PATHS TOWARDS SUCCESS AND FAILURE IN PHYSICS AT G.C.E. ADVANCED LEVEL : A LONGITUDINAL STUDY OF PUPILS' ATTITUDES

PART II

APPENDICES AND REFERENCES

APPENDIX 4.2.1

THE EXPLANATORY LETTER TO PUPILS

ATTITUDES TO PHYSICS PROJECT

Dear Student,

Although physics courses have been modernised in recent years, the proportion of A-level students choosing physics on a national scale has continued to fall. In a preliminary investigation at the University of Lancaster, I found that the attitudes of students like yourself towards physics were of considerable importance, and consequently a more extensive survey is now being introduced.

Briefly, the survey is going to study how fifth-form physics students feel about the subject; the reasons that would be given for choosing or rejecting physics at A-level, and the effect of different study methods, teaching methods and personality characteristics on attitudes to physics. So as to inconvenience you as little as possible in this important year, I have arranged to collect the information in three separate, short questionnaires, which your teacher will issue to you at suitable times. There will be no "right" or "wrong" answers to the questionnaire items: they are not tests, and very little writing will be required. The information will be processed at the University of Leicester and your individual responses will be treated in the strictest confidence.

After the summer examinations, I should like you to comment on some of your original responses. If you decide to study A-level physics, your attitudes to physics two years from now could be usefully compared with those you hold at present.

Whether you are taking part in the survey for one or for three years, I hope you will enjoy completing the attitude scales and contributing to a worthwhile educational study.

Best wishes for a successful year,

A. W. Pell

A. W. Pell

APPENDIX 4.2.2 UNIT 1: THE FIRST FIFTH-FORM QUESTIONNAIRE

ATTITUDES TO PHYSICS PROJECT

UNIT 1: O-LEVEL PHYSICS

Most items in this questionnaire require you to ring the code number appropriate to your answer. On other occasions, such as in SECTION A below, you will be required to write your answers in a box.
Remember that this is not a test with right and wrong answers. Work quickly giving your first 'natural' reply.

SECTION A: PERSONAL INFORMATION

This information will give me the background to any choice you make about your education after the O-level exams.

1. INITIALS

2. MALE OR FEMALE

3. AGE IN YEARS AND MONTHS

4. ROUGH ESTIMATE OF WHAT YOU THINK YOUR O-LEVEL GRADE WILL BE

A
B
C
D
E
UN

5. When you finish the fifth form course in the summer, and after any holiday employment, what do you intend to do?

(i) TAKE UP EMPLOYMENT — 1

(ii) ENTER THE SIXTH FORM OF YOUR SCHOOL OR SOME OTHER SCHOOL — 2

(iii) ENTER A TECHNICAL COLLEGE — 3

(iv) ENTER A SIXTH FORM COLLEGE — 4

(v) UNDECIDED — 5

(vi) NONE OF THESE — 6

6. (a) In which area do your immediate career interests lie(engineering, accounting, etc)?

(b) Have you a second 'reserve' career area that you might take up if you were unable to follow (a)? If your answer is YES, what is this second area?

7. How important is it that you do well in the O-level physics exam?

(i) A HIGH GRADE ESSENTIAL — 1

(ii) ANY PASS GRADE WILL BE SUFFICIENT — 2

(iii) A PASS IS NOT ESSENTIAL BUT YOU HOPE TO GET ONE — 3

(iv) A PASS IS NOT ESSENTIAL AND YOU DON'T CARE WHETHER YOU PASS OR NOT — 4

/cont.

SECTION B: ATTITUDES TO SCHOOL PHYSICS

The purpose of this section is to find out what you think about school physics. It contains a number of statements about physics. I want to find out how you feel about them and whether you agree with them or not.
A sample statement to show you how to mark your answers now follows:-

'I would rather read a book than watch television.'

1	2	3	(4)	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

The statement is followed by five numbered alternatives which can indicate your measure of agreement or disagreement. If you disagree with the statement, but not strongly, then alternative 4 would be ringed as shown.

Please read the alternatives carefully as well as the statements before deciding upon your response.

1. I enjoy physics lessons more than other lessons

1	2	3	4	5
Much	Slightly more	About the same	Less	Much less

2. Two hours of work in a physics laboratory are more fun than a week of work in other subjects.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

3. Physics lessons are a waste of time.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

4. I like to talk with people about new discoveries in physics.

1	2	3	4	5
Very much	Much	Some	A little	Not at all

5. Physics lessons give me a feeling of satisfaction.

1	2	3	4	5
Always	Most of the time	Some-times	Seldom	Never

6. I would like to be given a physics book or a piece of physics equipment.

1	2	3	4	5
Very much	I would be pleased	It would be all right	I don't think I would like it	Not in the least

7. I would rather be a member of a 'pop group' than a member of a physics research team

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

8. I would specialise in physics if I had the chance.

1	2	3	4	5
Definitely yes	Very likely	May be	Not likely	Never

/cont.

