, and standard deviations from 4.6 to 28.3. The frequency distributions are shown in Tables 4.1 and 4.2, page 30.

*Examinations in Liberal Studies, General Studies etc., have not been included.

Table 4.1

Frequencies of mean exam. marks

Mean	f
30 - 34.9	1
35 - 39.9	3
40 - 44.9	6
45 - 49.9	14
50 - 54.9	22
55 - 59.9	17
60 - 64.9	20
65 - 69.9	12
70 - 74.9	9
75 - 79.9	1

Table 4.2

Frequencies of s.d's of exam. marks

s.d.	f
4.0 - 6.9	1
7.0 - 9.9	19
10.0 - 12.9	37
13.0 - 15.9	24
16.0 - 18.9	13
19.0 - 21.9	9
22.0 - 24.9	1
25.0 - 27.9	1
28.0 - 30.9	1

Table 4.3, page 31, shows the means and standard deviations of the examination papers taken by each class of the research sample. In the second and third years of the Higher National Diploma course each class split into two groups to study either mechanical or production engineering, and so there were two sets of examinations for each.

It is of common occurrence for full-time students to produce better examination results than part-time, and there is some evidence for this in Table 4.3 where classes III, IV, VII and VIII are from full-time courses. Apart from this, no systematic variation in the marks was found which could be attributed to differences in ability or in diligence between classes.

Each paper is set and marked by an examiner, moderated by a colleague, discussed with any other lecturers who may be involved, and in the final examination for a National Certificate or Diploma, externally

Table 4.3

mean and s.d. of each exam. paper taken by the research sample

Class	mean	s.d.
I	54.5	13.6
	51.2	11.0
	56.8	18.8
II	54.2	11.1
	45.1	12.9
	38.2	15.2
III	74.4	11.5
	62.2	16.1
	78.4	11.3
	69.9	10.9
IV	74.7	14.2
	64.1	15.1
	62.7	20.9
	53.9	13.0
V	66.9	8.9
	43.1	14.0
	64.1	20.0
	46.8	7.4
VI	53.2	9.6
	61.6	8.7
	59.1	12.0
VII(M)	61.4	10.2
	60.9	11.0
	66.3	12.8
	63.3	11.3
	61.0	17.2
	64.8	16.0
	64.5	10.1
	62.5	10.8
	51.0	7.0
VII(P)	54.8	10.8
	71.9	12.3
	57.4	14.5
	48.4	7.7
	73.4	9.7
	72.6	9.5
	71.1	9.2
	55.6	10.5
VIII(M)	59.2	13.0
	53.0	11.5
	61.8	12.8
	62.8	18.4
	45.7	21.1
	50.0	11.0
VIII(P)	58.3	10.2
	60.0	9.3
	61.1	9.7
	65.7	9.6

assessed. Nevertheless some fluctuation in standards is inevitable. The research quoted by Cox (19) on fluctuations in standards of university examinations from year to year and from subject to subject indicates that the problem is not confined to the technical colleges. Ager and Weltman (25), discussing the university system of awarding first, upper and lower second and third class honours and pass degrees, "doubt whether present examination techniques are accurate enough to justify such an elaborate grading system." If a system using six categories is thus suspected of spurious accuracy, there is even more reason to suspect a system of reporting results in which raw marks are quoted as percentages in each subject, but the fundamental problem of unreliability in examinations is the same in each case.

Since papers which are too easy or too difficult for a class give skewed distribution curves, which would have the effect of exaggerating the standard deviations, spot checks were carried out using Pearson's first and second coefficients of skewness. No evidence was found that the distributions of marks in the examinations checked were so far from normal as to invalidate the use of the standard deviation as the measure of dispersion.

The raw marks from these examinations are used in connection with the award of vocational qualifications. They are also entered on report forms sent to students and to their employers as an index of academic attainment, and are even to some extent used by some lecturers and their superiors to indicate the effectiveness of teaching. In all these applications, it is implicitly assumed that the raw marks are stable in level and in dispersion from subject to subject and from year to year. Nothing in the above set of figures supports the uncritical use of this assumption.

b) Intelligence test scores

The mean and standard deviation of the AH5 scores of each class were calculated using the first part of the computer program "Standardisation" used for the calculation of the criterion scores. These results for each of the classes in the research sample are shown in Table 4.4, below.

Table 4.4

Part I (verbal/numerical), Part II (non-verbal) and total AH5 scores

Class		Pt I	Pt II	Total	N	Class		Pt I	Pt II	Total	N
I	m	12.1	17.6	29.7	14	II	m	13.1	20.1	33.3	11
	s.d.	3.2	2.9	5.8			s.d	4.1	3.8	6.9	
III	m	13.2	19.9	33.1	39	IV	m	13.9	20.8	34.8	16
	s.d.	3.2	4.2	6.4			s.d.	3.6	4.8	7.9	
V	m	13.8	22.8	36.6	17	VI	m	13.2	19.5	32.8	21
	s.d.	3.8	3.2	5.1			s.d.	2.9	2.3	4.6	
VII	m	16.3	22.3	38.6	19	VIII	m	15.5	21.8	37.4	26
	s.d.	4.4	3.8	7.2			s.d.	3.7	4.2	5.8	

The scores of the different classes at each academic level were compared by the t-test. The only difference of statistical significance between classes of the same course was between the Part II scores of classes V and VI, where the mean of 22.8 for class V was greater than that of 19.5 for class VI at a probability level of 0.01 - 0.02. This, however, was not convincing in the absence of any supporting evidence, and so the classes at each level were combined and the overall means and standard deviations calculated. (Table 4.5, p.34)

The scores of the first-year class of the H.N.D. M & P Eng. course were:

	Part I	Part II	Total	N
m	14.9	19.5	34.4	22
s.d.	3.5	3.9	6.0	

These scores were compared with those of classes VII and VIII. No significant difference was found, and these scores were included in the combined H.N.D. figures in Table 4.5.

Table 4.5

Raw AH5 scores combined by courses

Course		Part I	Part II	Total	II - I	N
MT3	m	12.6	18.7	31.3	6.1	25
	s.d.	3.7	3.6	6.5		
EE01	m	13.4	20.2	33.6	6.8	55
	s.d.	3.4	4.4	6.9		
BdgA1	m	13.5	21.0	34.5	7.5	38
	s.d.	3.3	3.2	5.2		
HND M&P	m	15.5	21.2	36.7	5.7	67
	s.d.	3.9	4.2	6.5		
All	m	14.1	20.5	34.6	6.4	185
	s.d.	3.8	4.1	6.7		

In the above table there is by inspection a progressive increase in scores on each part and the totals with increasing academic level of the courses. In relation to the standard deviations and sample sizes, however, the differences are not large. The difference in total scores between MT3 and HND M&P is statistically significant, ($p = 0.01 - 0.02$), by the two-tailed t-test; but for all the other differences in total score between pairs of courses, p was greater than 0.1.

Comparison of the combined scores of all courses with the norms published in the test manual shows that the mean total score of 34.6 with standard deviation of 6.7 is appreciably lower than that of

either the university students or the high-grade engineering apprentices for whom norms are given. This is as expected, although the intelligence ~~scores of university~~ scores of university students are not always as high as those of Heim's sample. Pilkington and Harrison (6) published figures for 246 psychology students in the University of Sheffield, from which the mean (but not the standard deviation) may be calculated. Their mean total score on AH5 was 36.13, much nearer to that of the South Birmingham students. In the light of this difference between scores in two universities, the level of total AH5 scores among the South Birmingham students is not surprising.

A more pronounced difference between the South Birmingham and Cambridge samples was found in the balance between the Part I and Part II scores. In the mean scores of every class, regardless of department or academic level, the non-verbal score is roughly one and a half times the verbal/numerical score. (This observation was foreshadowed in the pilot results shown in Tables 3.2 and 3.3, page 16). Not only is the result consistent in every class, but the standard deviations are lower than those quoted in the Manual, indicating greater homogeneity in the South Birmingham sample.

A slightly greater score on Part II than Part I was to be expected from the published norms. For university students the mean Part II score quoted is 1 mark higher than the Part I score, and for "High-grade engineering apprentices" the difference is 4 marks, at the mean. In the South Birmingham sample, the difference is 6.4.

In Lady Venables' local college sample, the apprentices had mean scores of 32 and 42 on the corresponding parts I and II respectively of AH4. The South Birmingham pilot sample had means greater than these

on AH4, and the difference between parts was a little smaller. Nevertheless the results from all the groups of South Birmingham students confirm previous work in demonstrating a non-verbal bias of ability among technical college engineering students.

Scores on AH5 can be further broken down, Part I being divisible into verbal and numerical items. There 23 verbal and 13 numerical items, each scoring one mark for a correct answer, so that the maximum possible score for the whole of Part I is 36. The means and standard deviations of the raw scores obtained by each class have been broken down as shown in Table 4.6.

Table 4.6

Raw n and v scores from Part I of AH5 (N as p. 34)

Class		n	v	Class		n	v
I	m	3.4	8.8	II	m	3.3	9.8
	s.d.	1.5	2.5		s.d.	1.5	3.0
III	m	4.0	9.2		m	4.6	9.2
	s.d	1.7	2.3		s.d.	1.7	2.3
V	m	3.8	10.1		m	3.7	9.5
	s.d.	1.6	2.7		s.d.	1.5	2.7
VII	m	5.5	10.7		m	4.9	10.7
	s.d.	2.5	2.7		s.d.	2.0	2.6
The first-year H.N.D scores were					m	4.8	10.1
					s.d.	1.6	2.9

Combining these results at each academic level, the figures of Table 4.7 were obtained. In order to facilitate comparison, the n and v scores are shown as percentages of the possible maxima (13 and 23 respectively)

Table 4.7

Combined n and v scores by courses

Course		Raw n	%n	Raw v	%v
MT3	m	3.3	26	9.2	40
	s.d.	1.5		2.8	
EE01	m	4.2	32	9.2	40
	s.d.	1.7		2.3	
BdgA1	m	3.7	29	9.8	42
	s.d.	1.5		2.7	
HND MP	m	5.0	39	10.5	46
	s.d.	2.0		2.7	

Hudson (26) found that the balance of verbal, numerical and spatial scores was associated with choice of career specialisation. Physical scientists and engineers were characterised by a numerical/spatial bias, whereas arts specialists tended to be the reverse.

For the separation of numerical and verbal ability, AH5 is not ideally suited. Not only are there only 13 numerical questions, compared with 23 verbal ones, but the directions include the specific instruction that the questions may be taken in any order, so that a low score on either factor may indicate a dislike of that type of question and not necessarily inability to answer. Also, in some items which appear to be numerical, incorrect answers may be the result of failure to grasp the precise meaning of the question, and not of lack of numerical ability. (The use of examples in this test ensures that each student is capable of understanding the phrases used, but observation of the answers shows that in many cases essential parts of the questions are ignored.)

Test scores are also affected by zeal and drive, and cannot be regarded simply as representing abilities alone. Although in every class tested the students were willing and even keen to cooperate in the research, and no lack of zeal was observed during administration of the test, an individual whose natural bias was non-verbal might be expected to find an item involving a diagram more attractive than a purely verbal one, so that Part II may be attacked with greater drive than Part I and the bias exaggerated. The same argument may be applied in the matter of the non-numerate bias, with added force because as noted above there is a choice of items within Part I. Technical college students often dislike written work, and say they are "no good at it", even when this is not entirely true; so it may be that the interpretation of the non-verbal and non-numerate bias of the South Birmingham sample should be sought as much in the personal and educational histories of the students as in a theory of intellectual types. Nevertheless the pronounced non-numerate bias shown in Table 4.7 could not have been predicted from Hudson's results and there is insufficient firm evidence to interpret it.

c) Personality factor scores

Raw scores obtained using Form B of the 16PF questionnaire were converted to sten scores by means of Cattell's standardisation tables for college students. Calculations from these sten scores were then carried out using computer programs written by the author. Anxiety and extraversion scores were found using the program "Second-order factors" (appendix B), which uses the weightings quoted in the Manual of the 16PFQ. Means and standard deviations were found using the first part of the program "Standardisation", written primarily for the standardisation of examination marks.

In addition to the results from the research sample, scores were also available from 78 other students of six other classes, who completed the 16PFQ as part of another project. Means and standard deviations of the sixteen first-order and two second-order factor scores were first found for each class separately, and for the combined classes of each course in the research sample. These figures are shown in Appendix I.

The standardisation tables used for the conversion of raw scores to standard stens were prepared by the author of the test from the results of a large sample of American students, and were so constructed as to give a mean of 5.5 and standard deviation of 2.0 when used with this population. In Table 4.8, the probabilities are shown that the means and standard deviations of the scores of the South Birmingham sample, totalling 263 when all available results were included, could have been obtained by sampling a population with the American means and standard deviations. On thirteen of the sixteen primary factors, there were significant differences, by the two-tailed t test. The mean scores on the second-order factors of anxiety and extraversion did not differ significantly from the American.

In the calculation of the second-order factor scores, which were made by using the weightings of first-order factors published in the Manual, it was assumed that their structure would be the same as in the American population. A paper by Cattell and Warburton (11) casts doubt on the validity of this assumption. These authors compared the factor scores of British and American students, primarily in order to examine the constancy of the structure of the second-order factors of anxiety and extraversion. On this question they concluded that "The

Table 4.8

m and s.d. of 16PFQ scores with probability that parent population has m of 5.5 and s.d. of 2.0 N = 263.

First-order factors	mean	s.d.	p less than
A (Affectothymia)	4.56	1.55	0.001
B (Intelligence)	6.00	1.53	0.001
C (Ego strength)	4.99	1.69	0.001
E (Dominance)	5.54	2.03	N/S
F (Surgency)	5.95	1.88	0.001
G (Superego strength)	4.25	1.73	0.001
H (Parmia)	5.24	2.15	0.05
I (Premsia)	4.34	1.94	0.001
L (Protension)	5.86	2.01	0.01
M (Autia)	6.38	1.78	0.001
N (Shrewdness)	4.94	2.00	0.001
O (Guilt proneness)	5.49	1.93	N/S
Q_1 (Radicalism)	6.45	1.94	0.001
Q_2 (Self-sufficiency)	5.88	2.08	0.01
Q_3 (Controlled)	5.99	1.96	0.001
Q_4 (Ergic tension)	5.51	1.90	N/S
Second-order factors			
Anxiety	5.61	1.77	N/S
Extraversion	5.36	2.02	N/S

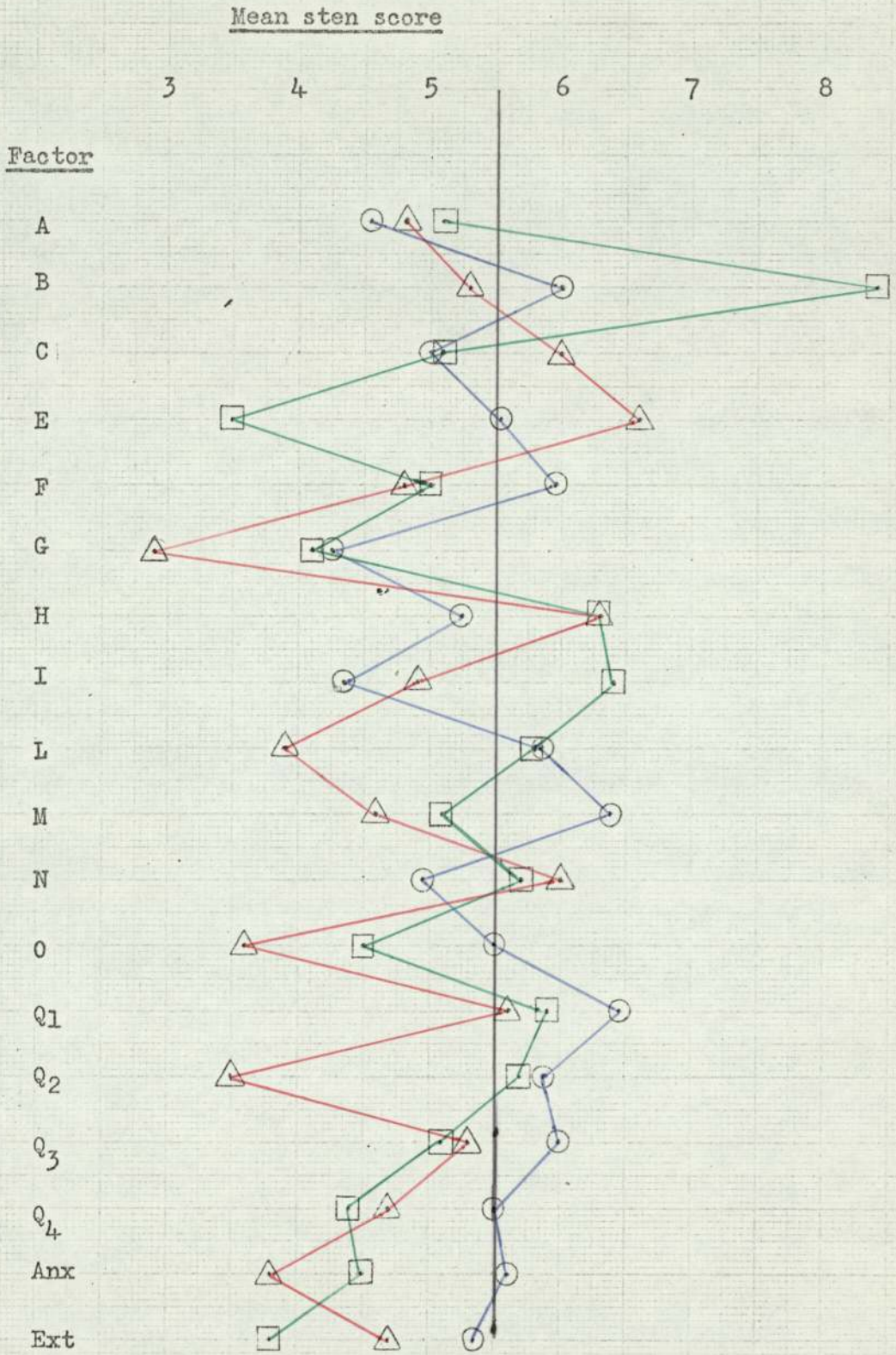
form of the anxiety and the extraversion-introversion patterns....were so similar in the two national subcultures that there is confirmation of the correctness of using the same concepts.....in both groups. However, there are considerable species differences within the common genus. For example, dominance is more instrumental in extraversion in Britain, and dispositional timidity differences play a larger role in the pattern of anxiety in America." Such differences could invalidate the use of the published weightings for the factor scores concerned.

The British samples used by Cattell and Warburton consisted of 112 graduate students in the Department of Education of the University of Manchester and 90 students in the (then) College of Advanced Technology, Birmingham. Figure II shows the personality profiles of these two samples, plotted from the figures given in the above paper, and the profile of the South Birmingham students.

For the comparison of 16PF profiles, the profile similarity coefficient r_p may be calculated from the sum of squares of the differences between each of the primary factor scores. Cattell provides a nomograph for this coefficient, which he recommends in preference to the product moment correlation because "It is superior in that it does not ignore absolute differences in the levels of the patterns." The sums of squares and similarity coefficients between the profiles of the four courses which made up the research sample are shown in Table 4.9.

Figure II

16PF profiles of three British samples



Key ⊡——⊡ 112 graduates in Dept of Education, Manchester

△——△ 90 Industr. Admin. students at Birmingham C.A.T.

⊙——⊙ 263 students of South Birmingham Technical College

Table 4.9

Profile similarity coefficients between courses

Course	MT3		EE01		Bdg A1		HND M&P	
	d^2	r_p	d^2	r_p	d^2	r_p	d^2	r_p
MT3	-	-	3.2	0.95	7.3	0.89	5.6	0.91
EE01			-	-	4.7	0.93	4.3	0.93
Bdg A1					-	-	7.3	0.89
HND M&P							-	-

When the profile of the combined South Birmingham sample was compared with those of the other British samples reported by Cattell and Warburton and with the American norms the coefficients were smaller. (Table 4.10)

Table 4.10

Profile similarity coefficients between 16PF profiles of American and three British student populations

	South B'ham		Manchester		B'ham C.A.T.		America	
	d^2	r_p	d^2	r_p	d^2	r_p	d^2	r_p
South B'ham	-	-	26.2	0.65	31.2	0.60	7.3	0.89
Manchester			-	-	35.0	0.57	23.1	0.70
B'ham C.A.T.					-	-	25.7	0.67
America							-	-

The resemblance between the South Birmingham sample and the American is greater than that between any two of the British samples. Those of Cattell and Warburton were highly selected, and it might be that the differences between these and the Americans could be

attributed to their specialised composition rather than to the nationality of the students. The South Birmingham sample, like the American, was less highly selected academically than the students of British universities; but it was selected by occupation, consisting almost entirely of employees in mechanical, production, electrical or civil engineering.