9. I look forward to physics lessons.

1	2	3	4	5
Always	Most of the time	Sometimes	Seldom	Never

10. I would enjoy school more if there were no physics lessons.

1	2	3	4	5
Much more	Slightly more	Just as much	Less	A great deal less

11. I should like to belong (or I like belonging) to a physics club.

1	2	3	4	5
Very much	Some	A little	Not sure	Not at all

12. Physics is just a load of technical terms.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

13. I would like to work with people who make discoveries in physics.

1	2	3	4	5
All the time	Most of the time	Occasionally	Seldom	Never

14. I do physics experiments in my spare time about:

1	2	3	4	5
once a week	once a month	once every three months	once a year	never

15. I think the school should have more physics periods each week.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

16. I find physics difficult to understand.

1	2	3	4	5
Extremely difficult	Difficult	In between	Easy	Very easy

17. I would much rather do experiments in physics than read about them.

1	2	3	4	5
Always	Most of the time	Sometimes	Seldom	Never

18. I would rather do a physics experiment than listen to a lecture on the same topic.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

19. I want to learn for myself why physics experiments turn out the way they do.

1	2	3	4	5
Very much	Much	A little	Not sure	Not at all

20. It is fun to guess the outcome of physics experiments.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

/cont

21. It is the experiments in physics that make me understand it.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

22. I am happy when working with equipment in the physics laboratory.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

23. Trying to solve a physics problem is interesting.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

24. I would rather work out how to do a physics experiment by myself than be told.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

25. I enjoy discussing physics problems raised in class with my friends.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

26. You can learn more from a physics text book than by doing experiments.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

27. Physics experiments demonstrated by teachers are more interesting than the ones you do yourself.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

28. The methods used by the physics teacher are interesting in themselves.

Strongly agree	Agree	Not sure	Disagree	Strongly disagree

/cont.

SECTION C: HOW O-LEVEL PHYSICS IS TAUGHT.

The way you react to physics depends in part on the way the subject is taught, so I have written out in this section a number of statements that describe aspects of O-level physics teaching.

During the year, your teacher is likely to use most of the methods described. To tell me which methods are most frequently used in your lessons, please ring the appropriate code number in column 1. In column 2 you have the chance to indicate which of all the methods seem to you to be good ones, but don't be afraid to use the "Don't Know" response.

	COLUMN 1			COLUMN 2		
	METHOD			STATEMENT DESCRIBES		
	OFTEN USED	SELDOM USED	DON'T KNOW	A GOOD METHOD	A POOR METHOD	DON'T KNOW
1. The teacher talks or writes and shows some experiments.	1	2	3	1	2	3
2. The teacher asks us questions as we do some theory or practical work, gives us notes, and generally guides us in the right direction.	1	2	3	1	2	3
3. The teacher discusses each new topic with us, then we investigate this by ourselves and draw our own conclusions without further assistance.	1	2	3	1	2	3
4. The teacher's methods are varied such as allowing us to experiment, showing films and filmstrips, discussing and explaining with a single demonstration experiment.	1	2	3	1	2	3
5. The lessons are planned to make experimental and theory work run smoothly.	1	2	3	1	2	3
6. Homework set is linked with the lesson.	1	2	3	1	2	3
7. The teaching seems to be most suitable for the most able pupils.	1	2	3	1	2	3
8. The teacher uses words rather than mathematical formulae whenever possible.	1	2	3	1	2	3
9. We work through a text-book.	1	2	3	1	2	3
10. Each topic we study is linked to another one we have previously understood.	1	2	3	1	2	3
11. The teacher tries to get us to understand ideas by explaining in simple terms.	1	2	3	1	2	3
12. Duplicated notes are issued at the end of each lesson.	1	2	3	1	2	3
13. We make our own notes from text-books or work sheets.	1	2	3	1	2	3

/cont.

	COLUMN 1			COLUMN 2		
	METHOD			STATEMENT DESCRIBES		
	OFTEN USED	SELDOM USED	DON'T KNOW	A GOOD METHOD	A POOR METHOD	DON'T KNOW
14. Groups of pupils make notes on different topics and these notes are circulated around the class.	1	2	3	1	2	3
15. Notes are made from dictation by the teacher.	1	2	3	1	2	3
16. Notes are made by copying from the board or overhead projector.	1	2	3	1	2	3
17. Notes are made by a number of different methods.	1	2	3	1	2	3
18. We work together in groups to do investigations and experiments.	1	2	3	1	2	3
19. We work individually through worksheets.	1	2	3	1	2	3

SECTION D

Thank you very much for your help.

If you would like to add to any of your responses or make any other comments on the statements I have used, please do so in the space below.

APPENDIX 4.2.3 UNIT 2 : THE SECOND FIFTH-FORM QUESTIONNAIRE

ATTITUDES TO PHYSICS PROJECT

UNIT 2: O LEVEL PHYSICS

This short questionnaire unit is concerned more with attitudes in general rather than with physics in particular. It will help me to put your feelings about the subject into perspective and make your responses on the other questionnaires more meaningful. Work as quickly as you can to give your first 'natural' reply, but please check at the end of each section to make sure that all the statements have been marked.

SECTION A: PERSONAL INFORMATION

1. INITIALS

2. DATE OF BIRTH

DAY/MONTH	YEAR	

SECTION B: STUDY ATTITUDES

The following statements cover a wide range of students' comments on their general attitudes to studying at school and at home. The statements deliberately follow no logical order. Please work quickly, indicating your agreement or disagreement by circling either 'A' or 'D'. It is most important that you make a definite response to every statement, even though your feelings may be rather indefinite.

1.	Background music helps me to study more effectively	A	D
2.	It is most unusual for me to be late handing in work ..	A	D
3.	I try to put off any work that I have to do for as long as possible	A	D
4.	I enjoy the challenge of a difficult new topic in lessons	A	D
5.	I find it rather difficult to organise my study time when I am at home	A	D
6.	I usually tackle the easy things first and leave the more difficult ones until the end	A	D
7.	I seem to have plenty of free time during the week	A	D
8.	I enjoy collecting things such as stamps, minerals, plants etc.	A	D
9.	I don't find much time to study during the holidays ..	A	D
10.	It is important to me that I do better than other students, if I can	A	D
11.	My lesson notes are often difficult to follow afterwards ..	A	D
12.	I sometimes wish I could leave school and start work now	A	D
13.	I usually plan my week's work in advance, if I can, either on paper or in my head	A	D
14.	I get disheartened and give up easily if something is too difficult for me	A	D

P.T.O.

15.	I find it easy to pick out the main points of a lesson without emphasis by the teacher	A	D
16.	I can't see any relevance in the work we do here	A	D
17.	I need to be in the right mood before I can study effectively	A	D
18.	I'm a pretty average student: I'll never be particularly good, so there is no point in striving to be something I am not	A	D
19.	I find it difficult to keep awake during some lessons ..	A	D
20.	It is important for me to do very well in my studies ..	A	D
21.	There seems to be little point in following up the lesson topics in reference and text-books	A	D
22.	I hate admitting defeat, even in trivial matters	A	D
23.	I don't often join in discussion lessons: I prefer to listen	A	D
24.	I usually hurry all my homework: there seems little point in spending more time	A	D
25.	I'm rather slow at starting work in the evening	A	D
26.	My friends always seem to be able to do things better than me	A	D
27.	It's not often that I can stick at work for more than an hour at a time	A	D
28.	I like working to a set plan when writing an essay rather than letting my ideas flow out freely	A	D
29.	I am determined to do my best in all subjects, even in those that least interest me	A	D

The statements above refer to study attitudes in general: the <u>two items below refer to physics only</u>. Please ring the code number of the response with which you most agree.

30. My study habits in physics, compared with those in other subjects, are

1	2	3	4	5
much more organised	a little more organised	no different	a little less organised	much less organised

31. Comparing my determination to do well in physics with that in other subjects, in physics

1	2	3	4	5
I am much less determined	I am a little less determined	there is no difference	I am a little more determined	I am much more determined

---

P.T.O.

SECTION C

EYSENCK PERSONALITY INVENTORY

by H. J. Eysenck and Sybil B. G. Eysenck

PERSONALITY QUESTIONNAIRE

FORM A

NAME..... AGE.....

OCCUPATION..... SEX.....

N= E= L=

Instructions

Here are some questions regarding the way you behave, feel and act. After each question is a space for answering "YES" or "NO".

Try to decide whether "YES" or "NO" represents your usual way of acting or feeling. Then put a cross in the circle under the column headed "YES" or "NO". Work quickly, and don't spend too much time over any question; we want your first reaction, not a long-drawn out thought process. The whole questionnaire shouldn't take more than a few minutes. Be sure not to omit any questions.

Now turn the page over and go ahead. Work quickly, and remember to answer every question. There are no right or wrong answers, and this isn't a test of intelligence or ability, but simply a measure of the way you behave.