It was reported by Lady Venables that the scores of her local college sample of more than 1000 first-year part-time engineering students fell on the extraverted side of the population norm on the M.P.I. "E" scale, whereas university students were on the introverted side (15). The South Birmingham students therefore lay between those of the local colleges and those of universities both in extraversion scores and in intellectual attainment (which was to be expected).

Although the American and South Birmingham samples showed differences in mean first-order factor scores which were statistically significant, their profile similarity was high; and the question of national differences in the structure of the second-order factors might well be pursued with the South Birmingham scores.

d) Semantic differential scores

This section deals only with the combined results of the research sample as a whole. The calculations and the different ways in which the results can be expressed are described in some detail, but the results from subsamples are reserved for a later section.

In the procedure described in the previous section students made seven-point ratings of 14 concepts on each of 16 scales. When scored, the ratings of each of the 142 students formed a table of 14 x 16 single-digit numbers in the series 1 to 7. These tables were used

according to the technique described by Osgood et al., to determine the dimensions of meaning used by the students in judging the concepts, and to find the mean position of each of these concepts in the semantic space.

Each table of ratings was numbered, using the numbers used to identify the individual students throughout the research. A computer program, "Selected mean and s.d." (Appendix D), was written by the author to obtain the mean and standard deviation of the scores in each cell of the table for any combination of these numbers. Grand means for factor analysis were found by using all the numbers, and are shown in Appendix J.

Factor analysis between scales was carried out on the means in this table, using the Elliott Applications program LS9 as modified by Jean M. Abbott (unpublished). The modification removes certain checks which limit the form of the data.

The factors extracted by this analysis, in the unrotated form*, do not fall exactly into the categories "evaluative", "potency" and "activity" which might be expected from the previous work. The first factor is evaluative plus potency, potency of the concepts judged here

*The factors or dimensions of meaning isolated with the program used are unrotated, and their composition could be modified by rotation. The interpretation, however, was straightforward as the results stood and in the present stage of development of this application of the technique, rotation was not attempted.

being expressed on the scales "wise", "clever", "successful", "knowledgable" etc. The second factor is activity, including the scales "rewarding", "useful" and "active", and the third, smaller, factor has its two largest scale loadings those of "interesting" and "enjoyable". The full factor analysis is given in Appendix K.

For the calculation of factor scores, the scale scores were converted from the 1 to 7 series which was used for the initial scoring and data tapes (because it saves labour by avoiding the extra symbol "-") to the -3 to +3 series. The latter series has the advantage of zero for the neutral point and makes the figures easier to understand.

Measurements of meaning obtained by the semantic differential technique can be expressed in a number of forms, of which the raw scores are the least convenient because they are too numerous and lacking in structure. In Appendix J, the means of the raw scores show some internal consistency, the level of scores reflecting the polarity of the scales. They can also be used for reference, but do not offer an overall picture.

The validity of the figures shown in Appendix J as standard deviations is suspect because the scale is so short. For example there are cases of means of 6.0 or above with standard deviations of 1.0 or greater, implying that some 16% or more of the scores were above the maximum of 7.0. The calculation was included in the computer program in order to find out whether students disagreed among themselves more on judgments of one concept than another, but no evidence of this was revealed by inspection of the figures.

In the following sample calculation, the example used is the concept, "lecturers". Factor scores were found by taking the mean of the scale scores which had the highest loadings on the factor concerned, after allowing for the polarity of the scale. Four scales were used for each of the first two factors, and two for the third.

Using the original 1 - 7 scoring and the loadings as shown in the computer printout, the data for the four most heavily loaded scales on factor 1 were as follows:

Scale number	Loading	Scale term		Concept score
		Low score	High score	
10	-0.94	Wise	Foolish	2.6
7	+0.87	Hostile	Friendly	5.4
16	-0.85	Fair	Unfair	2.2
4	- 0.82	Clever	Stupid	2.3

When converted to the alternative scoring method, and with the polarity of the scale reversed where required, this table becomes:

Scale number	Loading	Scale term	Concept score
10	0.94	Wise	1.4
7	0.87	Friendly	1.4
16	0.85	Fair	1.8
4	0.82	Clever	1.7
		Total	6.3

The factor 1 score for this concept = 6.3 ÷ 4 = 1.6

In the similar calculation for factor 2, a further complication arises. Tabulating as before,

Scale number	Loading	Scale term		Concept score
		Low score	High score	
9	+0.82	Frustrating	Rewarding	4.3
2	-0.80	Useful	Useless	2.1
8	+0.80	Active	Passive	2.8
6	+0.79	Busy	Resting	2.8

which converts to:

Scale number	Loading	Scale term	Concept score
9	0.82	Rewarding	0.3
2	0.80	Useful	1.9
8	0.80	Passive	-1.2
6	0.79	Resting	-1.2

However a negative score for "Passive" equals a positive score for "active", so the minus sign can be removed,

Scale number	Loading	Scale term	Concept score
9	0.82	Rewarding	0.3
2	0.80	Useful	1.9
8	0.80	Active	1.2
6	0.79	Busy	1.2
			Sum = 4.6

The factor 2 score for this concept is $4.6 \div 4 = 1.15$.

In the calculation of scores on factor 3, only two scales were used although a factor in this method should contain at least three scales. The first four scales in this factor as presented by the computer were as follows:

Scale term	Loading
Interesting	0.89
Enjoyable	0.66
Useful	0.53
Important	0.49

For some concepts, the scores on the first two scales differed considerably from those on the second two. The scale scores of the concept "paper qualifications" on the scales "interesting" and "enjoyable" were low, 0.3 and 0.5, but on "useful" and "important" the scores were 2.4 and 2.3 respectively. Other concepts were affected less markedly but in the same way, so that inclusion of the second two scales in a factor labelled "interesting/enjoyable" was likely to diminish its validity without increasing its reliability. The factor 3 score was therefore calculated as the mean of the two scale scores only.

The complete set of factor scores for all concepts is shown in Table 4.11, page 50.

The primary aim in calculating these factor scores was to establish norms with which the individual or subsample scores could be compared. This comparison may be made in two ways, firstly by taking each concept separately and comparing the factor scores in the different cases, and secondly by comparing the positions of the concepts in semantic space in relation to each other, rather than in absolute terms. Both these methods are used below in section 6.

In the present section, which is devoted to the description of the research sample, the mean scores may be noted as the consensus of attitudes in the college. The plausibility of the results may also

Table 4.11

Factor scores for the whole research sample

All x 100. N = 142.

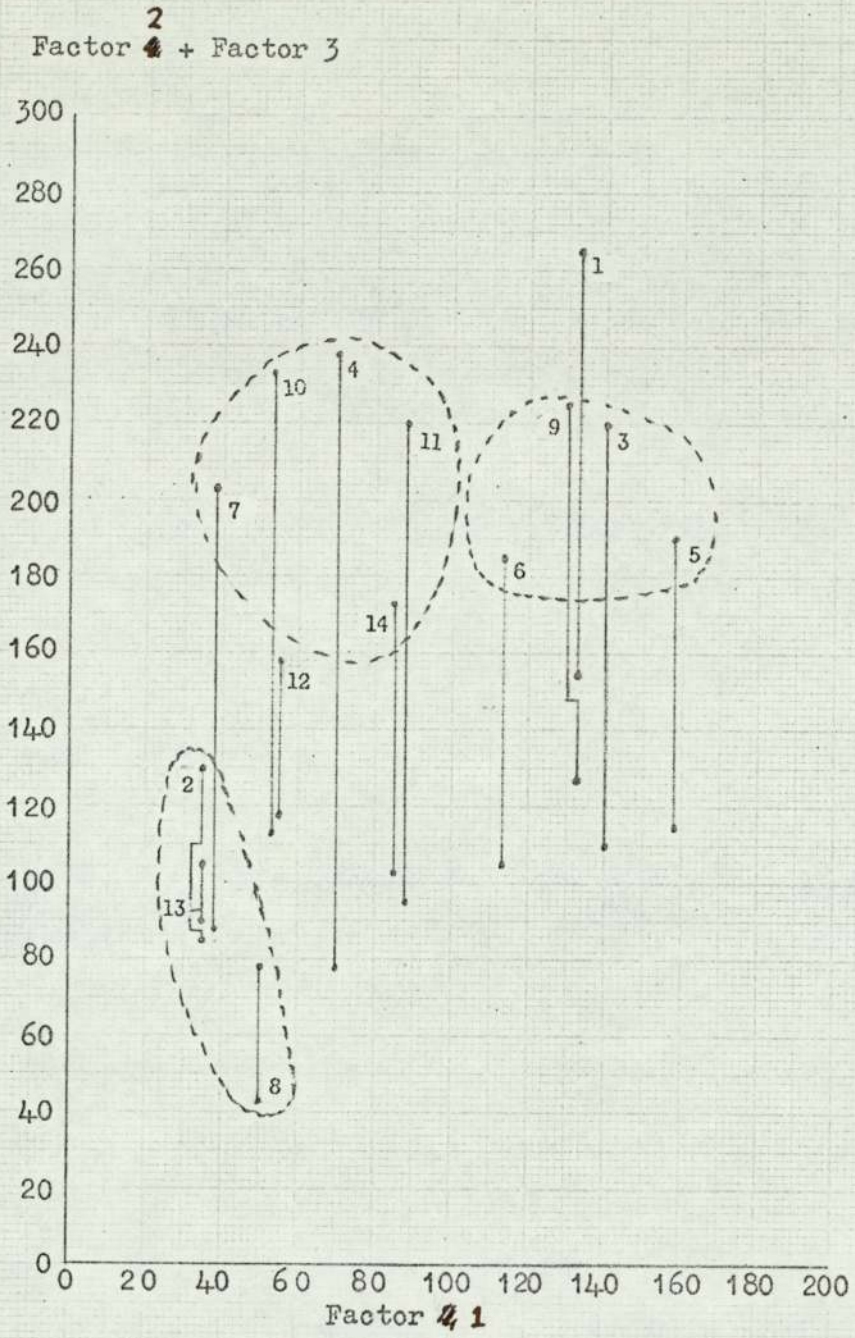
No	Concept Term	Factor 1 Eval/potency	Factor 2 Activity	Factor 3 Int/Enj	Sum
1	The college as a whole	133	155	110	398
2	Difficult calculations	35	85	45	165
3	Yourself as a student	140	110	110	360
4	Instructional films	70	78	160	308
5	Lecturers	158	115	75	348
6	Your employers	113	105	80	298
7	Unusual problems	38	88	115	241
8	Dictated notes	45	78	-35	88
9	Yourself as an employee	133	125	105	363
10	Laboratory work	53	113	120	286
11	College library	88	95	125	308
12	Paper qualifications	55	118	40	213
13	Homework	35	105	-15	125
14	Lectures	85	103	70	258

be taken as an indication of some validity in the instrument. (The term "instrument" is used here to mean that developed by the author for this particular application, which is to be distinguished from the semantic differential technique in general.) "Instructional films" and "Dictated notes", for example, were the least active of the concepts as predicted in the construction of the instrument, and were widely separated on Factor 3, "Interesting/enjoyable".

In Figure III, an attempt is made to represent the factor scores

Figure III

Semantic differential factor scores of the research sample



visually, by plotting the scores on two factors in two dimensions in the usual way, and then drawing a further vertical line from each point to represent the third factor score above or below the plane of the paper. In this diagram the concepts do not appear in well-defined clusters, but those with common attributes are neighbours. The four "human being" concepts, 3,5,6 and 9, are encircled in the diagram by one dotted line and popular activities, 4,7, 10, 11 and 14, by another. A further dotted line has been drawn round concepts 2,8 and 13, which are less popular activities. Among the concepts representing aspects of academic work, the highest factor 1 (value/potency) scores were given to the "college library" and "lectures", while the most active was "laboratory work" and the most interesting/enjoyable was "instructional films".

The distance between any two concepts in the semantic space may be calculated from the factor scores, and is the square root of the sums of squares of differences between factor scores in the three dimensions. The figures tabulated below illustrate this calculation for the concepts Difficult calculations, Instructional films and Dictated notes.

	Factor scores		
Concept	F1	F2	F3
Difficult calculations(2)	0.35	0.85	0.45
Instructional films (4)	0.70	0.78	1.60
Dictated notes (8)	0.45	0.78	-0.35

Factor	Differences x 100		
	2/4	4/8	2/8
F1	35	25	10
F2	7	0	7
F3	115	195	80

Squares of differences, sums and distances

	2/4	4/8	2/8
F1	1225	625	100
F2	49	0	49
F3	13225	38030	6400
Sums	14499	38655	6549
D	120	197	81

The "D" distances were calculated, as were the factor scores, for the purpose of comparison with the corresponding results from subsamples, and there is little to be learned from the matrix shown in Table 4.12 below which cannot be seen in the factor scores or in Figure III. Using a D matrix a three-dimensional model can be constructed, but Figure III or a solid version serves the same purpose and can be prepared directly from the factor scores.

Table 4.12 "D" matrix calculated from the data of Table 4.11

Concept	2	3	4	5	6	7	8	9	10	11	12	13	14
1	137	46	111	59	62	116	186	30	91	76	111	167	81
2		126	120	130	88	70	81	122	82	96	39	63	59
3			92	40	41	104	176	17	88	56	110	163	68
4				128	95	56	197	96	56	43	127	181	95
5					46	129	162	40	114	88	109	153	74
6						84	136	38	73	52	72	123	30
7							150	102	30	51	83	131	67
8								172	159	166	86	35	115
9									82	58	102	156	63
10										40	80	136	60
11											94	150	56
12												60	45
13													99

The sums of factor scores for each concept give an approximation to scores on the "dominant characteristic attribute", which in this application can be interpreted as an approach-avoidance scale, but this is even more dubious than a literal interpretation of the factor scores because there is no reason to suppose that the three factors should be equally weighted. In a more fully developed form of this instrument, weightings might be determined. In its present form, the total scores have been calculated simply by summing the factor scores, and are shown in Table 4.13. On this scale, the college as a whole is more favourably rated than any of its parts, and dictated notes and homework are the concepts least favourably rated. These scores are discussed further in section 6.

Table 4.13

Rank order of total factor scores N = 142

Rank		Concept	Score
1	1	The college as a whole	398
2	9	Yourself as an employee	363
3	3	Yourself as a student	360
4	5	Lecturers	348
5=	4	Instructional films	308
5=	11	College library	308
7	6	Your employers	298
8	10	Laboratory work	286
9	14	Lectures	258
10	7	Unusual problems	241
11	12	Paper qualifications	213
12	2	Difficult calculations	165
13	13	Homework	125
14	8	Dictated notes	88

Several outstanding statistical problems remain to be resolved before figures such as the above can confidently be interpreted. The question of scale-concept interaction, for example, has been mentioned in connection with the calculation of the factor 3 scores. Another problem to be considered before the scores of individuals can be calculated is that some students tend to use extreme ratings throughout whereas others tend to use the "slightly" columns, and this cannot be assumed to be related to the intensity of their feelings. Some further information, hwever, can be obtained by comparison with the results obtained from subsamples and this is discussed below in section 6.

5. Comparisons with the criterion scores

a) Comparison of intelligence with criterion scores

The criterion score for each student was calculated as described in the previous section, by taking a mean of his standardised examination marks in each subject. It thus represents only the examination achievement of the student in relation to the other students in the same class, and was chosen in order to allow inclusion of varied classes in the sample, because attitude factors were the main object of the research and these were expected to operate similarly in all academic classes.

The AH5 scores to be compared with this criterion were also standardised in the same way, using the same computer program. The scores of the various courses of the research sample shown in Table 4.5 show an upward trend with academic level of the course, but this variable is eliminated by using the standardisation procedure by which each class was given a mean score of 100 and standard deviation of 15 on Part I, Part II and the total.

Product moment correlations between the Part I, Part II and total standardised AH5 scores and the criterion score were calculated using the first part of Elliott Applications Program LS9, the whole of which was used elsewhere in this research for factor analysis. The correlations matrix is shown in Table 6.1. (N = 171)

Table 6.1 Intercorrelations between intelligence and exam. scores.

	Part I	Part II	Total	Criterion
Part I	1.00	0.44	0.83	0.01
Part II		1.00	0.86	0.03
Total			1.00	0.03
Criterion				1.00

Correlations between AH5 and the criterion score using the results of each course separately were also insignificant. One class (class III) gave a product moment correlation coefficient of 0.3, but with 29 degrees of freedom this was not statistically significant. Contingency tables for each class separately did not reveal any consistent relationships, and the numbers were too small for generalisation.

A further check was carried out by calculating mean AH5 scores for three groups of high-achieving students, using subsamples discussed in the next section. Table 6.2 shows these intelligence scores (not standardised) compared with grand means for all students for whom complete data were available. (The "criterion over 105" subsample includes those who scored over 110, who in turn include those over 115)

Table 6.2

AH5 scores of three subsamples of successful students

	N	Part I	Part II	Total AH5
All research sample	171	14.0	20.6	34.5
Criterion over 105	64	14.2	21.2	35.4
Criterion over 110	35	14.4	21.4	35.8
Criterion over 115	17	14.0	20.5	34.5

None of these subsamples had any AH5 score significantly above the grand mean.

In the comparison of profiles of ex-grammar school and ex-secondary modern school students, (see next section) the former had higher intelligence scores but their mean examination score was not higher. (100.5, compared with the S.M. school mean of 101.1, which is not statistically significant.)

There is therefore a lack of correlation between the intelligence and criterion scores, which was not entirely unexpected. It was noted in section 1 that correlations between intelligence scores and examination marks for highly selected samples tend to be low. Entry to all the courses represented in the research sample is controlled by previous examination performance, so that all entrants show that their intelligence is adequate at least at the level of their previous examination. In addition, any association between intelligence and the academic level of the course was deliberately eliminated in this research.

Pilkington and Harrison (6) found that "Test AH5 appeared more useful as a device for screening out poor candidates than as a means of predicting high academic achievement." No such threshold effect appeared at South Birmingham, however, where the profile of the seventeen most successful students included four whose total score was 28 or less. (section 7).

The abilities sampled by AH5 are not comprehensive, and when the new British intelligence scale becomes available other abilities could be investigated; but the present evidence suggests that the general ability of the research sample was adequate for high achievement in the courses for which they enrolled.

b) Comparison of personality and criterion scores

In the Handbook for the 16PFQ (10), Cattell and Eber formulate a specification equation for the prediction of academic performance. These authors do not claim that the equation is precise, but "the following is the rough specification equation suggested by present evidence: Grade = -0.4 A $+0.5$ B $+0.3$ C -0.2 E -0.2 F -0.2 H -0.2 L $-$ 0.3 M $-$ 0.2 O $+$ 0.2 Q_3 -0.4 Q_4." The signs and

weightings describe the direction and importance of the effect of each of the traits mentioned.

In this equation, it cannot be assumed that in every case the relationship between "Grade" and factor score is linear. Extreme scores might have disadvantages as well as advantages even for the narrowest scholasticism, and it is possible that the relationship might be curvilinear or reversed in direction at one end. The product moment correlation would not in such a case be an appropriate method of analysis.

In order to demonstrate the existence of any systematic relationship between the criterion and personality factor scores of the South Birmingham sample, the computer program "Relationships" (Appendix C) was written. Since on any first-order personality factor only ten different sten scores are possible, there are ten subsamples of the population defined by these factor scores, and a mean of the criterion scores for each subsample can be calculated. Using the computer, means were calculated of the criterion scores of each subsample for each factor in turn, together with the standard deviation, 5% confidence limits and the number of students in the subsample. The second-order factors of anxiety and extraversion were included at the end, the scores being rounded to the nearest sten. The computer output for the 249 students who completed both the 16PFQ and their examinations is given in full in Appendix L.

Most of the factors showed no relationship with the criterion score. Graphs of the results for factors A, F, Q_2, Q_3, M and extraversion are shown in Figures IV to IX, below. There is some evidence of slight negative correlations with cyclothymia (A) and

with surgency (F), and a positive correlation with self-sufficiency (Q_2). These three factors are all included in the second-order factor of extraversion, and the slope is in the expected direction in each case. In the graph of the relationship between the criterion and extraversion, however, the slope is not steep, and when a mean criterion score was found as described in section 7 for the 44 members of the research sample who had an extraversion score more than half a standard deviation above the research sample mean the result was not statistically significant. Self-concept control, (Q_3), was the only factor which showed any indication of a non-linear relationship with the criterion score. Both the sten 1 and the sten 10 subsamples had significantly high criterion scores. The sten 1 subsample however, consisted of only two students, and cannot be relied upon. Autia (M) is not included in the calculation of extraversion scores, although Cattell considers it to be related. None of the criterion scores of the sten subsamples differs significantly from the mean.

These relationships are further discussed under the heading of subsamples of successful students in section 6. In general, the conclusions from this section are that the specification as a whole was not confirmed, and that the association of the criterion score with personality factor scores was small.