HODDER AND STOUGHTON

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FORM A

		YES	NO
1.	Do you often long for excitement?	○	○
2.	Do you often need understanding friends to cheer you up?	○	○
3.	Are you usually carefree?	○	○
4.	Do you find it very hard to take no for an answer?	○	○
5.	Do you stop and think things over before doing anything?	○	○
6.	If you say you will do something do you always keep your promise, no matter how inconvenient it might be to do so?	○	○
7.	Does your mood often go up and down?	○	○
8.	Do you generally do and say things quickly without stopping to think?	○	○
9.	Do you ever feel "just miserable" for no good reason?	○	○
10.	Would you do almost anything for a dare?	○	○
11.	Do you suddenly feel shy when you want to talk to an attractive stranger?	○	○
12.	Once in a while do you lose your temper and get angry?	○	○
13.	Do you often do things on the spur of the moment?	○	○
14.	Do you often worry about things you should not have done or said?	○	○
15.	Generally, do you prefer reading to meeting people?	○	○
16.	Are your feelings rather easily hurt?	○	○
17.	Do you like going out a lot?	○	○
18.	Do you occasionally have thoughts and ideas that you would not like other people to know about?	○	○
19.	Are you sometimes bubbling over with energy and sometimes very sluggish?	○	○
20.	Do you prefer to have few but special friends?	○	○
21.	Do you daydream a lot?	○	○
22.	When people shout at you, do you shout back?	○	○
23.	Are you often troubled about feelings of guilt?	○	○
24.	Are *all* your habits good and desirable ones?	○	○
25.	Can you usually let yourself go and enjoy yourself a lot at a lively party?	○	○
26.	Would you call yourself tense or "highly-strung"?	○	○
27.	Do other people think of you as being very lively?	○	○

cont./

		YES	NO
28.	After you have done something important, do you often come away feeling you could have done better?	○	○
29.	Are you mostly quiet when you are with other people?	○	○
30.	Do you sometimes gossip?	○	○
31.	Do ideas run through your head so that you cannot sleep?	○	○
32.	If there is something you want to know about, would you rather look it up in a book than talk to someone about it?	○	○
33.	Do you get palpitations or thumping in your heart?	○	○
34.	Do you like the kind of work that you need to pay close attention to?	○	○
35.	Do you get attacks of shaking or trembling?	○	○
36.	Would you always declare *everything* at the customs, even if you knew that you could never be found out?	○	○
37.	Do you hate being with a crowd who play jokes on one another?	○	○
38.	Are you an irritable person?	○	○
39.	Do you like doing things in which you have to act quickly?	○	○
40.	Do you worry about awful things that might happen?	○	○
41.	Are you slow and unhurried in the way you move?	○	○
42.	Have you ever been late for an appointment or work?	○	○
43.	Do you have many nightmares?	○	○
44.	Do you like talking to people so much that you never miss a chance of talking to a stranger?	○	○
45.	Are you troubled by aches and pains?	○	○
46.	Would you be very unhappy if you could not see lots of people most of the time?	○	○
47.	Would you call yourself a nervous person?	○	○
48.	Of all the people you know, are there some whom you definitely do not like?	○	○
49.	Would you say that you were fairly self-confident?	○	○
50.	Are you easily hurt when people find fault with you or your work?	○	○
51.	Do you find it hard to really enjoy yourself at a lively party?	○	○
52.	Are you troubled with feelings of inferiority?	○	○
53.	Can you easily get some life into a rather dull party?	○	○
54.	Do you sometimes talk about things you know nothing about?	○	○
55.	Do you worry about your health?	○	○
56.	Do you like playing pranks on others?	○	○
57.	Do you suffer from sleeplessness?	○	○

PLEASE CHECK TO SEE THAT YOU HAVE ANSWERED *ALL* THE QUESTIONS

APPENDIX 4.2.4 UNIT 3 : THE THIRD FIFTH-FORM QUESTIONNAIRE

ATTITUDES TO PHYSICS PROJECT

UNIT 3 O-LEVEL PHYSICS

This is the third and final questionnaire in the O-level physics series. Its purposes are a) to find out how your attitudes towards physics compare with those towards other subjects, and b) to discover why you might choose or reject physics at A-level if you had this chance later in the year.

SECTION A : PERSONAL INFORMATION

1. INITIALS

2. DATE OF BIRTH

MONTH	YEAR

SECTION B : PHYSICS AND OTHER SUBJECTS

This section is to find out which subjects you are studying and how you feel about them.

1. SUBJECTS BEING STUDIED AT O-LEVEL OR C.S.E.

2. THE THREE SUBJECTS BEING STUDIED THAT YOU MOST ENJOY, IN ORDER

1.	2.	3.

P.T.O.

3. In the table below there are 9 possible school subjects. Column A contains 6 possible ways of describing these subjects. Column B gives 6 opposite ways of describing the subjects, for example "EASY" in column A and "DIFFICULT" in column B. For each of the subjects that you are studying, write "A" or "B" depending upon which best expresses your feelings about that subject. If neither "A" nor "B" seem suitable, write "X". For any subject you are not studying, leave the subject column blank. The first line of the table is just an example.