Relationships between 16PF scores and criterion scores

Figure 6.1 "A" factor scores

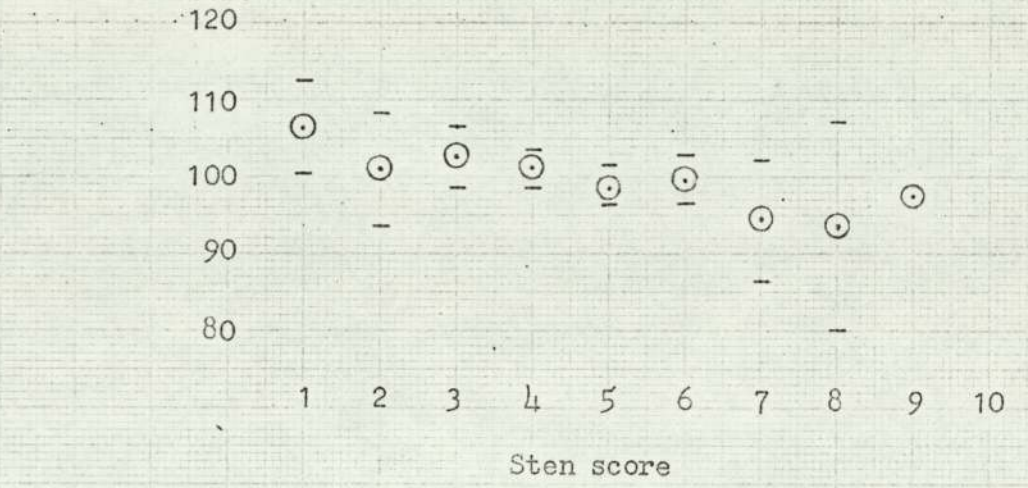


Figure 6.2 "F" factor scores

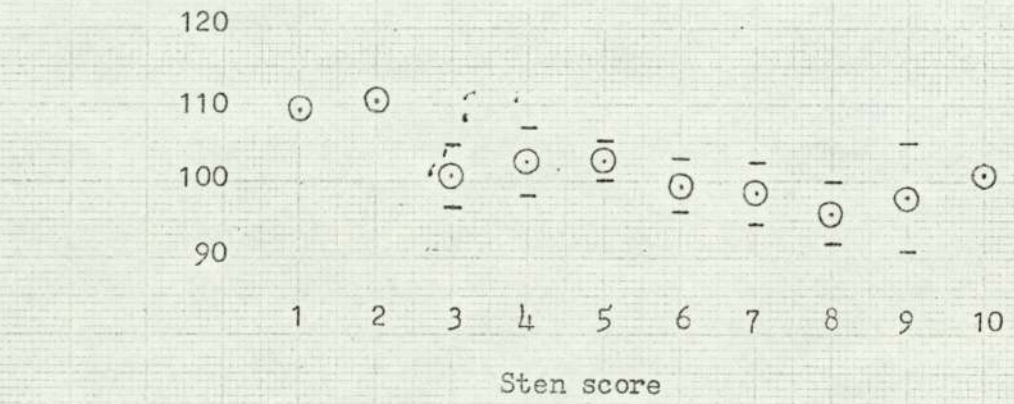
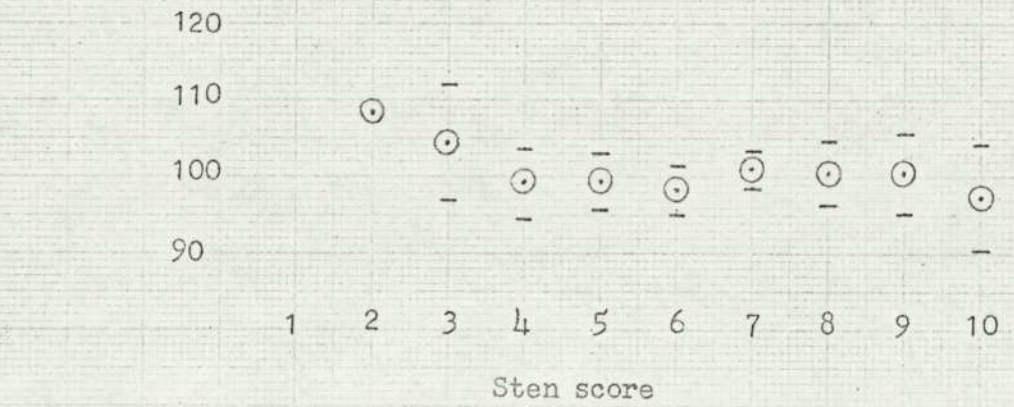


Figure 6.3 "M" factor scores



Relationships between 16PF scores and criterion scores

Figure 6.4 "Q_2" factor scores

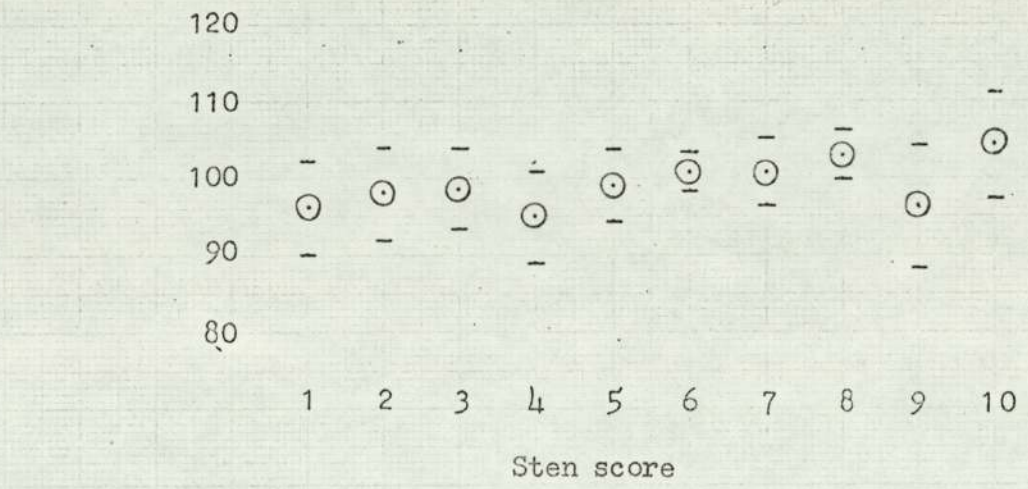


Figure 6.5 "Q_3" factor scores

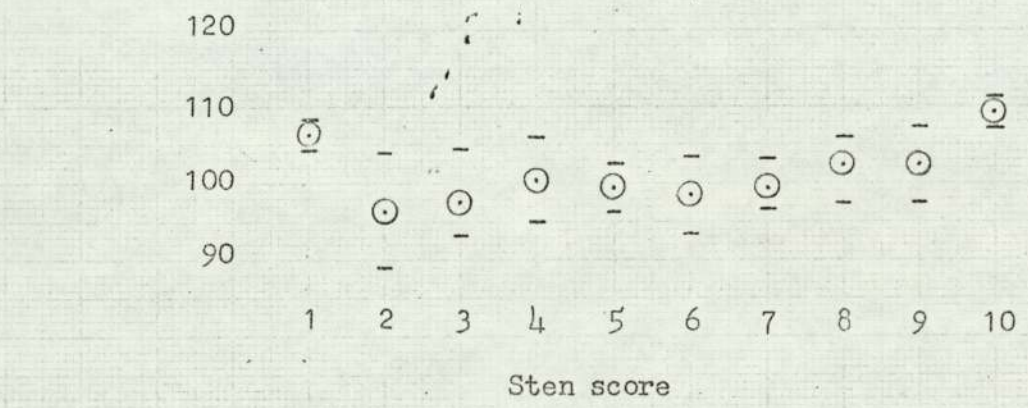
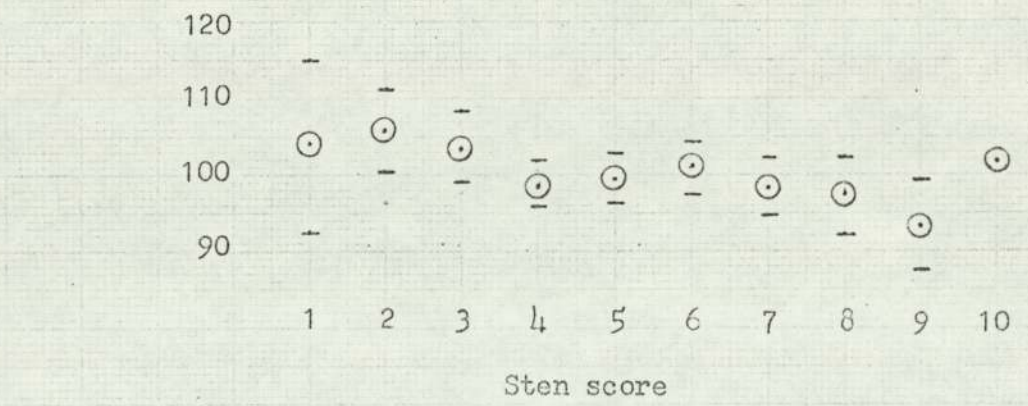


Figure 6.6 Extraversion scores



6. Profiles of subsamples

a) Standard test scores

Subsamples were selected by criterion scores and by personality factor scores, and also using biographical data. The object of the selection was to choose those who differed from their fellows in ways associated with academic achievement, in order to investigate their attitudes. The norms with which the subsample means were compared are given in Table 6.1, which shows the grand means and standard deviations of the intelligence, personality and criterion scores for the research sample as a whole, with the addition of the first-year H.N.D. class, omitting only those students whose data were incomplete.

In this section, the subsamples whose mean scores did not differ from the norms will be described first. The computer program "Short selected m and s.d.", by which the subsample mean scores were found from the complete table of scores, is given in Appendix E.)

One of the factors which J. A. Wankowski (12) has found to be associated with performance at the University of Birmingham is definiteness of vocational objective. Table 6.2 shows the means and standard deviations of the scores of the subsample whose responses on the biographical questionnaire gained the highest rating on a five-point scale of clarity of vocational goal. The mean criterion score of this subsample was 101.8 (s.d. 10.46) but neither this nor any other of the scores of this subsample differs significantly from those of Table 6.1. This does not necessarily contradict Wankowski's finding because at South Birmingham all the courses pursued by the research sample were vocationally orientated and the questions may not have differentiated between the students; and further, their vocational

aspiration may have been unrelated to a need for academic achievement.

Table 6.1

Personality, intelligence and criterion scores of the research sample plus first-year H.N.D. class N = 171

16PF scores

Factor	A	B	C	E	F	G	H	I	L	M
Mean	4.6	6.0	4.9	5.4	5.8	4.3	5.2	4.4	5.8	6.3
s.d.	1.6	1.5	1.6	2.1	1.9	1.7	2.1	2.0	1.9	1.8

Factor	N	O	Q_1	Q_2	Q_3	Q_4	Anxiety	Extraversion
Mean	4.9	5.6	6.5	5.8	5.9	5.5	5.6	5.2
s.d.	2.1	1.9	1.9	2.1	2.0	1.9	1.7	2.1

AH5 scores	Part I	Part II	Total	Criterion score
Mean	14.0	20.6	34.5	100.2
s.d.	3.7	4.2	6.8	11.4

Table 6.2 Numerical data for "definite vocational objective" students

16PF scores (N = 59)

Factor	A	B	C	E	F	G	H	I	L	M
Mean	4.8	6.1	5.3	5.3	5.8	4.3	5.3	4.2	5.8	6.0
s.d.	1.6	1.6	1.8	2.2	2.0	1.5	2.0	2.0	1.4	1.8

Factor	N	O	Q_1	Q_2	Q_3	Q_4	Anxiety	Extraversion
Mean	4.6	5.4	6.3	6.2	6.1	5.3	5.4	5.2
s.d.	1.9	2.1	1.9	2.1	2.0	1.8	1.8	2.1

AH5 scores	Part I	Part II	Total	Criterion score
Mean	14.1	20.6	34.7	101.8
s.d.	3.4	4.3	6.7	10.5

None of the differences between tables 6.1 and 6.2 is significant.

Another item in the questionnaire asked students to indicate whether their parents had been "extremely keen on your education", "pleased for you to get a normal education", 'hot really interested", "mildly discouraging" or "strongly against schools". 82 students ticked the "extremely keen" box, but there were no significant differences between their scores and the college norms.

Table 6.3

Numerical data for students whose parents had shown keen interest in their education (n = 82)

16PF scores

Factor	A	B	C	E	F	G	H	I	L	M
Mean	4.4	6.2	5.2	5.5	6.0	4.3	5.6	4.2	5.6	6.3
s.d.	1.6	1.5	1.7	2.1	2.1	1.8	2.1	2.0	1.9	1.7

Factor	N	O	Q_1	Q_2	Q_3	Q_4	Anxiety	Extraversion
Mean	5.0	5.4	6.8	5.8	5.9	5.5	5.5	5.5
s.d.	2.1	1.8	1.8	2.1	1.9	1.9	1.6	2.2

AH5 scores	Part I	Part II	Total	Criterion score
Mean	14.1	20.8	34.8	100.1
s.d.	3.5	4.0	6.5	10.2

The subsamples of ex-grammar school and ex-secondary modern school student were compared with each other. The former had higher intelligence scores than the latter, but there was no statistically significant difference between the mean criterion scores or personality factor scores. The figures are shown in Table 6.4.

Table 6.4

Numerical data for ex-grammar and ex-secondary modern students

(n = 64 and 55 respectively)

16PF scores

Factor	A	B	C	E	F	G	H	I	L	M
GS mean	4.5	6.3	4.9	5.4	5.8	4.4	5.3	4.3	5.7	6.5
SM mean	4.7	5.8	5.2	4.9	5.5	4.3	5.1	4.5	5.9	6.1
GS s.d.	1.5	1.4	1.5	1.8	2.0	1.7	2.1	1.9	1.7	1.8
SM s.d.	1.8	1.6	1.8	2.2	2.1	1.8	2.2	2.0	2.0	1.9

Factor	N	O	Q_1	Q_2	Q_3	Q_4	Anxiety	Extraversion
GS mean	4.8	5.7	6.7	5.7	5.6	5.5	5.7	5.3
SM mean	4.9	5.3	6.4	5.7	6.5	5.1	5.3	4.9
GS s.d.	2.1	1.7	1.9	2.0	2.1	1.8	1.5	1.9
SM s.d.	2.1	2.0	1.8	2.1	1.7	1.8	1.9	2.3

AH5 scores	Part I	Part II	Total	Criterion score
GS mean	15.5	21.3	36.8	100.5
SM mean	12.1	18.9	31.1	101.1
GS s.d.	3.2	4.0	5.8	11.8
SM s.d.	3.4	4.1	6.9	9.8
p	0.001	0.05	0.001	N/S

The ability to work quickly was expected to be an advantage, and in the absence of a better criterion the subsample of "Fast Workers" was selected by taking the first third of each class to complete the 16PFQ. This measure had some reliability (in a test-retest comparison of the order of finishing the 16PFQ on two occasions, 30 students gave a rank-order correlation of 0.7), but the introspection required may make demands on the students which are not the same as those

of academic work. The latter may be expected to be more demanding intellectually, but perhaps less demanding emotionally, than the 16PF; so the validity of this measure as an indicator of speed in college work cannot be assumed. This subsample had a significantly high mean score on the second-order factor of extraversion, and on some of the primary personality factor scores contributing to it. The mean M factor (Autia) was also high. Intelligence was higher on the 16PF B factor, but not significantly so on the AH5. The criterion score of the subsample was identical with that of the whole research sample.

Table 6.5

Numerical data for the "fast workers" (n = 57)

16PF scores

Factor	A	B	C	E	F	G	H	I	L	M
Mean	4.9	6.4	4.6	6.1	6.4	4.2	5.6	4.4	5.9	7.0
s.d.	1.5	1.3	1.6	2.2	1.9	1.6	2.0	2.2	1.9	1.7
p	N/S	.05	N/S	.05	.05	N/S	N/S	N/S	N/S	.01

Factor	N	O	Q_1	Q_2	Q_3	Q_4	Anxiety	Extraversion
Mean	4.9	6.0	6.1	5.6	5.6	6.0	6.0	6.0
s.d.	2.1	1.9	1.8	2.1	2.2	2.1	1.7	2.0
p	N/S	N/S	N/S	N/S	N/S	N/S	N/S	0.01

AH5 scores	Part I	Part II	Total	Criterion score
Mean	14.7	21.5	36.2	100.2
s.d.	4.1	4.2	7.3	11.5

A sample of students having a high mean extraversion score might normally be expected to show relatively low academic achievement. It is possible that the quickness shown by this subsample in completing

the 16PF was also characteristic of their approach to academic work, and that in this respect they had an advantage.

The subsamples "High anxiety" and "Extraverts" were selected by taking those whose second-order factor scores were more than half the standard deviation above the mean in each case. Neither subsample had a mean criterion score or AH5 score significantly different from the norm. The scores are shown in Tables 6.6 and 6.7.

Table 6.6

Numerical data for "High anxiety" subsample (n = 55)

16PF scores

Factor	A	B	C	E	F	G	H	I	L	M
Mean	4.5	6.1	3.7	5.1	5.6	4.2	4.0	5.2	6.5	7.1
s.d.	1.4	1.3	1.3	2.2	1.8	1.6	2.1	1.9	1.7	1.7
p	N/S	N/S	*	N/S	N/S	N/S	*	0.01	*	0.001

Factor	N	O	Q_1	Q_2	Q_3	Q_4	Anxiety	Extraversion
Mean	4.7	7.1	6.1	6.1	4.8	7.2	7.6	4.4
s.d.	2.1	1.3	2.0	2.2	2.0	1.4	0.9	2.1
p	N/S	*	N/S	N/S	*	*		0.001

AH5 scores	Part I	Part II	Total	Criterion score
Mean	14.0	21.2	35.2	100.3
s.d.	4.4	4.4	7.8	11.4
p	N/S	N/S	N/S	N/S

In the above table, and in Table 6.7 below, the asterisk denotes that the factor concerned contributes to the second-order factor for which the subsample was selected.

Table 6.7

Numerical data for "Extraverts" subsample (n = 44)

16PF scores

Factor	A	B	C	E	F	G	H	I	L	M
Mean	5.2	6.0	5.2	6.9	7.3	3.9	7.1	3.9	6.1	6.6
s.d.	1.6	1.7	1.7	1.7	1.4	1.7	1.0	1.9	1.9	1.9
p	*	N/S	N/S	*	*	N/S	*	.1-.05	N/S	N/S

Factor	N	O	Q_1	Q_2	Q_3	Q_4	Anxiety	Extraversion
Mean	5.4	4.8	6.8	4.8	5.7	5.5	5.2	7.5
s.d.	2.0	1.8	1.9	2.1	2.1	2.1	1.7	0.9
p	N/S	0.01	N/S	*	N/S	N/S	N/S	

AH5 scores	Part I	Part II	Total	Criterion score
Mean	14.4	21.0	35.3	97.8
s.d.	3.7	4.1	6.3	12.3
p	N/S	N/S	N/S	N/S

The biographical questionnaire also offered opportunities for free comment, and profiles were calculated for the 12 students who made favourable comments on their lecturers and the 15 who wrote unfavourably. The mean criterion scores, 103.0 (s.d. 12.34) and 104.3 (s.d. 9.30) at first sight appeared slightly higher than the norm, suggesting that high achievement was associated with critical evaluation of lecturers in either direction, but the differences in criterion score were found not to be statistically significant by the t test. The point might be worthy of further consideration in further work, but is not pursued in this thesis.

All the above subsamples raise side-issues of some interest, but none offered clearcut indications of factors affecting examination achievement. The evidence was not sufficient for negative conclusions to be drawn.

The subsamples so far described did not differ from their fellows in ways associated with academic achievement, as represented by the criterion score. Five other subsamples were also selected. Three of these were chosen by their criterion scores, and so were by definition high achievers. These were the students whose criterion scores were over 105, over 110 and over 115, so that the members of the last-mentioned subsample were also included in each of the other two, and the second and third were both included in the first. The term "highest achievers" is used here to refer to the students whose criterion scores were over 115.

The subsample of students who left their courses after completing the standard tests but before the examinations, here termed the "leavers", might be expected to contrast with the successful subsamples.

The students who in the biographical questionnaire responded to the item, "Have you, in your opinion, worked....." by ticking the box marked "Extremely hard" were termed the "hard workers". This subsample had a mean criterion score of 110.8 (s.d. 8.79) which was significantly high.

The numerical data for the three subsamples chosen by their criterion scores are shown in Table 6.8, page 69. The intelligence scores of these subsamples have already been tabulated in Table 5.2, page 56. All these intelligence scores are close to the means for the whole research sample, and the differences are not statistically significant, confirming the negative results of section 5. The personality scores supplement the data of section 5. Extraversion is significantly low only in the "Over 105" subsample, and none of the

Table 6.8

Numerical data for subsamples selected by their criterion scores

(n = 64, 35 and 17 resp.)

16PF scores

Factor	A	B	C	E	F	G	H	I	L	M
Over 105 mean	4.4	5.9	4.7	5.4	5.2*	4.4	4.7	4.2	6.1	6.2
Over 105 s.d.	1.6	1.5	1.5	2.1	2.0	1.6	2.2	2.0	1.8	1.9
Over 110 mean	4.3	5.7	4.7	5.3	5.5	4.6	4.9	3.9	6.1	6.3
Over 110 s.d.	1.7	1.6	1.5	2.5	2.1	1.5	2.1	1.8	1.7	2.0
Over 115 mean	4.5	5.6	4.6	5.5	5.9	4.4	5.0	3.4*	6.4	6.1
Over 115 s.d.	1.9	1.7	1.5	2.4	2.5	1.9	2.5	1.9	1.8	2.2

Factor	N	O	Q_1	Q_2	Q_3	Q_4	Anx.	Extr.
Over 105 mean	4.6	5.6	6.4	6.4*	6.2	5.5	5.8	4.6*
Over 105 s.d.	2.0	1.7	1.9	2.0	2.2	2.0	1.7	2.3
Over 110 mean	4.8	5.5	6.6	6.5*	6.3	5.5	5.7	4.8
Over 110 s.d.	2.0	1.5	1.4	2.1	1.9	1.8	1.4	2.6
Over 115 mean	4.8	5.1	6.3	6.0	6.2	5.4	5.6	5.2
Over 115 s.d.	2.3	1.6	1.2	1.9	1.9	1.9	1.5	3.0

AH5 scores	Part I	Part II	Total	Criterion scores
Over 105 mean	14.2	21.2	35.4	111.6
Over 105 s.d.	3.5	3.9	6.3	5.3
Over 110 mean	14.4	21.4	35.8	115.2
Over 110 s.d.	3.4	4.1	6.4	4.5
Over 115 mean	14.0	20.5	34.5	118.6
Over 115 s.d.	3.1	4.3	6.4	4.1

* p = 0.01 - 0.05. In all other results, p is greater than 0.05.

five first-order factors contributing to the extraversion score is significant in all the three subsamples. Of the first-order factors not contributing to the extraversion score, the only statistically significant finding was that the mean I factor (Premsia) of the "criterion over 115" subsample was lower than the grand mean. There is an apparently progressive decrease in I factor score in the three subsamples, but in the distribution of scores shown in Appendix L it can be seen that this apparent trend is due to a few extreme scores only. The twelve students whose sten score on this factor was 1 had a mean criterion score of 110 (s.d. 15, p = less than 0.05), but no other sten subsample had a mean criterion score significantly different from 100 and the evidence is not conclusive.

The "leavers", whose mean scores are shown in Table 6.9, numbered only 9 for AH5 and 11 for the 16PFQ. The slightly higher mean score for verbal/numerical intelligence is not statistically significant. There were, however, three significant differences in scores on first-order personality factors. These students collectively had high surgency (F), low superego strength (G) and high autia (M).

The "hard workers" (Table 6.10) was the only subsample studied whose intelligence score differed significantly from the grand mean. Their verbal/numerical score was low. (m = 11.5, s.d. = 2.1, p = 0.01 - 0.001). Their mean criterion score was high at 110.8 (s.d. 8.79, p = 0.001). The personality scores of the "hard workers" were significantly different from the grand means on three of the first-order factors, surgency (F), superego strength (G) and self-concept control (Q_3). In Figure X, the profiles of the "leavers" and the "Hard workers" are shown by comparison with that of the whole sample from which these subsamples were drawn.

Table 6.9 Numerical data for the "leavers" (n = 11 (16PF), n = 9 (AH5))

16PF scores

Factor	A	B	C	E	F	G	H	I	L	M
Mean	4.7	6.1	4.3	6.1	7.*1	3.*4	5.1	4.5	6.8	7.*3
s.d.			2.1		1.6	1.3			2.7	1.2

Factor	N	O	Q_1	Q_2	Q_3	Q_4	Anx.	Extr.
Mean	4.0	7.3	5.9	5.9	5.8	5.5	6.1	6.0
s.d.	2.3							

AH5 scores	Part I	Part II	Total	Criterion score
Mean	16.8	20.2	37.0	Exam not taken
s.d.	4.2	3.7	5.9	

Table 6.10 Numerical data for the "Hard workers" (n = 12)

16PF scores

Factor	A	B	C	E	F	G	H	I	L	M
Mean	3.8	6.4	5.3	5.0	4.**	5.*5	4.9	4.1	6.7	5.3
s.d.	1.6	1.3	1.6	2.5	1.4	1.6	2.5	1.9	2.0	1.8

Factor	N	O	Q_1	Q_2	Q_3	Q_4	Anx.	Extr.
Mean	5.5	5.6	6.7	6.5	7.***	4.7	5.1	4.0
s.d.	2.6	1.3	1.2	2.1	1.5	1.7	1.3	2.2

AH5 scores	Part I	Part II	Total	Criterion score
Mean	11.5**	20.1	31.*6	110.***8
s.d.	2.1	2.9	4.1	8.79

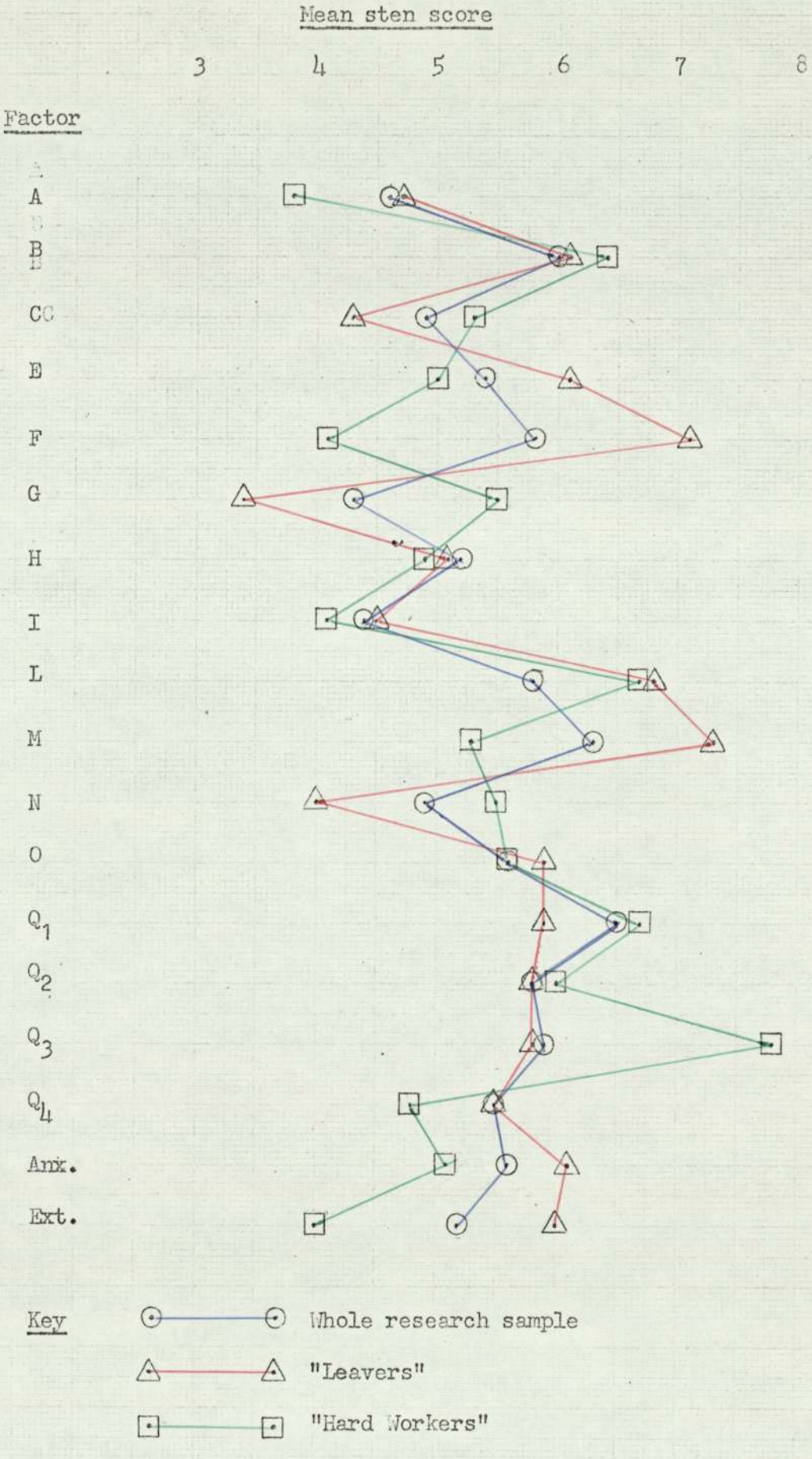
*p = 0.01 - 0.05

**p = 0.001 - 0.01

***p = less than 0.001

Figure X

16PF profiles of the research sample and two subsamples



The F (surgency) and G (superego strength) scores of the "hard workers" are significantly low and high respectively, while the "leavers" scores are significant in the opposite directions. The "Hard workers" also had a high Q_3 (Controlled) score. Their M (Autia) score, which in the "leavers" profile was significantly high, had a higher standard deviation and so although numerically equidistant in the opposite direction it is not significantly different from the grand mean. ($p = 0.1 - 0.05$). Several other factor scores show a contrast between the two profiles, notably ego strength, dominance, shrewdness and the two second-order factors.

Cattell's specification equation for high academic performance predicts the direction and loading of eleven of the sixteen first-order factors. The results reported in section 5b showed slight correlation in the expected direction in the relationships between the criterion and the factors of cyclothymia, surgency and self-sufficiency*, but none of convincing significance or considerable magnitude. The subsamples of high-achieving students had among them significant relationships between the criterion and the factors F (surgency), I (premsia), Q_2 (Self-sufficiency) and extraversion. Of the fore-going results, the significance of the premsia score of the "Highest achievers" (criterion score over 115) is due to a few extreme individuals and may or may not be fortuitous. For the remainder of the personality factors mentioned, so far as the evidence permits a firm

*Self-sufficiency is not among Cattell's eleven predictive factors, but an association of high Q_2 with high achievement is to be expected.

conclusion it is that the personality scores show some association with criterion scores in the expected directions but that the difference in criterion score associated with personality is small. The evidence was not sufficient to show whether the relationships were linear.

The subsample "Hard workers" had a profile which contrasted with that of the students who left the course early. The attitude scores of the "hard workers" are considered together with those of the "highest achievers" in the next section.

6 b) Semantic differential scores of successful subsamples

In section 4, mean score of all the students who completed the semantic differential were presented as factor scores, and also as a "D" matrix representing the distances between each of the concepts in semantic space. In the present section, the results of similar calculations for the subsamples of successful students are compared with the grand means. The results are not inconsistent with the existence of differences in attitude structure between the subsamples and the parent sample.

The simplest hypothesis relating attitudes and achievement in this research is that high criterion scores are associated with high semantic differential scores on each factor for every concept which represents an aspect of the college or of academic work, the successful students taking a more favourable view of each concept on each factor. If this simplified hypothesis were sufficient to account for the observations there would be no need to use factor analysis. The complete procedure as developed by Osgood and his co-workers has

not in fact always been thought necessary in attitude studies. Barclay and Thumin (27), for example, showed that raw scores on bipolar scales could be used to indicate a negative attitude without further analysis.

Table 6.11 shows the factor scores and their sums for the whole research sample and the two successful subsamples. The sums of the factor scores have the attraction of simplicity, but offer no more information than the sums of raw scores mentioned above. There is no reason to assume that for the prediction of behaviour all the factors should be equally weighted. If in future work weightings for each factor could be calculated, linear representation of the data in the form shown in Figure XI might be convenient for some purposes.

Comparison of the sums of factor scores did not support the simplified hypothesis, that the successful students are those who without discrimination take a more favourable view than their fellows of all aspects of the college and academic work, and a more detailed comparison was made using all the dimensions of meaning to detect possible differences in pattern. This was a speculative exercise, as it is possible to be misled by fortuitous results, and the findings must be treated with caution. However it has been noted in section 3 that the choice of the semantic differential technique in this research was indicated by the expectation that students attitudes to the college and academic work might not be expressible on a single continuum and that the successful students might be distinguishable by the pattern, rather than the absolute level, of their scores. The meanings of the concepts were therefore considered using the factor scores, first taking a few concepts at a time and later the whole structure together.

Table 6.11

Semantic differential factor scores

Research sample (N = 142)

Concept	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Factor 1	133	35	140	70	158	113	38	45	133	53	88	55	35	85
Factor 2	155	85	110	78	115	105	88	78	125	113	95	118	105	103
Factor 3	110	45	110	160	75	80	115	-35	105	120	125	40	-15	70
Sum	398	165	360	308	348	298	241	88	363	286	308	213	125	258

Criterion over 115 (n = 13)

Concept	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Factor 1	148	81	166	63	167	133	27	38	125	27	90	40	58	98
Factor 2	148	108	89	71	110	103	81	71	117	36	104	94	123	94
Factor 3	104	116	100	200	92	66	88	-38	89	62	150	-4	31	65
Sum	400	305	355	334	369	302	196	71	331	125	344	130	212	257

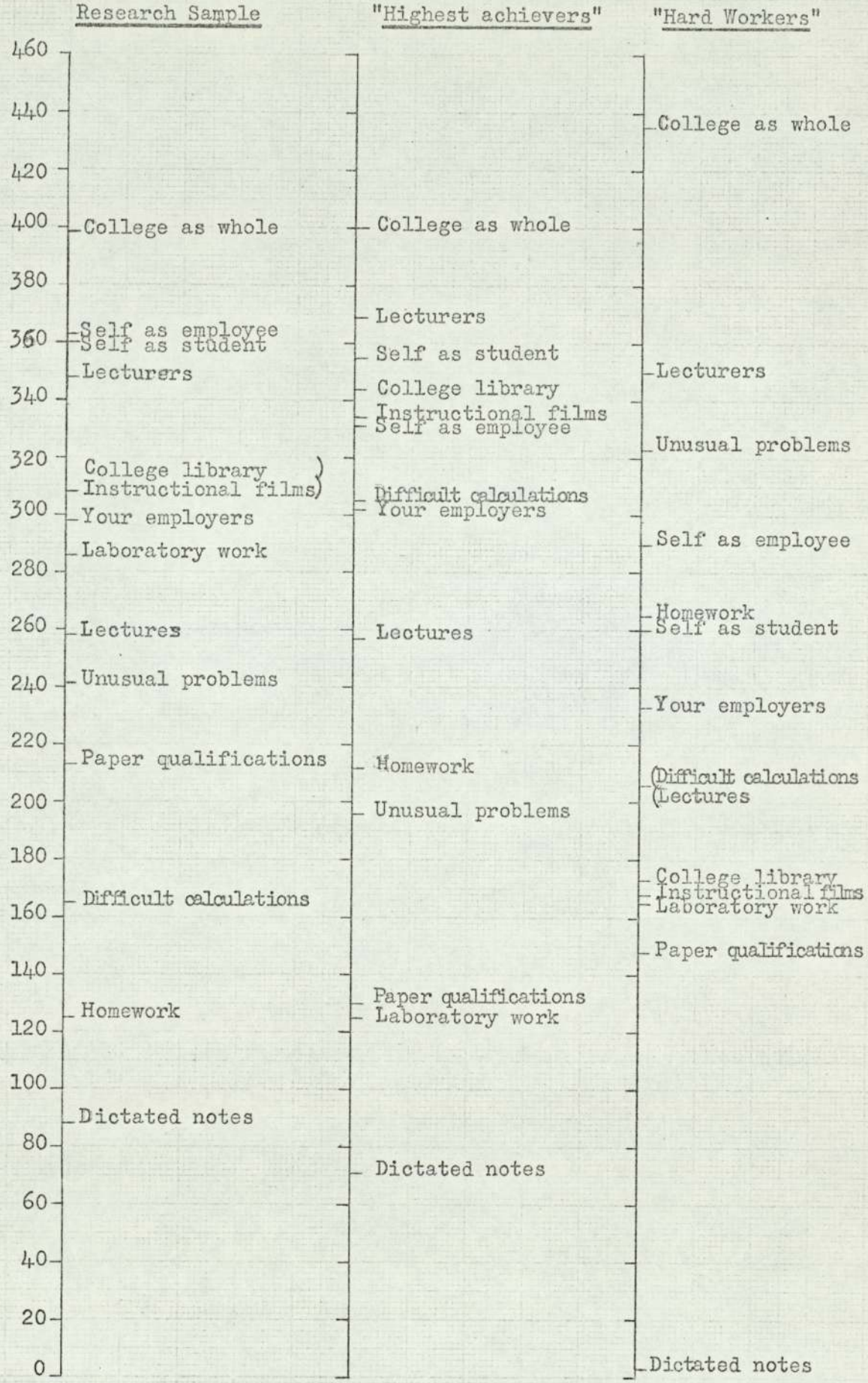
Hard workers (n = 10)

Concept	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Factor 1	135	18	85	30	135	105	15	-3	90	5	43	30	55	78
Factor 2	150	98	85	38	135	78	118	45	120	75	75	118	145	58
Factor 3	150	90	90	100	80	50	190	-40	80	85	55	0	65	70
Sum	435	206	260	168	350	233	323	2	290	165	173	148	265	206

Key to concepts

1 The College as a whole
2 Difficult Calculations
3 Yourself as a Student
4 Instructional films
5 Lecturers
6 Your Employers
7 Unusual Problems
8 Dictated notes
9 Yourself as an employee
10 Laboratory work
11 The College Library
12 Paper qualifications
13 Homework
14 Lectures

Figure XI Linear representation of semantic differential total scores



An alternative method of comparison of semantic differential scores developed by Osgood et al. is by the distances between concepts in the semantic space. Concepts having closely similar meanings are separated by shorter distances in the "D" matrix than concepts of different meaning. Innumerable hypotheses could be advanced as to possible differences between successful and average students in meaning systems expressed in this way. For instance the successful students might show a smaller distance between "homework" and "paper qualifications", indicating a belief that diligence in homework brings its reward, or between "self as a student" and "lecturers", indicating identification with lecturers. Such speculation could produce no more than an indication of possible avenues for future research, but it is the strength of this multidimensional approach that differences in attitude systems should be observable as self-consistent differences in the structures described by the "D" matrices.

The composition of the "hard workers" and "highest achievers" subsamples was dissimilar, only two students appearing in both. (In other words only two of the "hard workers" had criterion scores over 115, although the mean for this subsample was 110.8). The "hard workers" subsample of 12 students, of whom 10 completed the semantic differential, was distinguishable from the whole research sample by significantly high mean criterion score, low verbal/numerical intelligence score and by low surgency, high superego strength and high self-concept control on th 16PFQ, inviting speculation as to causal relationships between these factors. The "highest achievers" subsample of 17 students, of whom 13 completed the semantic differential, had intelligence and personality scores indistinguishable from those of their fellows, with the possible exception of a low "I" factor score. Although some overlapping could be expected between these two subsamples,

it appeared likely from consideration of their dissimilarities that differences might be found in their attitude structures.

When individuals or groups are compared by the semantic differential, it is possible that they may differ in the factorial structure of their responses. These differences could include the number of factors, the nature of factors, and the relative weights attributable to them in arriving at judgments. It might therefore be desirable to use subsamples large enough for separate factor analysis and to check that the factor structure emerging in each case was the same, before making direct comparisons.

A further possible criticism lies in the assumption that the dimensions of meaning used by the students are the same for all concepts, i.e. that there is no scale-concept interaction. Osgood et al. themselves point out that in fact the meanings of scales and their relations to other scales vary with the concepts being judged. A. S. Presley (28) confirmed this when he calculated the correlations between 11 scales separately for each of the concepts judged by ten agorophobic married women, and found that the correlations between scales varied greatly. In a pilot trial in the present study, the author remembers one student, who outwardly preserved a rather dignified manner, reaching the concept, "Yourself as a student". With great solemnity he asked the class at large, "Am I enjoyable?" The problem arose more seriously in the factor analysis described in section 4b, when the scales "useful" and "important" had loadings of 0.5 on factor 3 but were omitted from the calculations of factor scores because their contributions could be seen by inspection to vary from one concept to another. Apart from this omission, the factor scores were calculated by giving equal weighting to each of the most heavily loaded scales on each factor. It might be possible in future work to improve the

validity of the factor scores by reconsidering the questions of rotation, scale-concept interaction, and scale weightings. Possibly, separate forms of the instrument should be used for investigating concepts so widely different as say, the self and dictated notes.

With these reservations, an indication of the significance of the scores obtained with this form of the semantic differential (i.e., that used in this research) in its present stage of refinement was obtained by comparing the scores of the two concepts, "Yourself as a student" and "Yourself as an employee" shown in Table 6.12. The concepts are not, of course, identical and there is some systematic variation. Allowing for this, it is plausible that a difference greater than one-quarter of a scale division (i.e. about 25 in this Table) in mean factor score could be due to some source other than random variation. For convenience, the decimal point has been removed and one division on the scale +3 to -3 is shown as 100.