A.	FRENCH	PHYSICS	GEOGRAPHY	BIOLOGY	ENGLISH LITERATURE	CHEMISTRY	MATHS	HISTORY	ENGLISH LANGUAGE	B.
SCIENTIFIC	B	A		A	B	A	X	B	B	NOT SCIENTIFIC
DULL										INTERESTING
CONTAINS SUFFICIENT MATERIAL										CONTAINS TOO MUCH MATERIAL
EASY										DIFFICULT
EXCITING										BORING
OUT OF DATE										MODERN
HIGH PRESTIGE										LOW PRESTIGE

/cont.

Imagine that it is now September and you have done reasonably well in your examinations with a number of passes, including physics.

1. WOULD YOU THEN GO ON TO STUDY ONE OR MORE A-LEVEL SUBJECTS?

YES OR NO ☐

If your answer is YES, please continue with SECTION C.
If your answer is NO, but you intend to continue with your education at school/college, please go on to SECTION E.
If your answer is NO, and you do not intend to remain at school/college, please go on to SECTION F.

SECTION C : CHOOSING A-LEVEL SUBJECTS

Your A-level choices may or may not include physics but the reasons for your decision are most important for this survey. In this and the following sections I should like to find out what these reasons might be and what A-level subjects you might choose.

1. IF YOU HAD A FREE CHOICE AND DID NOT HAVE TO CONSIDER UNIVERSITY OR CAREER REQUIREMENTS, WHICH A-LEVEL SUBJECTS WOULD YOU CHOOSE (IN ORDER OF PREFERENCE)?

1.	2.	3.

2. IN PRACTICE, CAREER REQUIREMENTS MIGHT LIMIT OR DECIDE YOUR CHOICE, SO WHICH A-LEVEL SUBJECTS ARE YOU MOST LIKELY TO CHOOSE?

If you have chosen physics as one of the subjects in your answer to question 2, please go on to SECTION D. If you have not chosen physics as one of your subjects in answer 2, please go on to SECTION E.

SECTION D : CHOOSING A-LEVEL PHYSICS.

Each of the statements below could be a reason for choosing A-level physics. Please ring the code number of each statement that gives one of your reasons.

You have a high O-level physics grade	1
You have a better grade in physics than in most other subjects	2
University and/or career requirements	3
It is not a main subject but it was decided by school/college timetable	4
The O-level course was interesting	5
You have heard that the A-level course is interesting	6
The O-level course was easy	7
Physics allows you to use your mathematical ability	8
You are attracted by the amount of student experimental work in physics	9
Not so much hard work is expected in A-level physics as in other subjects	10
You have heard that it is easier to pass in A-level physics than in most other subjects	11

P.T.O.

You are attracted by the A-level teaching methods in physics	12
You are attracted by the type of exams in A-level physics	13
You have heard that it is more difficult to pass in A-level physics than in most other subjects, but you are confident that you can manage	14
More hard work is expected than in some other subjects but you think that you can manage	15
To improve your understanding of science in the world today	16

Of the reasons you have indicated, which <u>three</u> do you think would be the most important ones in your case?

Please enter them in the table in order of importance

FIRST	
SECOND	
THIRD	

<u>Now go on to SECTION F.</u>

<u>SECTION E : REJECTING A-LEVEL PHYSICS</u>

Each of the statements below could be <u>a reason for not choosing A-level physics</u>. Please ring the code number of each statement that gives one of your reasons.

You have a low O-level physics grade	1
Your physics grade is lower than the grades in most other subjects	2
University and/or career requirements mean other subjects must be studied	3
It would not have been a main subject and it could not be fitted into school/college timetable	4
The O-level course was not intersting	5
You have heard that the A-level course is not interesting	6
The O-level course was difficult	7
The O-level course was too mathematical	8
There was not enough student experimental work in the O-level course	9
You have heard that you must work much harder in A-level physics than in most other subjects	10
You have heard that it is more difficult to pass at A-level in physics than in most other subjects	11
You are not attracted by the teaching methods of the A-level physics course	12
You are not attracted by the type of A-level physics exam	13
A-level physics will not allow your personal opinions to be expressed	14
A-level physics is too narrow and specialist to be useful for you	15
The A-level course seems to have too much mathematics in it	16

Of the reasons you have indicated, which <u>three</u> do you think would be the most important ones in your case?

Please enter them in the table in order of importance

FIRST	
SECOND	
THIRD	

<u>Now go on to SECTION F.</u>

/cont.

SECTION F.

Thank you for your help in the survey and for all the trouble you have taken.

A number of interesting comments were made by students at the end of Unit 1. This time, if you want to add to your section B responses or give other reasons for choosing/rejecting A-level physics, please do so in the space below.

APPENDIX 4.2.5 UNIT 4: THE LOWER SIXTH-FORM QUESTIONNAIRE

ATTITUDES TO PHYSICS PROJECT

UNIT 4: FIRST YEAR A-LEVEL STUDIES

This is the only questionnaire this year. Its purpose is, mainly, to review your reasons for choosing or rejecting A-level physics now that students who were successful in the O-level physics examination have been identified. In addition, you have the chance to make observations on your revision in physics just before the O-level examination, and if you are now studying A-level physics you can comment on your course.

SECTION A: PERSONAL INFORMATION

1. Initials

2. Date of Birth — Day Month Year

3. Number of passes at O-level (or at C.S.E. Grade 1)

4. O-level Physics Grade

5. a) In which area do your immediate career interests lie (engineering, accounting, etc.)?

   b) Have you a second 'reserve' career area that you might take up if you were unable to follow (a)? If your answer is YES, what is this second area?

6. a) Subjects being studied at A-level

   b) Subjects being studied at A/O level

   c) Subjects being studied at O-level

If physics is one of your A-level subjects, please go on to SECTION B. If you are NOT studying A-level physics, please go on to SECTION C.

P.T.O.

SECTION B: CHOOSING A-LEVEL PHYSICS

Each of the statements below could be a reason for choosing A-level physics. Please ring the code number of each statement that gives one of your reasons.

You had a high O-level physics grade	1
You had a better grade in physics than in most other subjects	2
University and/or career requirements	3
It was not to be a main subject but it was decided by school/college timetable	4
The O-level course was interesting	5
You had heard that the A-level course is interesting	6
The O-level course was easy	7
Physics allows you to use your mathematical ability	8
You were attracted by the amount of student experimental work in physics	9
Not so much hard work in expected in A-level physics as in other subjects	10
You had heard that it is easier to pass in A-level physics than in most other subjects	11
You were attracted by the A-level teaching methods in physics	12
You were attracted by the type of exams in A-level physics	13
You had heard that it is more difficult to pass in A-level physics than in most other subjects, but you were confident that you could manage	14
More hard work is expected that in some other subjects but you thought that you could manage	15
To improve your understanding of science in the world today	16

Of the reasons you have indicated, which three were the most important ones in your case?

Please enter them in the table in order of importance

FIRST	
SECOND	
THIRD	

Now go on to SECTION D

SECTION C: REJECTING A-LEVEL PHYSICS

Each of the statements below could be a reason for not choosing A-level physics. Please ring the code number of each statement that gives one of your reasons.

You had a low O-level physics grade	1
Your physics grade was lower than the grades in most other subjects	2
University and/or career requirements meant other subjects must be studied	3
It would not have been a main subject and it could not be fitted into school/college timetable	4
The O-level course was not interesting	5

P.T.O.

You had heard that the A-level course is not interesting	6
The O-level course was difficult	7
The O-level course was too mathematical	8
There was not enough student experimental work in the O-level course	9
You had heard that you must work much harder in A-level physics than in most other subjects	10
You had heard that it is more difficult to pass at A-level in physics than in most other subjects	11
You were not attracted by the teaching methods of the A-level physics course	12
You were not attracted by the type of A-level physics exam	13
A-level physics would not allow your personal opinions to be expressed	14
A-level physics was too narrow and specialist to be useful for you	15
The A-level course seemed to have too much mathematics in it	16

Of the reasons you have indicated, which <u>three</u> were the most important ones in your case?

Please enter them in the table in order of importance

FIRST	
SECOND	
THIRD	

<u>Now go on to SECTION E</u>

SECTION D: THE A-LEVEL PHYSICS COURSE

After two months or so, your feelings about A-level physics, which would have been partly expressed in your answers to SECTION B, can now be more definitely judged. The attitude scales below are an extension of the ones you answered in an earlier Unit, and they will allow attitudes towards different courses to be compared.

To answer the scales, judge the course on each one in turn.

e.g. MODERN 1 2 3 4 5 6 7 OUT OF DATE

If you think that your course is modern, but not extremely so, then ring number 2 or 3 depending upon the degree of your feelings. An extremely out of date course would be rated "7".

Ring number 4 if you think the words are unsuitable or if you can't decide in favour of one extreme or the other.

As usual when answering attitude scales, work as quickly as you can, giving first natural replies.