Table 6.12 Semantic differential scores (x 100) for self-ratings

Sample	Concept	Factor 1	2	3	Sum
All students	Self as student	140	110	110	360
(n = 142)	Self as employee	133	125	105	363
Hard workers	Self as student	85	85	90	260
(n = 10)	Self as employee	90	120	80	290
Highest achievers	Self as student	166	89	100	355
(n = 13)	Self as employee	125	117	89	331

Apart from providing this indication of the internal consistency of the method, the self-concept is of intrinsic importance as a basic attitude. Coombs and Davies (29) found that American college students

adjusted their behaviour to conform to a self-image derived from school assessments and social environment. The scores of the "Highest achievers" subsample are in the direction suggested by this finding. Their value/potency score for the concept "Yourself as a student was higher than the norm but their activity score was lower, suggesting self-confidence. Their factor 3 score, representing self-ratings on the scales "Interesting" and "Enjoyable" is almost the same as the norm. As employees, this subsample saw themselves as less valuable/potent, more active and marginally less interesting/ enjoyable than as students, if the differences are large enough to be of any significance.

J. A. Wankowski (12) has described the phenomenon of the disenchanted elite at university. Sixth-formers who form an elite at school may find themselves mediocre performers in the university environment, and become discouraged. In a technical college the reverse may occur, and might perhaps be termed a "Cinderella" effect. In the case-histories of the members of the subsamples of successful students (section 6c, below) there were several expressions of frustration at school and, weak as the evidence is, the point might be worthy of more rigorous investigation.

The "hard workers", by comparison with the norms and with the "highest achievers" subsample, were modest. Their self-ratings on all factors as students were low, although since they were selected on the basis of their own assessment of working extremely hard it had been expected that their activity score, at least, should be high. In Figure XI, page 77, their total score is strikingly lower than those of the other samples. This modest assessment of the self, together

with lower intelligence scores than the grand mean and often some frustration at school, was associated with high scores on the 16PFQ "self-concept control" (Q_3) and "superego strength" (G) factors, and low "Surgency" (F). These students tended to feel that in spite of their difficulties and earlier disappointments they could prove themselves at the college. This is reminiscent of Lady Venables' finding, noted on page 6, of a relationship between social class and motivation at the local technical college.

Table 6.13 shows the factor scores of the same subsamples for three axpects of their college work, together with the sum of these factor scores. With one exception, (the factor 1 score for "difficult calculations" by the "hard workers") each of the factor scores for the concepts "Homework" and"Difficult calculations" is above the norm, while each of the scores for "laboratory work" is below the norm.

Table 6.13 Semantic differential scores (x 100) for three concepts

Sample	Concept	Factor 1	2	3	Sum
All students	Homework	35	105	-15	125
(n = 142)	Difficult calculations	35	85	45	165
	Laboratory work	53	113	120	286
Hard workers	Homework	55	145	65	265
(n = 10)	Difficult calculations	18	98	90	206
	Laboratory work	5	75	85	165
Highest achievers	Homework	58	123	31	212
(n = 13)	Difficult calculations	81	108	116	305
	Laboratory work	27	36	62	125

"Laboratory work" was included in the list of concepts as possibly being an active way of spending class time, compared with dictation or films. This was confirmed for students in general by the factor 2 score, which is higher than that of any other college activity. The successful subsamples, however, both gave this concept lower scores on all three factors, including activity. This may mean that the successful students are those who take a favourable view of homework and difficult calculations but are less happy with the time-consuming and sometimes stereotyped laboratory work.

The concepts included in Table 6.14, which are also aspects of the college work, show differences between the successful subsamples.

Table 6.14 Semantic differential scores for four concepts

Sample	Concept	Factor 1	2	3	Sum
All students	Instructional films	70	78	160	308
(n = 142)	Dictated notes	45	78	-35	88
	College library	88	95	125	308
	Unusual problems	38	88	115	241
	Lectures	85	103	70	258
Hard workers	Instructional films	30	38	100	168
	Dictated notes	-3	45	-40	2
	College library	43	75	55	173
	Unusual problems	15	118	190	323
	Lectures	78	58	70	206
Highest achievers	Instructional films	63	71	200	334
	Dictated notes	38	71	-38	71
	College library	90	104	150	344
	Unusual problems	27	81	88	196
	Lectures	98	94	65	257

The concepts "Instructional films" and "Dictated notes" were chosen for this research as examples of circumstances in which students are required mainly to absorb the information provided, without much thinking for themselves. The mean factor 2 scores for the 142 students for these two concepts were the lowest of the 14 concepts used. The "hard workers" considered them less valuable/potent and less active than the norm, and enjoyed films less. The "highest achievers" made small and probably insignificant differences in the same directions, but enjoyed the films more than the majority. These results are consistent with a more serious-minded, earnest approach among the hard workers, compared with the research sample as a whole.

The college library, at the time of this research, was sometimes crowded and noisier than it should have been, so that it is not surprising that the hard workers rated it low on all three factors. The highest achievers, however, enjoyed it.

Unusual problems were scored higher on factors 2 and 3 by the hard workers, but lower on factor 3 by the highest achievers. Like "difficult calculations", this concept was intended to represent a challenging situation. The hard workers responded similarly, but the highest achievers did not.

Responses to "Paper qualifications" (Table 6.15) were unexpected.

Table 6.15 Semantic differential scores (x 100) for "Paper qual's

Sample	Factor 1	2	3	Sum
All students	55	118	40	213
"Hard workers"	30	118	0	148
"Highest achievers"	40	94	-4	130

The award of a certificate or diploma is the main incentive in

college work, and the inclusion of this concept was intended to provide an index of vocational ambition. This may have been naive, but it is unexpected that the successful subsamples regarded this concept less favourably than did students in general.

The concepts "Lecturers" and "Your employers", as far as can be judged from the factor scores, appeared to be similarly rated by the successful as by the whole research sample. (But see later the "D" distances)

"The college as a whole" was given higher total scores (sum of factor scores) than any other concept, by all the groups studied.

Table 6.16

Semantic differential scores (x 100) for "The college as a whole"

Sample	Factor 1	2	3	Sum
All students	133	155	110	398
"Hard workers"	135	150	150	435
"Highest achievers"	148	148	104	400

In the above table, the only appreciable difference between the scores of the three sets of students was that the hard workers enjoyed the college more than the rest of the students.

The interpretation of factor scores can be facilitated by use of the "D" matrix. Osgood et al. have used the distances between concepts in the semantic space to construct three-dimensional models, which may be interpreted with reference to the factor axes as well as to the distances. "D" matrices have been calculated in this research for the subsamples mentioned above and are presented in Tables 6.17 and 6.18. These are comparable with Table 4.12, page 52.

Table 6.17

"D" matrix for the "Highest achievers"

Concept	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	-	79	62	149	44	61	139	195	41	170	86	162	118	83
2	-	-	88	94	89	72	67	164	52	105	35	127	89	56
3	-	-	-	145	22	49	140	189	51	79	92	111	133	77
4	-	-	-	-	155	154	118	239	135	147	119	206	177	141
5	-	-	-	-	-	43	143	187	43	161	97	160	125	76
6	-	-	-	-	-	-	111	144	28	125	94	117	85	36
7	-	-	-	-	-	-	-	127	104	52	91	94	77	76
8	-	-	-	-	-	-	-	-	161	106	198	41	89	121
9	-	-	-	-	-	-	-	-	-	130	78	128	89	43
10	-	-	-	-	-	-	-	-	-	-	128	89	97	92
11	-	-	-	-	-	-	-	-	-	-	-	71	125	86
12	-	-	-	-	-	-	-	-	-	-	-	-	49	90
13	-	-	-	-	-	-	-	-	-	-	-	-	-	60
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Key to concepts

1) The college as a whole
2) Difficult calculations
3) Yourself as a student
4) Instructional films
5) Lecturers
6) Your employers
7) Unusual problems
8) Dictated notes
9) Yourself as an employee
10) Laboratory work
11) The college library
12) Paper qualifications
13) Homework
14) Lectures

Table 6.18

"D" matrix for the "Hard workers"

Concept	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	-	141	102	161	72	127	130	257	88	163	152	186	117	135
2	-	-	68	62	123	98	102	142	76	27	56	93	65	75
3	-	-	-	73	71	45	126	159	37	81	56	111	72	34
4	-	-	-	-	144	99	121	144	104	64	60	128	115	60
5	-	-	-	-	-	71	163	204	47	143	112	137	82	96
6	-	-	-	-	-	-	171	144	54	106	62	99	85	39
7	-	-	-	-	-	-	-	242	133	114	154	191	134	148
8	-	-	-	-	-	-	-	-	169	129	110	90	156	137
9	-	-	-	-	-	-	-	-	-	96	70	100	46	64
10	-	-	-	-	-	-	-	-	-	-	48	98	88	76
11	-	-	-	-	-	-	-	-	-	-	-	71	72	42
12	-	-	-	-	-	-	-	-	-	-	-	-	75	104
13	-	-	-	-	-	-	-	-	-	-	-	-	-	90
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-

For visual representation of the spatial models, however, Figures III, XII and XIII have been constructed directly from the factor scores. In these figures, the second and third dimensions are both shown on the vertical axis but the latter is to be imagined to be at right angles to the plane of the paper.

In these models, all the concepts used in the research are included, although it is open to question whether their representation as occupying a common semantic space is justified, in view of the observed scale-concept interaction. Even if the same axes are

Figure III

Semantic differential factor scores of the research sample

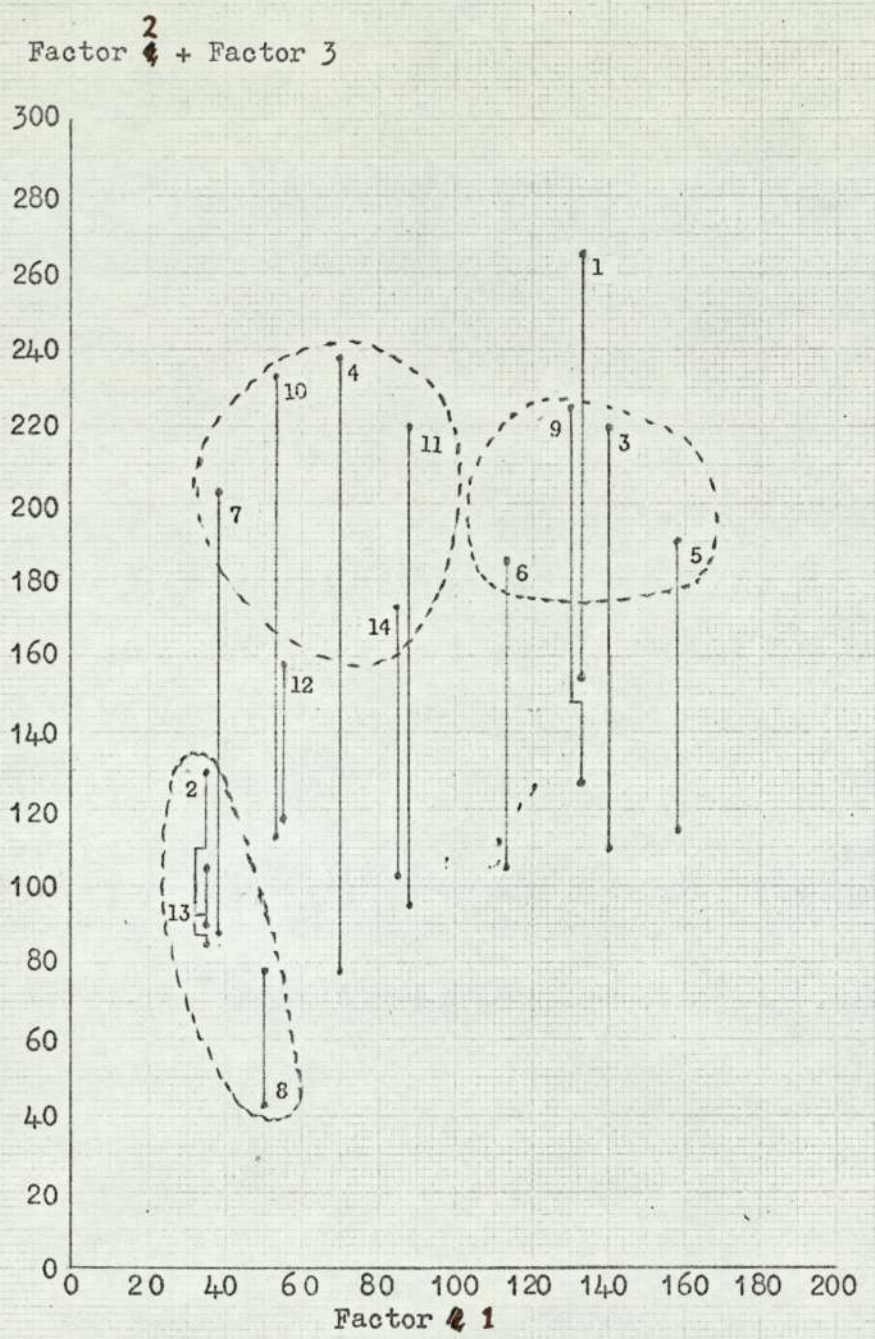


Figure XII

Semantic differential scores of "Highest Achievers"

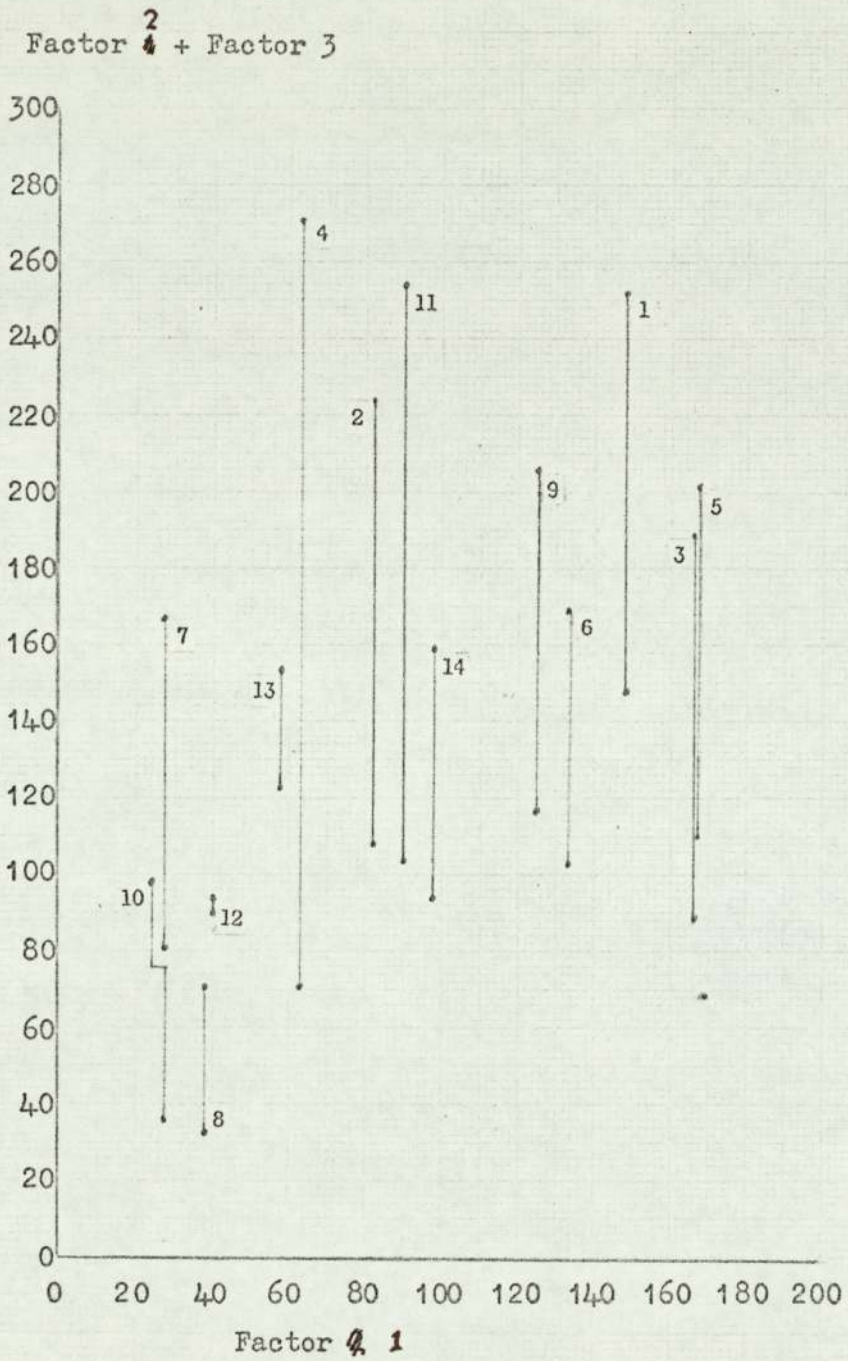
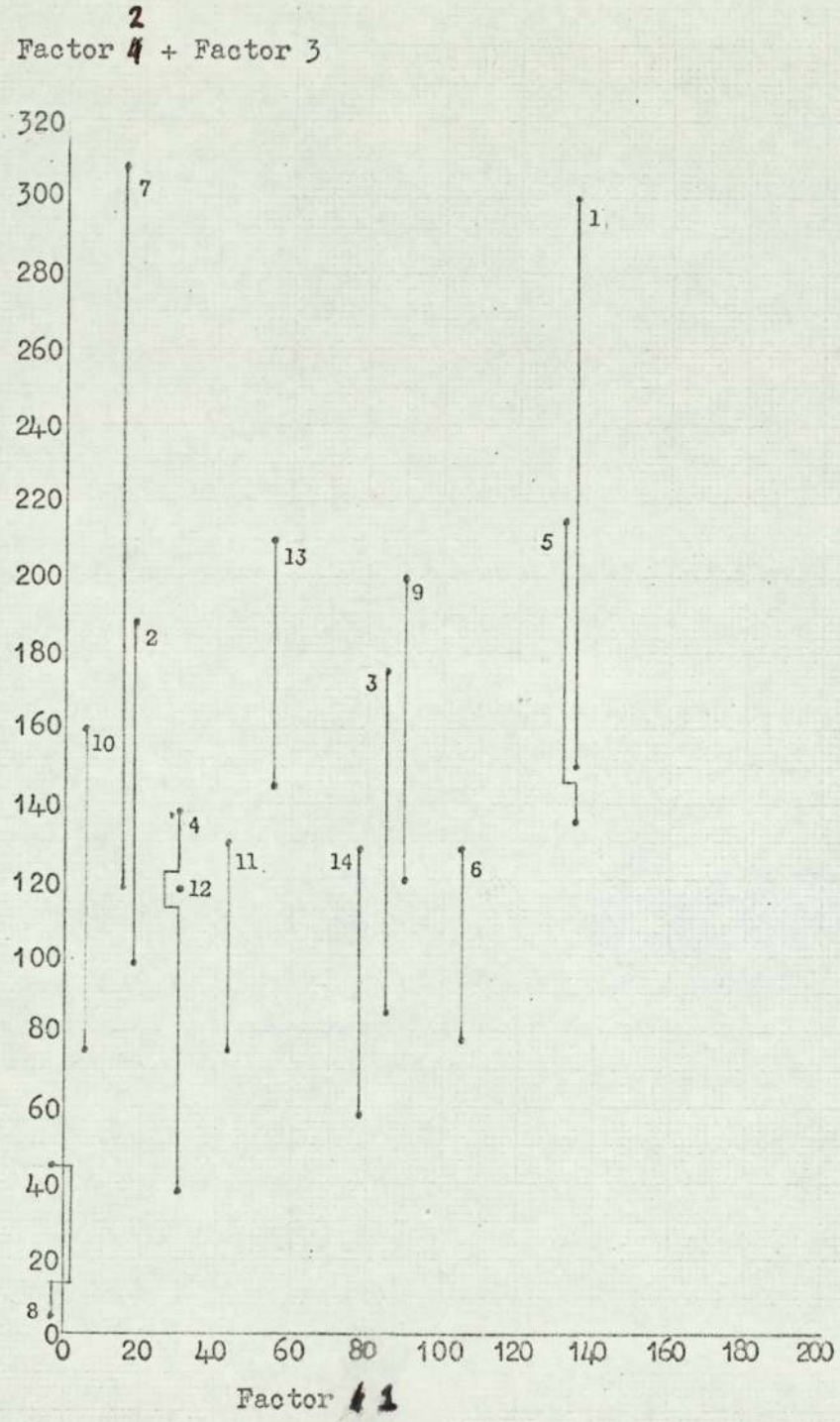


Figure XIII

Semantic differential factor scores of "Hard Workers"



valid for the human concepts as for the inanimate or abstract ones, it is not clear that the numerical values are comparable.

With these reservations, the subsample structures may be compared by considering the "clustering" of concepts and their positions in relation to "Yourself as a student", which was originally intended as a marker concept as well as being of intrinsic interest as a fundamental attitude.