	SATISFYING	1	2	3	4	5	6	7 FRUSTRATING
	EARLY THEORIES LINKED TO PRESENT DAY THEORIES	1	2	3	4	5	6	7 PRESENT DAY THEORIES ARE CONSIDERED ONLY
	REQUIRES HARD WORK	1	2	3	4	5	6	7 REQUIRES LITTLE WORK
	INTERESTING	1	2	3	4	5	6	7 DULL
	LOATHSOME	1	2	3	4	5	6	7 ENJOYABLE
	LOW PRESTIGE	1	2	3	4	5	6	7 HIGH PRESTIGE
	PLEASANT	1	2	3	4	5	6	7 UNPLEASANT
	SOCIAL IMPLICATIONS NEVER CONSIDERED	1	2	3	4	5	6	7 SOCIAL IMPLICATIONS ALWAYS CONSIDERED
	CONTAINS TOO MUCH MATERIAL	1	2	3	4	5	6	7 CONTAINS SUFFICIENT MATERIAL
	DOES NOT AFFECT YOUR PERSONAL VIEWS	1	2	3	4	5	6	7 MAKES YOU THINK DEEPLY ABOUT YOUR PERSONAL VIEWS
	MATHEMATICAL	1	2	3	4	5	6	7 NON-MATHEMATICAL
	BORING	1	2	3	4	5	6	7 EXCITING
	MODERN	1	2	3	4	5	6	7 OUT OF DATE
	DIFFICULT	1	2	3	4	5	6	7 EASY

Now go on to SECTION E

SECTION E: O-LEVEL PHYSICS REVISION

When you expressed your views last year on how O-level physics was taught it was not sensible to include questions about revision as the examination was, at that time, still several months away. To complete the full description of the O-level course could you mark the statements below as you did before in Unit 1. Column 1 allows you to say whether the revision method was used or not, and Column 2 gives you the chance to say whether you think the method is a good one. Don't be afraid to use the "Don't know" response.

Answer by ringing the appropriate code number.

	Column 1 Method Actually Used			Column 2 Statement Describes		
	True	False	Don't know	A good method	A poor method	Don't know
1. We had regular practice in answering O-level examination questions	1	2	3	1	2	3
2. A revision plan was followed by the class in the time before the examination	1	2	3	1	2	3
3. Examination revision was done by using the student's own notes on the course	1	2	3	1	2	3
4. The topics covered in the O-level course were thoroughly treated	1	2	3	1	2	3
5. The O-level syllabus was completely covered	1	2	3	1	2	3
6. All O-level topics covered in the course were revised for the examination	1	2	3	1	2	3
7. The topics covered in the O-level course were restricted to those thought essential for an examination pass	1	2	3	1	2	3

SECTION F:

Thank you again for your continued assistance.

If you have any further comments about choosing/rejecting A-level physics or your physics course that you think are relevant please make use of the space below.

APPENDIX 4.2.6 UNIT 5 : THE UPPER SIXTH-FORM QUESTIONNAIRE

ATTITUDE TO PHYSICS PROJECT

UNIT 5: SECOND YEAR 'A' LEVEL PHYSICS

This is the final questionnaire of the project. Second year 'A' level physics students are now the only survivors in the investigation, which started in the fifth form. The purpose of this questionnaire is to check on your progress towards the 'A' level examinations; to review your attitudes to the physics course as it nears its end; to seek your opinions on teaching methods, and to clarify your approach to studying.

Responses, as usual, are indicated by either making entries in the appropriate boxes or circling code numbers.

SECTION A: PERSONAL INFORMATION

1. Initials

2. Date of Birth — Day Month Year

3. (a) In which area do your career interests now lie (civil engineering, medicine, accounting, etc.)?

   (b) Have you a second 'reserve' career area that you would take up if you were unable to follow (a)? If your answer is yes, what is this second area?

4. (a) Subjects being studied at 'A' level

   (b) Any other subjects being studied at 'A'/'O' or 'O' level (indicate level)

   (c) Any additional passes gained during your sixth form studies

5. When you leave school or college, and after any holiday employment, what do you intend to do?

   i) Take up employment — 1
   ii) Enter higher education or take a sandwich course — 2
   iii) Undecided — 3
   iv) None of these — 4

P.T.O.

6. How important is it for you to do well in the 'A' level physics examination?

i) A grade D or above is essential
ii) Any pass grade will be sufficient
iii) A pass is not essential but you hope to get at least a grade E
iv) A pass is not essential and you are unconcerned about passing

[1] [2] [3] [4]

7. Can you estimate the 'A' level Physics grade you are likely to achieve this summer?

Estimate [ ]

SECTION B: THE 'A' LEVEL PHYSICS COURSE

You will remember completing an attitude scale on your 'A' level course just after it had started. Now, towards the end of your physics studies, your feelings can be expressed again. This technique, which has been used with physics students in the U.S.A. and Australia, allows changes brought about by your course to be identified.