In section 4d a possible structure was suggested in which the human concepts formed one cluster, popular college activities another, and less popular activities a third. The college as a whole was isolated, and paper qualifications could not be fitted in. In both the subsamples the human concept remains although the relative positions of the various concepts differ. This however could be an artefact of the scale-concept interaction. The second and third clusters do not appear in the subsample results. In each subsample structure the concepts "difficult calculations" and "homework" appear in positions in which they are surrounded by the "popular" activities, in more favourable positions.

The concept "Yourself as a student" in the hard workers structure is closer to the college activities, particularly to difficult calculations, homework and lectures. In the "highest achievers" structure it is very close to "lecturers". These positions clarify the tentative interpretations of the numerical data advanced in the previous section, that the hard workers tend to a Cinderella-like appreciation of new-found opportunities while the highest achievers are more relaxed and confident, identify with lecturers and enjoy an intellectual exercise. There is of course overlapping between the subsamples, and the sweeping generalisations above represent tendencies

among successful students rather than exclusive categories. In view of the reservations expressed in the course of this section, and in particular the lack of a satisfactory estimate of the statistical significance of the figures, this work requires confirmation. Nevertheless the results offer some support for the view that students' attitudes to the college and their academic work are more complex than could be expressed on a single unidimensional attitude scale, and that the attitudes of successful students differ from the general consensus in ways which are likely to dispose them to make better use of their opportunities and abilities.

6c) Composition of the subsamples

In all the foregoing discussion of the characteristics of subsamples, each has for the purpose of the discussion been treated as homogeneous. Convenient as it was to make this false assumption for the sake of statistical generalisation, examination of the available case material on the successful students emphasizes the individuality of each. The test scores of the students mentioned are shown in Table 6.19.

The "Highest achievers" subsample

Biographical information, drawn from the questionnaire or interview or both, was available for eleven members of this subsample.

Student no 5 took six "O" levels at his grammar school, became a Sub-Prefect and played a full part in games and the dramatic society, but "went off studies" in the first-year sixth and left. He joined the G.P.O. apprenticeship scheme for the chance to become qualified, knew all about the promotion structure but had reservations about it and

Table 6.19

Test scores of members of successful subsamples

	16PF scores																	AH5			
No	A	B	C	E	F	G	H	I	L	M	N	O	Q_1	Q_2	Q_3	Q_4	Anx	Ext	I	II	Sum	Criterion
5	6	6	3	3	6	6	5	7	7	10	4	8	5	3	4	7	7.9	5.1	17	25	42	115.6
19	7	6	7	5	3	4	4	1	6	4	7	7	7	8	5	5	5.9	3.5	12	21	33	106.4
22	4	1	6	6	4	4	5	4	6	3	3	4	7	7	9	5	4.3	4.3	9	14	23	115.4
23	5	6	5	4	5	5	3	4	7	5	1	7	6	7	5	4	6.3	3.3	12	12	24	123.4
34	3	7	4	4	5	10	1	4	3	9	6	8	6	6	6	4	6.1	2.1	9	18	27	115.3
64	5	7	5	3	5	6	1	6	2	4	1	6	7	6	9	4	4.6	2.2	12	24	36	103.4
65	4	7	8	3	5	7	8	6	6	5	7	5	7	10	7	2	2.9	4.7	7	15	22	100.0
109	5	6	7	9	10	4	9	1	6	8	8	5	7	2	7	1	2.6	10.7	15	23	38	117.4
115	3	7	5	5	1	6	4	1	6	2	3	5	7	7	7	3	4.5	2.1	11	20	31	130.5
119	2	7	7	4	3	9	7	5	7	5	10	4	5	6	9	3	3.2	4.0	15	20	35	97.5
125	1	4	4	1	4	3	1	6	7	6	3	6	4	10	9	6	6.5	-0.2	11	20	31	115.2
133	6	5	7	5	3	6	5	3	7	4	7	8	7	3	7	4	5.5	4.6	13	24	37	109.8
152	6	5	4	7	9	1	7	2	8	7	5	2	9	4	3	6	5.6	8.5	20	19	39	117.7
221	3	7	4	9	4	6	9	3	9	8	4	3	9	7	9	5	4.2	7.1	9	18	27	109.9
222	3	9	3	3	4	5	2	6	9	7	7	5	6	6	9	7	6.9	1.9	14	18	32	122.9
402	5	5	8	4	10	3	7	1	6	7	3	4	5	5	5	5	4.4	7.6	12	19	31	119.0
413	9	4	4	5	7	5	6	4	7	2	9	6	8	8	9	7	6.0	6.4	13	15	28	115.0
456	3	6	3	6	6	4	6	4	6	6	3	5	6	6	4	9	7.4	5.6	18	24	42	122.7

intended eventually to become a teacher. He found satisfaction in the college work and said, "It's a pleasure to find I can do this - it makes up for school." He enjoyed settling down to homework at a table in his bedroom at home, read magazines on wireless and motoring, and mentioned the Post Office Journal, (relating to his practical activities) but considered himself lazy and lacking in concentration.

Student 22 went to a secondary modern school, would have liked to take more interest in science and fiercely resented that the science master would only take an interest in the brighter boys. He was glad to leave school and begin work, but was successful enough in his "G" course to obtain entry to O.N.C. He too was a G.P.O. apprentice but unlike 5 felt that the opportunities were good. He would probably stah in the Post Office and hoped to specialise in telecommunications, but the work was more important than the employer. The college course was "O.K.", apart from too much English and General Studies. 22 was nervous, diffident, tended to agree with anything suggested to him and smiled only once, when saying that he now travels in his own car, but gave the impression that he regarded the course as his first and last real opportunity and intended to take it.

Student 23 left grammar school with four "O" levels and was glad to leave because he was fed up with it. The school "used to be highly respected but has lost that now." It "used to be a good class of school". He joined the Post Office after "me mate showed me this in the paper about the G.P.O. so we both went and did the tests", but would not change because the work was varied and interesting and the facilities were very good, books etc. being provided. He found the course was no trouble "if you keep up a steady pace", and could keep

his weekends free for going out. 23 appeared to take everything easily, but accepted that he must obtain qualifications for promotion and was very appreciative of the care for him shown by his employers.

34 was the fourth G.P.O. student in this subsample. Of his secondary modern school he wrote, "It was a good school. I wish I had stayed on and tried for some G.C.E's." After leaving it took him four years at four different colleges to become qualified to enter O1. This student was not interviewed, and the only indications of his motivation were to be found in his questionnaire responses. To the question, "Has anything seriously hindered you in your college work?" he answered, "The small amount of time allowed for the O2 course" and to "If you had to give advice to somebody aged fifteen but otherwise like yourself, what would you tell him about a career?" he wrote, "Stay on and earn some qualifications, or go to further education centres while at work."

109 was a member of the H.N.D. course in Mechanical Engineering. He had left school with 8 "O" and 2 "A" levels, ('not the right "A" levels for university") after taking part in various extracurricular activities. In the biographical questionnaire he commented, "Difficulty here was that teaching was very Achademic (sic)* - lecturing as opposed to teaching was carried out throught the 6th Form on the principl "All of the 6th go to university". At a College of Technology he found "Exellent Social Life" and very much enjoyed it, but failed in the examinations at

*After this example, errors in spelling etc. in this and other quotations are reproduced without comment.

the end of the second year. At South Birmingham his extraversion score of 10.7 was the highest recorded and his anxiety fairly low at 2.6, but by this time it had become clear to him that his clear and very ambitious career aspirations could not be fulfilled without a change of way of life - at least temporarily - and at interview he was able to say, "Here I've got myself tied down". 109 was also clear about his lack of verbal ability and his preference for the outdoor life and practical activities, but had thought about himself objectively and decided what was necessary in order to reach a position of leadership (i.e. a directorship).

Student 115 left his non-selective secondary school at fifteen with five "O" levels, having been a prefect and a very good football player. He was happy with his school and felt that it was better than a grammar school because metalwork and engineering drawing were well catered for. After taking O.N.C. he hoined the H.N.D. Mechanical Engineering course, and had clear plans leading to Associate membership of the Institute of Mechanical Engineers. He stopped playing football in his final year, with considerable regret, planned his revision carefully and arranged to work alone in the laboratory as well as in the library. He objected to the noise of the building constructional work in progress at the time, but was appreciative of the help given by lecturers.

Student 125 had an extraversion score on the 16PFQ of -0.2, the lowest recorded. After leaving his secondary modern school at fifteen he entered the H.N.D. course through O.N.C., of which he wrote, "Hard work, a great achievement at the time." The H.N.D. course was "Even harder work little spare time, spending most of my time on college work. It is great chance to obtain high qualifications. Pleased with my achievements so far, considering my poor basic education." 125 expressed

no intention of attempting further courses after H.N.D., and could not contemplate moving to another firm because it would involve an interview. He could tolerate theory "when applied to something I can understand." In the biographical questionnaire he expressed appreciation of "Concise and interesting lectures. Meeting people with different attitudes from my own. Learning to appreciate other peoples attitudes. Friendship." , and had been hindered by "Laziness. Boring lecturers. Subject matter of some subjects, i.e. will have little or no use in my job." He would advise a fifteen-year-old to "Choose something that you are interested in and good at. Security, and financial rewards are important when choosing a career. Having choosen a career, strive to achieve the greatest qualification that are possible for you to obtain."

Student 152 left grammar school with 10 "O" levels and 4 "A" levels and went to university, but failed at the end of his second year. At school he did not like some of the masters, but played games well and was a prefect, house captain, and prizewinner. He intended to go on to C.E.I. and M.Sc. after the H.N.D. course. At the college, he thought the lack of women and union facilities was helpful, as also was its nearness to his home.

Student number 222 gained 3 "O" level passes at a comprehensive school, of which he wrote, "I failed my 11 plus so had to work my way up into the grammar stream of the school to be able to take "O" level." He was held back by "in English the turnover of staff, at least two or three per year therefore one was not able to get settled down." 222 gained his pass in English at "O" level at a technical college after another two years of study, and went on to pass the Ordinary National Certificate in Construction with no mark in examination or classwork

below 70%. He intended to continue for membership of the Society of Architectural and Allied Technicians.

Student 402 passed 5 U.E.I. subjects at his secondary modern school and at a local college took City and Guilds courses up to Part I of the Technicians' Certificate. He felt that school was "More worth while in the last 2 years before leaving", and intended to take the Full Technological Certificate in due course. He felt he had been held back by the 11 plus examination.

Student 413 was a prefect at his secondary modern school, passed 3 "O" levels and considered it a very good school. He considered the first year of the City and Guilds Technicians course unnecessary and the second "rather restful", and obtained first class passes in each year. He intended to take the Full Technological Certificate.

Student 456 was resentful. He left grammar school at 17 with two "O" levels, and commented in the questionnaire, "A good school when I first started but went downhill with a change of headmaster." He began an Ordinary National Certificate course in 1959/60, passed all the examinations but did not satisfy the requirements in attendance or, in one subject, homework marks. He repeated the year, passed S1 in 1961 and S2 in 1962, but failed S3 in 1963. All this time his attendance was not very good. In 1964 he failed S3 for the second time and abandoned the course. After two years break he started again almost at the bottom and gained a first class pass in Part I of the City and Guilds Mechanical Engineering Technicians' Certificate. At the time of this research he was with the third year technicians, and at work was employed on jig and tool design. A selection of his comments at interview was recorded. The course had no bearing at all on his work. The maths was childish and boring, and he couldn't be bothered

with it. When pressed on the relevance of the engineering lessons he said, "I just specify that something has to be hardened - I don't need to know what temperature it needs, that's his job." He didn't suppose he would stop in jig and tool design for ever because design work will be done by computers, but failed to take the point about broad engineering training. On future plans he said, "Shan't be coming next year. I'm cheesed off. Absolute boredom." In one drawing lesson the class had spent two hours writing 17 dimensions on a drawing. "I've always had the duff lecturers", he thought, but also his superior at work was known throughout the industry - not just the one firm - as an idiot. "He'll spend hours deciding where to put the screws, nice and symmetrically, he doesn't realise that the toolmaker will just bang them through where he thinks. He won't look at the drawing."

456 did not give up the course. After gaining high marks at the end of the year he went on to complete the following year for Part II of the Certificate, and enrolled in the fifth year class for the next stage of a technical college career which, if he passes the remaining examinations on schedule, will gain him his full technological certificate at the end of the twelfth year after first enrolling.

The "Hard workers" subsample

Student number 19 had been disappointed in the eleven plus examination, and at his secondary modern school was "usually in top 3 of the top form during the school year." He passed "O" level in only one subject, but had 6 C.S.E. passes including 3 at grade 1. He entered the O.N.C. course through a G* course, and hoped in future years to become "at less a technical Officier in Exchange Mtce." (at least a Technical Officer in Exchange Maintenance) As advice to a fifteen-year-old like himself he wrote, "To take a job with good prospects of promotion and pay and one that provides good after school education

so that he can gain external certificates which will help him obtain promotion or another good job if he decides to leave the one he starts with."

Student 64 was appreciative of his primary schools but at grammar school "Did not like the system of teaching. Found most lessons boring. Too many exams." He left grammar school at fifteen with 8 "O" levels, and said that he did so because he could get on just as well outside. Concerning ambitions, 64 was reticent. In the questionnaire he hoped in five years time to be "Working on radio" and in future years to gain H.N.C., perhaps a degree". At interview he was very reluctant to admit to any ambition, but gave the impression of aiming definitely higher than H.N.C. The question, "If you did get a degree, what would you do then?" produced the understatement, "I might consider leaving the Post Office then.", with the impression of fairly definite dreams or plans. Academic theories, however, were not to be valued for their own sake. "I like to know what things are for, but not too deep into theory." Learning the formula was a better way to pass exams than understanding principles.

Student 65 was critical of his junior school. ("Poor school, to large class were, poor teachers") and of his secondary modern school wrote, "Good school, but not very well equiped. Good sports facilities. Good masters. Very active school both in the class room and out in the field." 65 was a member of five sports teams, "Perfect. Librarian. fencing club chairman. Senior camper" and "Passed C.S.E." He hoped to go to university to take a degree, and would advise a fifteen-year-old like himself to stop at school to take "A" levels. His apprenticeship with the G.P.O. was a good one and a stable job, but he might shift after becoming qualified.

This student (65) had the lowest AH5 score in his class, the Part I (verbal/numerical) score being particularly low. When, however, this class took three of the tests of creative thinking described by Hudson (26), he had the highest score for the "Uses of objects" test, in which the exercise is to write down as many uses as possible for the objects named. The full results for this class are shown in Table 6.20.

Table 6.20

Intelligence scores of class IV

No	AH5 I	AH5 II	AH5 total	Uses of objects	"meanings"	16PFQ "B"
51	21	24	45	46	37	8
52	17	27	44	57	36	4
53	13	24	37	37	33	8
54	16	25	41	40	32	6
55	16	25	41	65	32	6
56	10	15	35	70	35	6
57	12	12	24	42	26	6
58	9	15	24	41	32	5
59	12	15	27	57	23	6
60	17	25	42	52	30	5
61	18	23	41	63	27	6
62	17	22	39	28	24	6
63	15	25	40	30	31	5
65	7	15	22	84	26	7
66	11	17	28	45	18	7
67	12	22	34	46	34	-

The "meanings" test included above requires the definition of as many meanings as possible of each of a number of words, and thus tests vocabulary as well as divergent thinking.

In the "Uses" test 65 wrote for the uses of a paper clip, "Holding paper, bending it, making designs out of it, stopping some thing vibrating, to wire some thing together, to make an electrical connection, to wedge a door closed, to write with, to put polish of shoes, to break stones, a pin, a weight, paint it, move by means of a magnet, to fill a hole up, to repair other wire, a screwdriver, a prode, a nail, to make fishing hook, a lever, tie pin." His responses to the other items, although slightly less numerous, were similar in range of ideas and also in the occasional difficulties in spelling or grammar. (The use of d in place of b, common among young children, perhaps epitomises the problem). It would be dangerous to assume that a high score on the Uses test indicates simply originality or creativity of thought. The instructions make clear that subjects may write down anything they like, but even in an informal atmosphere not everyone is prepared to commit himself to the more extravagant ideas. To some extent the exercise is a test of self-confidence. Nevertheless fluency on this test may indicate the presence of an ability not revealed by AH5.

Student 119 was profoundly interested in aviation. At his grammar school, where he played a leading part in athletics, scientific society, radio society and sailing club, his main interest was the A.T.C. After leaving school with 10 "O" level and 1 "A" level (the "A" level results were , he said, "wrong - too low") he continued in the A.T.C., held the rank of Cadet Warrant Officer for four years, gained gliding and powered aircraft flying licences, won an International Cadet Exchange and went to Canada for five weeks, and also won an Overseas Flight to Singapore. At his firm, an aircraft manufacturer, he was assistant treasurer of the Flying Group and lecturer in air law. At the college, he found his H.N.D. course patchy, and wished they didn't go over the same things so many times, but appreciated the use of a technical library and lecturers who were prepared to discuss problems.

He hoped in five years time to be doing "R and D work and/or Management" and to obtain "Membership of Institution and M.Sc." He was a member of the Methodist Church. Although capable of applying himself to some purpose in his chosen activities, 119 was not easily persuaded to undertake activities he did not favour, and said at interview, "If I can't get up any enthusiasm for something it's a hell of a job to drag me in." His criterion score was the lowest of the "hard workers" subsample, and below the research sample mean.

Student 123 passed 6 "O" levels and 2 "A" levels at his public school, was a house prefect and C.Q.M.S. in the Cadet Force, but voiced no strong opinion about school. "I was more interested in science, metalwork, handicrafts. However we did a lot more sport than grammar schools seem to do." At a College of Advanced Technology he had passed H.N.D. I and II, and failed in the third year. "Not a very startling career. A bit of (a) jolt from Boarding School." The standard at the C.A.T. had been very high, whereas at South Birmingham it was very low. The "schoolmastering" at South Birmingham was childish, with too much spoon-feeding. In five years time he hoped to be "possibly systems analyst". After H.N.D. he would take "C.E.I. Part 2 or attend some I.B.M. computer courses." At work he was "changing to computing" with the same firm. "Nothing in this world has been made from a set of engineering calculations." In the questionnaire he wrote that he had been helped by "Interest of lectures", but at interview qualified this by "The trouble is only a few of them are interesting." He had been hindered by "lack of quiet working space". His leisure reading, "Times, Guardian, New Statesman, Novels, thrillers, technical books relating to my hobbies." and his use of English in the questionnaire seemed to be at variance with his low verbal/numerical AH5 score, but he would not himself comment on this. His career in

general was summed up in the words, "As soon as I can do something I'm not interested."

Student 125, described under the "highest achievers", was also one of the "hard workers".

Student 133 obtained 5 "O" levels at his secondary modern school, "A good school without which I would not have had my later chances." Up to the age of 8 or 9 he had been bad at reading and Maths, and his mother was worried about this. He agreed with the 13/24 balance of his verbal/non-verbal AH5 scores, but disagreed strongly with his 1/12 ratio of numerical/verbal scores within Part I. He started an O.N.C. course in building on leaving school, but after the first year his employers (manufacturers of metal windows) advised him to change to mechanical engineering. He took G* and O1 as full-time courses, won an award for engineering drawing, took a City and Guilds Intermediate examination and came second, and proceeded to O2 by day release. He hoped eventually to become a chartered engineer and work in production engineering or management. 133 was married. His advice to somebody aged fifteen was "Advise him to work for a good firm with a good training programme which would allow him if he had the ability to go to full-time college." The impression he gave at interview was recorded as "Seems.....thrilled at discovery of own ability after late start and works hard to make up for lost time, perhaps enjoying being able to..."

Student 221 was a girl, who married during the course. Her grammar school was "Excellent" and she gained 8 "O" levels and 2 "A" levels, one of the latter in art. After leaving school she began a commercial course at a college which was "no good at all for education",

then changed to another college for U.E.I. and O.N.C. Building, before enrolling for H.N.C. Building at South Birmingham. At both colleges day release students were neglected, "e.g. why 4th floor at night for lessons when college empty." 221 found her sex a disadvantage at work and had "given career idea up", but felt that at the college she was making progress and proving herself. The work was at a higher level than she did at the office (of an architect). Her relaxation, hobbies etc. consisted of "work", but her reading included "Anything - mostly History and Science Fiction, Archaeology, Art."

Student 222 was also a member of the HNC Building course, working for an architect, but was male. He has already been described in the "highest achievers" subsample.

The students mentioned above had a broad range of scores on both the intelligence test and the personality questionnaire. In their educational careers there was no single pattern of experience. The evidence is incomplete and in some cases fragmentary; but it is sufficient to show that, far from exhibiting any uniformity, each subsample includes great diversity of intelligence, personality and backgrounds.

A few students had some outstanding feature of personal circumstances or constitution by which the observer may be tempted to interpret the whole career pattern. In others it is possible to infer the "Cinderella" effect, in which the student is motivated by the recognition, by himself and by others, of ability previously undeveloped or unrewarded. The case material in general is complementary to the statistical generalisations made earlier, and emphasizes the individuality

of each student.

The psychological effects of traumatic experiences at school or in other educational institutions are not always so obvious as in the case of 456, whose style was to carry a chip on his shoulder and keep on studying. A certain degree of frustration, if followed by satisfaction, may appear eventually to produce an educational drive of some consequence; but this does not justify the practices which lead a child to feel neglected and deprived in the first place. The subsamples were selected for their success and enthusiasm, but the majority were not thus distinguishable.

7. Conclusions

The most successful students of a sample drawn from four varied courses in the college investigated, as defined by the mean standardised examination marks used as the criterion of relative academic achievement, showed great diversity in intelligence, personality and backgrounds.

In intelligence, the research sample as a whole had a mean non-verbal score close to that of university students, while the mean of the verbal/numerical scores was at approximately two-thirds of this level. In addition to this expected non-verbal bias, there was also an unexpected non-numerate bias.

The verbal/numerical, non-verbal and total intelligence scores, when compared with the criterion scores, showed no significant relationships. The criterion score expresses only the relative examination performance of each student by comparison with the standard of his class, and takes no account of the level of this standard or of the academic level of the ourse. The conclusion to be drawn from this observation is therefore a limited one, that the intelligence measured by the test used was not a limiting factor in the relative achievement of a student within his own class, as far as could be detected with the sample size used. There was some increase in level of intelligence scores with the academic level of the course, but at every level some students obtained very high criterion scores and very low intelligence scores. This may be interpreted as showing that students are sufficiently selected before entry to their courses, i.e. that the existing selection procedures exclude those below a threshold

of ability and that above this threshold other factors operate.

In most of the personality factor scores, the research sample showed small but statistically significant differences from the American college population, but the profile as a whole showed more resemblance to that of the Americans than to those of some British students sampled by previous workers at a university and at a College of Advanced Technology.

There was some indication, although of marginal significance, of the expected association of high examination marks with introversion. In the profile of the 64 most successful students (about one-third of the sample), mean scores on the factors "surgency", "self-sufficiency" and the second-order factor "extraversion" fell significantly on the introverted side. Also, the profile of the "hard workers" was on many factors the opposite of that of those students who left their courses without completing the examinations. Over the whole research sample, however, augmented by further results from the same college, when the personality data were plotted against criterion scores in the manner shown in Figures IV to IX, pages 60 and 60a, the importance of the relationships was seen to be slight.

The main conclusion from the standard test results was therefore that they were not good predictors of the relative examination performance of the students in the college investigated. The subsamples of successful students were characterised by diversity both of intelligence, including some with very low scores, and of personality. It happened that the most extraverted and the most introverted students in the research sample both appeared in the subsample of the seventeen "highest

achievers". The backgrounds and educational histories of the successful students were equally heterogeneous, and demonstrated that the technical college system serves students of all types, and is capable of rehabilitating some who suffer setbacks elsewhere.

These observations, however, do not detract from the validity of the tests used as measuring instruments. The case material collected showed that the test scores were generally in keeping with the educational careers of the individuals. The results emphasize the importance of regarding each student as an individual.

By the use of the semantic differential technique, the attitude structure of the students of the research sample was described in the three dimensions "value/potency", "activity" and "interest/enjoyability". Although the conclusions from this analysis are subject to certain reservations, this application of the technique to the description of students' attitudes to aspects of their academic environment appears to offer more information than could be obtained by unidimensional attitude scales. The most successful students, as represented by the "Highest achievers" and "Hard workers" subsamples, differed from their fellows in the pattern of their attitudes. Certain of the more arduous activities, including "homework", were rated by the successful not merely as more valuable and active but more interesting and enjoyable than was the general consensus; but others, e.g. "laboratory work", were less favourably rated. These results, taken together with the case histories of the members of the subsamples, suggest hypotheses which might be tested in further work.

In brief, the students who achieved the greatest success in their examinations did not in general do so by virtue of superior intelligence

or of an unusually studious personality. There were indications that some (the "Cinderellas") who had previously been disappointed in their educational experiences and who tended to have a modest opinion of themselves as students, found great satisfaction and encouragement in the realisation of their abilities at the college. Multidimensional measurements of the attitude structures of the two subsamples of successful students suggested that greater individual attention to students' attitudes offers a better prospect of improvement of academic performance than any further selection by ability.

Appendix A

Computer program, "Standardisation"

```
TITLE STANDARDISATION'
BEGIN INTEGER N,C,Y,R'
REAL X'
      READ N,Y'
         BEGIN ARRAY SUM,SQ,MEAN,STDV (1:N)'
               REAL MARK'
      FOR C:=1 STEP 1 UNTIL N DO
          SUM(C):=SQ(C):=MEAN(C):=STDV(C):=0'
      FOR R:=1 STEP 1 UNTIL Y DO
        BEGIN FOR C:=1 STEP 1 UNTIL N DO
              BEGIN READ X'
                    SUM(C):=SUM(C)+X'
                    SQ(C):=SQ(C)+X**2'
               END'
        END'
      FOR C:=1 STEP 1 UNTIL N DO
        BEGIN MEAN(C):=SUM(C)/Y'
              STDV(C):=SQRT(SQ(C)/Y-(MEAN(C)**2))'
              PRINT MEAN(C),STDV(C)'
        END'
        WAIT'
      FOR C:=1 STEP 1 UNTIL N DO
        SUM(C):=SQ(C):=0'
      FOR R:=1 STEP 1 UNTIL Y DO
        BEGIN FOR C:=1 STEP 1 UNTIL N DO
              BEGIN READ X'
                    SUM(C):=((X-MEAN(C))*15/STDV(C))+100'
                    SQ(C):=SQ(C)+SUM(C)'
```

```
            END'
          MARK:=SQ(C)/N'
          PRINT ££L??,SUM1,SAMELINE,SUM2,SUM3,SUM4,SUM5,SUM6,SUM7,
             SUM8,SUM9,SUM10,
            ££S2??,MARK,
            PUNCH2,MARK'
      END'
END'
```

Appendix B

Computer program, "Second-order factors"

```
TITLE SECOND-ORDER FACTORS
BEGIN INTEGER F,N,R'
      REAL X,SUM,ADD'
      REAL ARRAY Q(1:16), I(1:16)'
    FOR F:=1 STEP 1 UNTIL 16 DO
  BEGIN Q(F):=0'
        I(F):=0'
  END'
  SUM:=ADD:=0'
  Q(3):=-0.18'Q(7):=-0.17'Q(9):=+0.19'Q(12):=+0.30'Q(15):=-0.20'
  Q(16):=+0.38'I(1):=+0.17'I(4):=+0.33'I(5):=+0.41I(7):=+0.48'
  I(14):=-0.16'
   READ N'
   FOR R:=1 STEP 1 UNTIL N DO
   BEGIN
    SUM:=ADD:=0'
    FOR F:=1 STEP 1 UNTIL 16 DO
    BEGIN
      READ X'
      SUM:=SUM + (X*Q(F))'
      ADD:= ADD + (X*I(F))'
    END'
    SUM:= SUM + 3.74'
    ADD:= ADD - 1.26'
    PRINT ££L??, SUM, SAMELINE, ADD'
   END'
END'
```

Appendix C

Computer program "Relationships"

```
TITLE RELATIONSHIPS'
BEGIN INTEGER M,Y,C,R,P,Q'
READ READER(1),M,Y'
BEGIN ARRAY A,B,L(1:M,1:10),MARK(1:Y),T(1:120)'SWITCH S:=AGAIN'
      INTEGER ARRAY F(1:M,1:10)'
      FOR C:=1 STEP 1 UNTIL M DO
        BEGIN FOR R:=1 STEP 1 UNTIL Y DO
         BEGIN A(C,R):=0'B(C,R):=0'L(C,R):=0'F(C,R):=0'
         END'
        END'
      FOR R:=1 STEP 1 UNTIL Y DO
        READ READER (2),MARK(R)'
          T(1):=12.71'T(2):=4.30'T(3):=3.18'T(4):=2.78'T(5):=2.57'
          T(6):=2.45'T(7):=2.37'T(8):=2.31'T(9):=2.26'T(10):=2.23'
          T(11):=2.20'T(12):=2.18'T(13):=2.16'T(14):=2.15'T(15):=2.13'
          T(16):=2.12'T(17):=2.11'T(18):=2.10'T(19):=T(20):=2.09'
          T(21):=2.08'T(22):=T(23):=2.07'T(24):=T(25):=T(26):=2.06'
          T(27):=T(28):=2.05'
      FOR R:= 1 STEP 1 UNTIL Y DO
        BEGIN FOR C:=1 STEP 1 UNTIL M DO
          BEGIN READ READER(1),P'
            A(C,P):=A(C,P)+MARK(R)'
            B(C,P):=B(C,P)+MARK(R)**2'
            F(C,P):=F(C,P)+1'
          END'
        END'
      FOR C:=1 STEP 1 UNTIL M DO
        BEGIN FOR P:=1 STEP 1 UNTIL 10 DO
```

```
            BEGIN IF F(C,P)=0 THEN GOTO AGAIN
                  ELSE IF F(C,P)=1 THEN
                     BEGIN PRINT ££L??,C,SAMELINE,P,A(C,P)'
                           GOTO AGAIN
                     END'
            A(C,P):=A(C,P)/F(C,P)'
            B(C,P):=SQRT(B(C,P)/F(C,P)-A(C,P)**2)'
            Q:=F(C,P)-1'
            IF Q GREQ 120 THEN Q:=1208
            IF Q GREQ 29 AND Q LESS 40 THEN T(Q):=2.04
            ELSE IF Q GREQ 40 AND Q LESS 60 THEN T(Q):= 2.02
            ELSE IF Q GREQ 60 AND Q LESS 120 THEN T(Q):=1.98
            ELSE IF Q = 120 THEN T(Q):=1.96'
            L(C,P):=T(Q)*B(C,P)/SQRT(F(C,P))'
            PRINT ££L??,C,SAMELINE,P,A(C,P),SAMELINE,B(C,P),L(C,P),F(C,P)'
         AGAIN: END'
         PRINT ££L??'
         END'
      END'
   END'
```

Appendix D

Computer program, "Selected mean and s.d."

```
TITLE SELECTED MEAN AND SD'
BEGIN REAL ARRAY SUM(1:16,1:14)'
      REAL ARRAY SQ(1:16,1:14)'
      INTEGER X,Y,Z,N,R,C'
      SWITCH S:= START'
      SWITCH F:= FINISH'
      SWITCH T:= RESTART'
      FOR R:=1 STEP 1 UNTIL 16 DO
       FOR C:=1 STEP 1 UNTIL 14 DO
          BEGIN SUM(R,C):=0'
                SQ(R,C):=0'
          END'
          X:=Y:=Z:=N:=R:=C:=0'
     START: READ READER(2), Z'
          IF Z NOTEQ 0 THEN
          BEGIN RESTART: READ READER(1), Y'
                IF Y NOTEQ Z THEN BEGIN FOR R:=1 STEP 1 UNTIL 16 DO
                                        FOR C:=1 STEP 1 UNTIL 14 DO
                                         READ X'
                                         GOTO RESTART'
                                  END'
                ELSE BEGIN FOR R:=1 STEP 1 UNTIL 16 DO
                           FOR C:=1 STEP 1 UNTIL 14 DO
                            BEGIN READ X'
                                  SUM(R,C):=SUM(R,C)+X'
                                  SQ(R,C):=SQ(R,C)+(X**2)'
                            END'
                     N:=N+1'
```

```
                GOTO START'
        END'
        ELSE GOTO FINISH'
FINISH: FOR R:=1 STEP 1 UNTIL 16 DO
        BEGIN PRINT ££L2??, DIGITS(2),R'
              FOR C:=1STEP 1 UNTIL 14 DO
                  PRINT SAMELINE, ALIGNED(1,1),££S??,SUM(R,C)/N'
                  PRINT ££LS3??'
                   FOR C:=1 STEP 1 UNTIL 14 DO
                   PRINT SAMELINE, ALIGNED(1,2),SQRT(SQ(R,C)/N-
                                                SUM(R,C)/N**2))'
        END'
END'
```

Appendix E

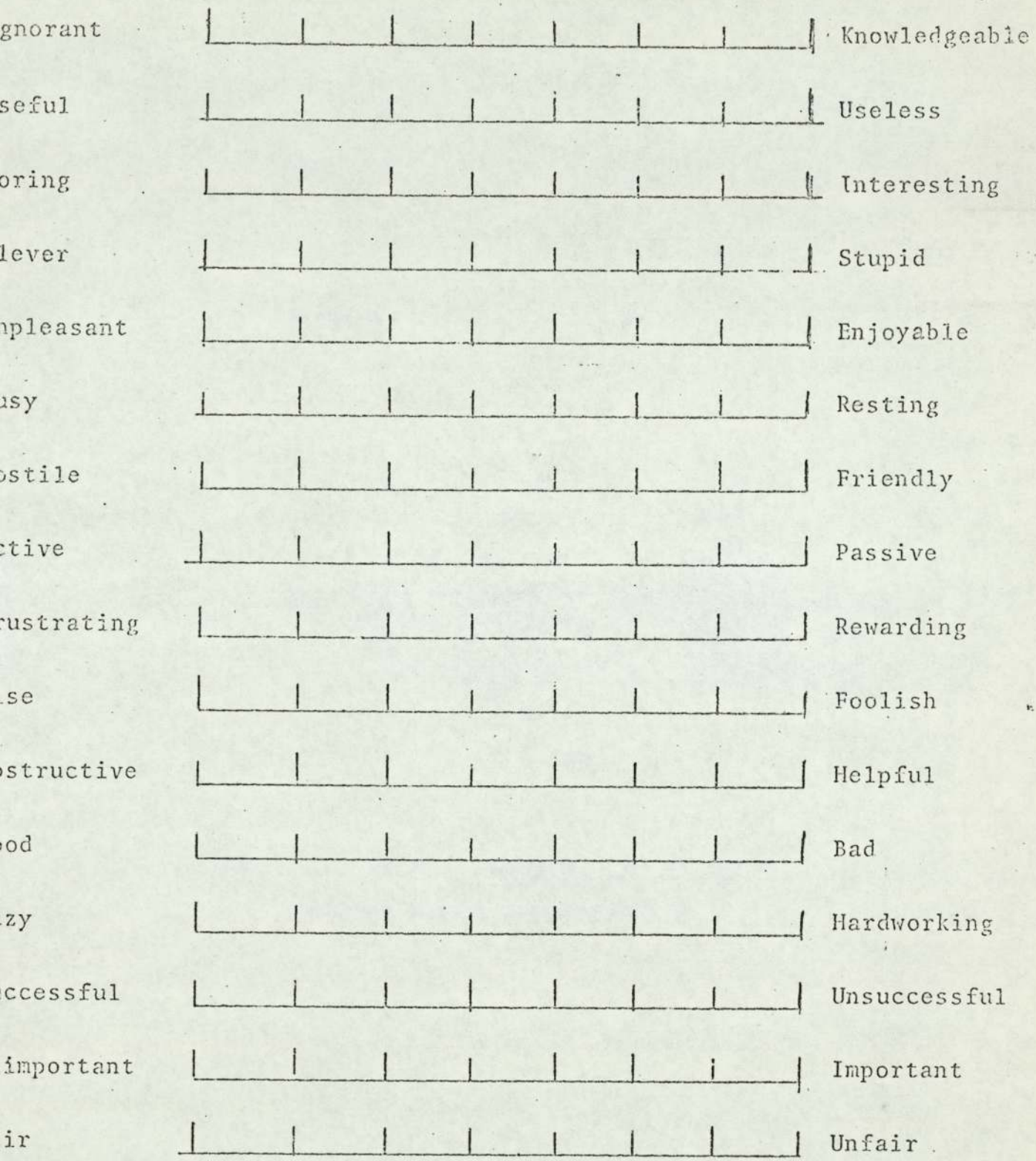
Computer program "Short selected m and s.d."

```
TITLE SHORT SELECTED M AND SD 22 COLS
BEGIN REAL ARRAY SUM(1:22)'
      REAL ARRAY SQ(1:22)'
      INTEGER Y,Z,N,C'
      SWITCH S:=START'
      SWITCH F:=FINISH'
      SWITCH T:=RESTART'
      FOR C:=1 STEP 1 UNTIL 22 DO
        BEGIN SUM(C):=0'
              SQ(C):=0'
         END'
      Y:=Z:=N:=C:=0'
      X:=0'
START: READ READER(2), Z'
      IF Z NOTEQ 0 THEN BEGIN FOR C:=1 STEP 1 UNTIL 22 DO
                              READ READER(1), X'
                              GOTO RESTART'
                             END'
      ELSE BEGIN FOR C:=1 STEP 1 UNTIL 22 DO
                  BEGIN READ READER(1), X'
                        SUM(C):=SUM(C)+X'
                        SQ(C):=SQ(C)+(X**2)'
                  END'
                  N:=N+1'
           END'
      GOTO START'
      END'
      ELSE GOTO FINISH'
```

```
FINISH: FOR C:=1 STEP 1 UNTIL 22 DO
      BEGIN PRINT ££L2??, DIGITS(2),C ££L??'
            FOR C:=1 STEP 1 UNTIL 22 DO
  PRINT SAMELINE, ALIGNED(3,1),££S??,SUM(C)/N'
  PRINT ££LS4??'
  FOR C:=1 STEP 1 UNTIL 22 DO
   PRINT SAMELINE, ALIGNED(3,2),SQRT(SQ(C)/N-(SUM(C)/N)**2)'
      END'
END'
```

Appendix F

Sample answer sheet as used for administration of semantic differential



Appendix G

Copy of scoring sheet as used for scoring the semantic differential

S.D. scores 1957/8 Class Number

1	2	3	4	5	6	7	8	9	10	11	12	13	14

Appendix H

Copy of biographical questionnaire

Name _____ Class _____

e of school / llege	Age on entry	Age on leaving	Achievements	Comments

Name _____ Class _____

Date of birth _____ Employer _____

What are your duties at work at present?

What job do you hope to be doing in five years' time?

If you pass your exams this year, what qualifications do you hope to obtain in future years?

What is your overall opinion of your present course as training for your career? (Please tick) a) Excellent ☐ b) Reasonably good ☐ c) Average ☐ d) Rather unsatisfactory ☐ e) Useless ☐

In your present course, what are your best subjects?

What are your worst subjects?

During your school days, was your written work (a) Brilliant ☐ (b) Better than average ☐ (c) Average ☐ (d) Worse than average ☐ (e) Very bad ☐

In Arithmetic, or calculations in other subjects, were you (a) Brilliant ☐ (b) Better than average ☐ (c) Average ☐ (d) Worse than average ☐ (e) Very bad ☐

While at school, did you have any long absence through illness or any other cause? If so when & for how long?

Did anything else hold you back?

Were your parents (a) Extremely keen on your education ☐ (b) Pleased for you to get a normal education ☐ (c) Not really interested ☐ (d) Mildly discouraging ☐ (e) Strongly against schools ☐

Did you enter your present occupation because any of your relations were in the same line? (a) Yes ☐ (b) Partly ☐ (c) No ☐

What is your father's occupation?

How far do you have to travel to the College?

Name _____ Class _____

What do you do for relaxation, hobbies etc?

Are you married?

What do you read, apart from textbooks etc? (Include newspapers, magazines etc)

What aspects of the college course or facilities have been particularly helpful to you in your studies?

Has anything seriously hindered you in your College work?

Have you, in your own opinion, worked (a) Extremely hard ☐
(b) Harder than average ☐ (c) Average ☐ (d) Less than average ☐
(e) As little as possible ☐ .

Do you find your course (a) Extremely interesting ☐ (b) Mainly fairly interesting ☐ (c) Just something that has to be done ☐
(d) Rather a nuisance ☐ (e) Extremely boring ☐

If you had to give advice to somebody aged fifteen but otherwise like yourself, what would you tell him about career?

The above questionnaire was originally produced on foolscap paper, and has been cut to fit the A4 size.

Appendix Ia Mean and standard deviation of 16PF scores of each class of the research sample

Class	n		A	B	C	E	F	G	H	I	L	M	N	O	Q_1	Q_2	Q_3	Q_4	Anx.	Extr.
I	13	Mean	4.9	5.4	4.5	6.0	6.6	4.1	6.2	4.8	5.9	6.5	5.0	4.9	6.2	5.6	6.1	5.8	5.4	6.4
		s.d.	1.8	1.7	2.0	1.8	1.9	1.1	1.0	1.9	1.9	2.1	2.1	1.5	1.2	1.9	1.7	1.5	1.3	1.4
II	13	Mean	4.5	5.7	4.4	6.1	6.1	4.2	4.8	3.9	6.5	6.3	3.5	6.3	5.4	4.6	6.5	5.8	6.1	5.6
		s.d.	1.1	2.1	1.2	1.3	1.7	1.5	2.3	1.6	1.8	1.5	2.0	2.3	1.9	2.3	2.2	2.1	2.0	1.8
III	39	Mean	5.1	5.7	4.9	5.2	5.3	4.3	4.8	4.3	6.1	5.8	4.7	5.6	6.2	5.9	6.0	5.3	5.7	4.9
		s.d.	1.7	1.4	1.9	2.2	1.8	2.0	2.2	1.6	1.9	1.8	1.8	1.9	1.7	2.0	1.7	1.9	2.0	2.2
IV	16	Mean	3.9	6.1	4.8	5.3	6.2	4.5	5.4	4.4	5.8	6.7	4.7	5.3	5.9	6.2	5.8	5.6	5.6	5.3
		s.d.	1.7	1.1	1.5	2.2	1.5	1.7	2.1	1.7	2.2	1.9	2.4	1.4	2.1	2.1	2.1	2.2	1.7	1.7
V	17	Mean	4.7	5.5	4.3	5.5	6.5	3.8	4.0	5.4	5.7	7.2	4.5	5.9	5.8	6.1	4.8	5.8	6.4	4.9
		s.d.	1.3	1.1	1.6	1.9	1.5	1.7	1.6	2.2	2.1	1.9	2.4	1.9	2.3	2.4	2.2	1.4	1.4	1.9
VI	20	Mean	4.4	6.5	5.1	4.6	5.6	4.1	5.1	5.5	5.5	7.3	4.9	6.2	6.7	6.4	6.1	6.4	6.1	4.7
		s.d.	1.2	6.3	1.7	2.6	2.1	1.5	2.3	2.0	2.2	1.5	1.8	1.8	2.1	1.6	2.0	1.8	1.8	2.4
VII	19	Mean	4.6	6.4	5.0	5.2	5.3	4.2	4.7	4.2	5.8	5.7	4.7	6.2	6.3	6.2	5.2	5.7	6.1	4.7
		s.d.	1.7	1.5	2.0	1.4	2.0	1.6	2.0	1.9	1.7	1.1	2.1	1.6	2.1	1.4	2.0	1.8	1.2	1.8
VIII	28	Mean	4.4	6.3	5.1	5.9	6.3	4.6	5.6	4.0	5.4	6.7	5.4	5.2	7.3	5.7	6.0	5.4	5.2	5.8
		s.d.	1.5	1.2	1.4	1.7	2.0	1.8	2.3	1.9	1.6	1.9	2.4	1.7	1.5	2.3	1.9	2.0	1.6	2.3

Appendix Ib Mean and standard deviation of 16PF scores by courses, and all combined

Course	n		A	B	C	E	F	G	H	I	L	M	N	O	Q_1	Q_2	Q_3	Q_4	Anx.	Extr.
MT3	26	Mean	4.7	5.5	4.5	6.0	6.4	4.2	5.5	4.4	6.2	6.4	4.3	5.6	5.8	5.1	6.3	5.8	5.8	6.0
		s.d.	1.5	2.0	1.6	1.6	1.8	1.3	1.9	1.8	1.9	1.8	2.2	2.1	1.7	2.1	2.0	1.9	1.7	1.7
EE01	55	Mean	4.8	5.8	4.9	5.2	5.6	4.4	5.0	4.3	6.0	6.0	4.7	5.5	6.1	6.0	6.0	5.4	5.7	5.0
		s.d.	1.8	1.3	1.8	2.2	1.8	1.9	2.2	1.7	2.0	1.9	2.0	1.8	1.8	2.1	1.9	2.0	1.9	2.1
BdgA1	37	Mean	4.5	6.0	4.7	5.0	6.0	4.0	4.6	5.4	5.6	7.2	4.7	6.1	6.3	6.2	5.5	6.1	6.2	4.8
		s.d.	1.3	1.5	1.7	2.4	1.9	1.6	2.1	2.1	2.1	1.7	2.1	1.8	2.2	2.0	2.2	1.7	1.6	2.2
HND M&P	67	Mean	4.7	6.3	5.1	5.6	5.8	4.4	5.5	4.0	5.6	6.1	5.2	5.4	7.1	5.7	5.9	5.2	5.3	5.5
		s.d.	1.7	1.4	1.6	1.8	2.0	1.7	2.1	2.0	1.9	1.8	2.1	1.9	1.8	2.0	1.9	2.0	1.6	2.1
All	263	Mean	4.6	6.0	5.0	5.5	6.0	4.3	5.2	4.3	5.9	6.4	4.9	5.5	6.5	5.9	6.0	5.5	5.6	5.4
		s.d.	1.6	1.5	1.7	2.0	1.9	1.7	2.2	1.9	2.0	1.8	2.0	1.9	1.9	2.1	2.0	1.9	1.8	2.0

Appendix J Means and standard deviations of semantic differential scores

Concept		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Scale															
1	Mean	5.4	4.9	5.2	5.5	5.8	4.9	4.7	5.0	5.1	5.0	5.4	4.7	5.0	5.3
	s.d.	1.3	1.2	1.0	1.1	1.0	1.6	1.0	1.2	1.1	1.3	1.3	1.2	1.1	1.2
2	Mean	1.9	2.5	2.7	2.1	2.1	2.5	2.6	2.2	2.5	2.2	2.1	1.6	2.2	2.0
	s.d.	1.2	1.3	1.2	1.2	1.2	1.4	1.1	1.4	1.0	1.2	1.1	1.0	1.4	1.1
3	Mean	5.0	4.8	5.1	5.5	4.5	4.7	5.4	3.6	5.0	5.3	5.4	4.3	4.0	4.6
	s.d.	1.6	1.7	1.2	1.6	1.6	1.5	1.2	1.6	1.2	1.7	1.4	1.3	1.9	1.8
4	Mean	3.0	3.2	2.9	3.2	2.3	3.1	3.4	3.5	2.9	3.4	3.2	3.3	3.6	3.1
	s.d.	1.1	1.2	1.0	1.2	1.1	1.4	1.0	1.2	1.1	1.2	1.1	1.4	1.1	1.0
5	Mean	5.2	4.1	5.1	5.7	5.0	4.9	4.9	3.7	5.1	5.1	5.1	4.5	3.7	4.8
	s.d.	1.3	1.7	1.1	1.3	1.1	1.3	1.4	1.4	1.1	1.6	1.2	1.3	1.7	1.4
6	Mean	2.3	3.0	2.6	4.5	2.8	2.7	3.3	3.2	2.6	3.1	3.7	3.5	2.8	3.4
	s.d.	1.1	1.3	1.4	1.2	1.3	1.6	1.2	1.2	1.2	1.2	1.6	1.1	1.2	1.2
7	Mean	5.6	3.5	5.8	4.3	5.4	5.5	3.9	4.0	5.7	4.0	4.9	4.1	3.6	4.6
	s.d.	1.0	1.0	1.1	0.8	1.1	1.2	0.7	0.8	1.1	0.8	1.3	1.0	1.0	1.2
8	Mean	2.7	3.2	2.6	3.7	2.8	2.8	3.3	3.4	2.4	3.0	3.3	3.7	3.0	3.3
	s.d.	1.2	1.1	1.4	1.2	1.2	1.5	0.9	1.2	1.1	1.2	1.4	1.1	1.2	1.3
9	Mean	5.1	4.1	4.3	5.4	4.3	4.2	4.7	3.9	4.5	4.8	4.9	5.5	4.2	4.8
	s.d.	1.6	2.2	1.3	1.3	1.3	1.7	1.8	1.7	1.2	1.9	1.5	1.8	2.0	1.5
10	Mean	2.9	3.5	3.0	3.1	2.6	3.2	3.6	3.5	2.9	3.3	3.1	3.1	3.3	3.2
	s.d.	1.0	1.0	1.0	1.2	0.9	1.3	0.8	1.2	1.0	1.1	1.2	1.4	1.2	1.0
11	Mean	5.9	5.3	5.5	6.0	5.8	5.2	5.2	5.6	5.7	5.7	5.9	6.1	5.5	5.8
	s.d.	1.0	1.4	1.0	1.1	1.0	1.6	1.3	1.3	1.0	1.2	1.1	1.2	1.4	1.2
12	Mean	2.2	3.0	2.7	2.2	2.5	2.7	2.8	2.9	2.6	2.5	2.5	2.3	2.9	2.5
	s.d.	0.9	1.2	1.1	1.2	1.0	1.3	1.2	1.5	1.1	1.2	1.3	1.5	1.4	1.0
13	Mean	5.2	4.9	5.0	4.2	5.1	5.0	4.6	4.3	5.4	4.8	4.5	4.8	4.9	4.7
	s.d.	1.2	1.2	1.4	0.8	1.4	1.5	1.0	1.2	1.3	1.2	1.2	1.3	1.2	1.1
14	Mean	2.4	3.4	2.9	2.6	2.6	2.4	3.3	3.0	2.6	3.0	2.8	2.7	2.9	2.5
	s.d.	1.1	1.0	1.0	1.2	1.1	1.4	1.0	1.2	1.1	1.2	1.3	1.6	1.1	1.1
15	Mean	6.2	5.6	4.7	5.8	6.0	5.8	5.3	5.6	4.9	5.6	6.1	6.3	5.7	6.1
	s.d.	1.1	1.1	1.4	1.1	1.1	1.2	1.2	1.2	1.2	1.4	1.0	1.3	1.3	1.1
16	Mean	2.4	3.4	2.3	3.2	2.2	2.7	3.4	3.2	2.6	3.2	3.1	3.5	3.3	2.9
	s.d.	1.1	1.2	1.1	1.1	1.0	1.3	1.1	1.2	1.1	1.2	1.3	1.7	1.5	1.1

Appendix K Factor analysis between scales 1. Matrix of correlations

Scale	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1.00	-0.22	0.19	-0.68	0.50	0.08	0.49	-0.20	0.11	-0.73	0.49	-0.47	0.04	-0.50	0.23	-0.64
2	-	1.00	0.27	-0.05	-0.01	-0.32	0.15	-0.49	-0.64	0.29	-0.83	0.66	0.19	0.44	-0.85	-0.18
3	-	-	1.00	-0.17	0.83	0.25	0.24	-0.09	0.47	-0.12	0.04	-0.39	-0.01	0.03	-0.20	-0.10
4	-	-	-	1.00	-0.49	0.31	-0.74	0.51	0.05	0.83	-0.19	0.31	-0.52	0.45	0.02	0.83
5	-	-	-	-	1.00	0.21	0.58	-0.17	0.58	-0.52	0.34	-0.72	0.08	-0.45	-0.04	-0.43
6	-	-	-	-	-	1.00	-0.46	0.86	0.53	0.24	0.40	-0.30	-0.85	0.09	0.30	0.58
7	-	-	-	-	-	-	1.00	-0.69	-0.00	-0.77	0.14	-0.37	0.56	-0.68	-0.19	-0.91
8	-	-	-	-	-	-	-	1.00	0.45	0.46	0.31	-0.15	-0.85	0.24	0.50	0.77
9	-	-	-	-	-	-	-	-	1.00	-0.24	0.72	-0.86	-0.21	-0.35	0.46	0.20
10	-	-	-	-	-	-	-	-	-	1.00	-0.55	0.61	-0.52	0.71	-0.14	0.78
11	-	-	-	-	-	-	-	-	-	-	1.00	-0.82	-0.15	-0.50	0.52	-0.06
12	-	-	-	-	-	-	-	-	-	-	-	1.00	0.01	0.68	-0.49	0.24
13	-	-	-	-	-	-	-	-	-	-	-	-	1.00	-0.28	-0.23	-0.61
14	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	-0.39	0.57
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	0.20
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00

Appendix K 2. Extraction of factors

Factor 1 = 6.19

Factor 2 = 5.00

Factor 3 = 2.15

Factor 4 = 1.08

Factor 5 = 0.54

Factor 6 = 0.46

3. Scale loadings

Scale	Factor 1	Factor 2	Factor 3
1	0.73	0.16	-0.03
2	-0.20	-0.80	0.53
3	0.30	0.13	0.89
4	-0.82	0.24	0.02
5	0.69	0.24	0.66
6	-0.27	0.79	0.35
7	0.87	-0.34	0.07
8	-0.52	0.80	0.01
9	0.30	0.82	0.26
10	-0.94	-0.02	0.16
11	0.49	0.75	-0.20
12	-0.68	-0.68	-0.10
13	0.52	-0.61	-0.22
14	-0.76	-0.23	0.27
15	0.12	0.70	-0.49
16	-0.85	0.46	0.06

Appendix K 4. Concept weightings

Factor 1 C'ept	Wt.	Factor 2 C'ept	Wt.	Factor 3 C'ept	Wt.
1	9.52	1	1.09	1	-1.44
2	-8.70	2	-3.86	2	0.23
3	4.12	3	-7.44	3	2.21
4	1.93	4	9.72	4	3.33
5	10.30	5	-1.93	5	-2.13
6	1.37	6	-4.87	6	-0.27
7	-8.21	7	-1.62	7	3.59
8	-8.89	8	-0.74	8	-2.84
9	6.12	9	-6.08	9	0.90
10	-1.97	10	1.20	10	1.64
11	1.41	11	4.79	11	1.31
12	-1.57	12	8.62	12	-2.44
13	-6.83	13	-2.36	13	-2.97
14	1.41	14	3.49	14	-1.13

Appendix L "Relationships" output, 16PF/Criterion N = 249

Factor	Sten	Mean	s.d.	95%CL	n	Factor	Sten	Mean	s.d.	95%CL	n
A	1	106.6	6.6	6.1	7	C	1	96.4	1.3	12.1	2
	2	101.0	13.1	7.2	15		2	103.2	8.6	5.5	12
	3	102.8	12.4	4.2	39		3	102.6	13.6	5.1	30
	4	101.3	10.1	2.5	64		4	98.6	11.2	2.8	61
	5	98.5	11.4	3.0	57		5	102.0	11.9	3.5	48
	6	99.8	11.1	3.3	46		6	99.5	11.9	3.6	45
	7	94.4	12.9	7.8	13		7	98.4	10.0	3.6	33
	8	93.8	10.8	13.5	5		8	101.7	8.0	4.6	14
	9	97.7	13.0	32.3	3		9	94.1	13.8	21.9	4
	10	-	-	-	0		10	-	-	-	0
B	1	103.1	16.7	41.5	3	E	1	100.4	10.1	7.3	10
	2	-	-	-	0		2	95.8	0.5	1.3	3
	3	93.7	8.7	7.3	8		3	101.8	10.9	4.2	28
	4	103.0	13.3	5.9	22		4	101.6	10.6	3.3	42
	5	98.5	12.5	3.3	58		5	99.8	12.8	4.3	36
	6	100.5	9.9	2.4	68		6	98.7	11.5	3.4	48
	7	101.4	10.6	2.9	55		7	98.8	11.5	3.3	52
	8	100.9	12.0	5.3	22		8	103.9	10.9	9.1	8
	9	98.1	14.4	11.1	9		9	97.3	13.5	7.8	14
	10	97.4	2.3	3.7	4		10	109.0	4.0	3.4	8

Factor	Sten	Mean	s.d.	95%CL	n	Factor	Sten	Mean	s.d.	95%CL	n
F	1	109.6	18.5	46.0	3	H	1	103.1	9.3	4.5	19
	2	110.3	9.3	23.1	3		2	99.1	13.4	7.1	16
	3	100.8	9.2	4.1	22		3	99.2	11.5	6.4	15
	4	102.7	11.6	4.3	30		4	99.1	11.8	3.9	38
	5	102.7	9.5	2.6	53		5	104.6	9.8	3.3	36
	6	99.6	10.7	3.3	44		6	100.1	9.7	2.7	51
	7	98.6	11.1	3.9	34		7	97.0	14.6	5.0	36
	8	95.9	12.3	3.8	42		8	99.6	9.6	3.6	30
	9	98.0	12.1	7.0	14		9	99.0	14.0	12.9	7
	10	101.0	19.6	31.2	4		10	98.1	-	-	1
G	1	99.3	13.1	6.0	21	I	1	110.0	15.0	9.5	12
	2	98.6	7.9	5.3	11		2	101.5	10.3	3.4	39
	3	98.6	11.7	3.7	41		3	99.4	10.4	3.7	33
	4	100.7	11.4	2.8	67		4	99.2	12.9	3.4	60
	5	101.9	10.8	2.9	58		5	99.4	10.5	3.9	30
	6	101.9	12.2	5.4	22		6	98.5	10.9	3.4	43
	7	97.3	11.8	5.1	23		7	101.0	9.0	4.5	18
	8	95.7	8.3	74.7	2		8	97.5	10.0	10.5	6
	9	92.0	5.5	49.8	2		9	101.7	11.1	10.3	7
	10	109.3	6.0	54.2	2		10	101.3	-	-	1

Factor	Sten	Mean	s.d.	95%CL	n	Factor	Sten	Mean	s.d.	95%CL	n
L	1	96.2	8.5	13.5	4	N	1	97.9	12.9	9.2	10
	2	100.6	3.8	4.0	6		2	96.7	7.7	6.5	8
	3	98.4	11.6	5.3	21		3	103.3	10.5	3.0	50
	4	100.1	9.3	3.1	37		4	102.4	13.0	4.1	41
	5	97.7	9.7	3.9	27		5	98.9	11.5	3.7	40
	6	102.7	11.4	2.7	71		6	96.8	10.5	3.5	37
	7	99.9	13.4	4.1	43		7	99.7	11.0	3.4	43
	8	99.2	13.3	10.3	9		8	103.3	15.1	15.8	6
	9	100.7	11.5	4.9	24		9	99.7	10.7	7.2	11
	10	93.0	13.4	12.4	7		10	95.9	3.8	9.3	3
M	1	-	-	-	0	O	1	100.5	8.3	8.7	6
	2	108.6	13.4	16.7	5		2	102.4	13.5	10.4	9
	3	104.4	10.5	7.5	10		3	96.8	11.5	5.0	23
	4	99.3	9.2	4.6	18		4	102.0	13.8	4.9	33
	5	99.4	12.4	3.6	48		5	99.9	12.0	3.4	51
	6	98.2	11.4	3.3	48		6	100.6	9.4	2.6	55
	7	101.4	11.1	2.8	61		7	100.6	12.15	4.2	35
	8	100.7	10.4	4.1	27		8	98.8	11.5	4.8	25
	9	100.6	12.6	5.9	20		9	98.3	7.9	8.3	6
	10	97.5	10.9	6.9	12		10	102.7	5.8	6.1	6

Factor	Sten	Mean	s.d.	95%CL	n	Factor	Sten	Mean	s.d.	95%CL	n
Q_1	1	-	-	-	0	Q_3	1	106.3	0.2	2.2	2
	2	101.7	6.1	9.7	4		2	96.6	9.6	7.4	9
	3	96.0	10.6	6.1	14		3	97.9	9.5	4.7	18
	4	98.6	10.8	5.7	16		4	100.5	13.1	5.7	23
	5	100.0	12.1	3.7	44		5	99.6	12.0	3.2	57
	6	100.6	12.7	3.9	43		6	98.6	13.3	5.1	29
	7	102.3	11.8	3.0	61		7	99.5	11.0	2.8	62
	8	101.8	9.7	4.5	20		8	102.4	9.3	4.8	17
	9	98.0	11.0	3.9	33		9	102.7	11.4	4.8	24
	10	98.6	8.6	5.0	14		10	109.4	2.6	2.2	8
Q_2	1	96.2	2.5	6.2	3	Q_4	1	113.2	4.1	37.2	2
	2	98.1	12.1	6.0	18		2	99.1	12.8	11.9	7
	3	98.9	10.4	5.3	17		3	102.0	11.6	5.0	23
	4	95.1	13.7	5.9	23		4	97.1	11.1	3.2	48
	5	99.0	11.9	4.6	28		5	100.9	11.0	3.0	53
	6	101.0	11.1	2.7	68		6	99.0	13.8	4.3	43
	7	101.0	11.1	4.3	28		7	102.1	10.2	3.6	34
	8	103.1	10.8	3.2	45		8	103.1	8.5	4.1	19
	9	96.4	10.3	7.9	9		9	99.1	10.5	5.8	15
	10	104.4	9.6	6.9	10		10	98.6	10.1	12.6	5

Factor	Sten	Mean	s.d.	95%CL	n
Anx.	1	-	-	-	0
	2	102.2	13.9	12.9	7
	3	100.3	11.6	4.7	26
	4	101.0	9.0	3.2	33
	5	98.8	11.5	3.1	56
	6	101.0	13.0	3.6	52
	7	100.8	11.2	3.5	41
	8	98.3	12.0	5.3	22
	9	100.9	5.4	5.7	6
	10	100.2	10.0	10.5	6
Extr.	1	103.9	12.0	11.1	7
	2	105.9	11.5	5.6	19
	3	103.7	9.5	4.6	19
	4	98.9	10.1	2.9	48
	5	99.7	9.0	3.3	32
	6	101.2	12.0	3.5	48
	7	98.4	12.6	3.9	42
	8	97.3	12.2	5.2	24
	9	93.5	5.8	6.1	6
	10	102.0	18.8	29.9	4

Appendix M

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