To complete the scale, judge your course on each attribute in turn.

e.g. MODERN 1 2 3 4 5 6 7 OUT OF DATE

If you think that your course is modern, but not extremely so, then ring number 2 or 3 depending upon the degree of your feelings. An extremely out of date course would be rated "7".

Ring number 4 if you think the words are unsuitable or if you can't decide in favour of one extreme or the other.

As usual, when answering attitude scales, work as quickly as you can giving first natural replies.

SATISFYING	1	2	3	4	5	6	7	FRUSTRATING
EARLY THEORIES LINKED TO PRESENT DAY THEORIES	1	2	3	4	5	6	7	PRESENT DAY THEORIES ARE CONSIDERED ONLY
REQUIRES HARD WORK	1	2	3	4	5	6	7	REQUIRES LITTLE EFFORT
INTERESTING	1	2	3	4	5	6	7	DULL
LOATHSOME	1	2	3	4	5	6	7	ENJOYABLE
LOW PRESTIGE	1	2	3	4	5	6	7	HIGH PRESTIGE
PLEASANT	1	2	3	4	5	6	7	UNPLEASANT
SOCIAL IMPLICATIONS NEVER CONSIDERED	1	2	3	4	5	6	7	SOCIAL IMPLICATIONS ALWAYS CONSIDERED
CONTAINS TOO MUCH MATERIAL	1	2	3	4	5	6	7	CONTAINS SUFFICIENT MATERIAL
DOES NOT AFFECT YOUR PERSONAL VIEWS	1	2	3	4	5	6	7	MAKES YOU THINK DEEPLY ABOUT YOUR PERSONAL VIEWS

Continued/-

MATHEMATICAL	1	2	3	4	5	6	7	NON-MATHEMATICAL
BORING	1	2	3	4	5	6	7	EXCITING
MODERN	1	2	3	4	5	6	7	OUT OF DATE
DIFFICULT	1	2	3	4	5	6	7	EASY

SECTION C: HOW THE 'A' LEVEL PHYSICS COURSE IS TAUGHT

Your feelings about the course have most meaning if I know how the course is taught. Accordingly, in this section there are a number of statements that describe aspects of 'A' level physics teaching. Some of the methods you will be familiar with from your own lessons, others you may have only heard about.

Indicate which methods are used in your course by circling the appropriate code number in column 1. In column 2, express your own feelings about each method by circling the appropriate number.

	Column 1 — Method Actually Used			Column 2 — Statement Describes		
	True	False	Some Times	Good Method	Poor Method	Don't Know
1. Teaching is by lectures with experimental demonstrations.	1	2	3	1	2	3
2. Learning is by finding out by oneself after each new topic has been introduced by the teacher.	1	2	3	1	2	3
3. The class works through a textbook.	1	2	3	1	2	3
4. The teacher guides you in your learning, acting as a source of information, asking questions and using experimental demonstrations to help.	1	2	3	1	2	3
5. Part of the course is devoted to an individual student project.	1	2	3	1	2	3
6. Individual homework and practical accounts are assessed and discussed by the teacher.	1	2	3	1	2	3
7. The teacher uses words rather than mathematics in explanations whenever possible.	1	2	3	1	2	3
8. The teaching order appears logical.	1	2	3	1	2	3
9. The teacher anticipates the students' problems and sees the subject from their point of view.	1	2	3	1	2	3

Continued/-

	Column 1 — Method Actually Used			Column 2 — Statement Describes		
	True	False	Some Times	Good Method	Poor Method	Don't Know
10. The teaching style encourages the interest of the student.	1	2	3	1	2	3
11. To help you understand, films, filmstrips and filmloops are used as well as experimental demonstrations.	1	2	3	1	2	3
12. Students' practical work is related to recent teaching lessons.	1	2	3	1	2	3
13. The lessons are planned to make experimental and theory work run smoothly.	1	2	3	1	2	3
14. Visits to outside events are sometimes arranged to broaden your knowledge of physics.	1	2	3	1	2	3
15. The teacher uses lesson material from outside the examination syllabus when it is felt necessary.	1	2	3	1	2	3
16. You are encouraged to work as an individual rather than as part of a large group of four or more.	1	2	3	1	2	3
17. All students make their own notes and records of work covered in lessons.	1	2	3	1	2	3
18. Some students make notes and circulate them to others.	1	2	3	1	2	3
19. Notes are made from dictation by the teacher.	1	2	3	1	2	3
20. Notes are made by copying from the board or overhead projector.	1	2	3	1	2	3
21. Duplicated lesson notes are issued on a short loan.	1	2	3	1	2	3
22. Notes are made by a number of different methods.	1	2	3	1	2	3
23. The teaching relates each new idea to a previously understood one.	1	2	3	1	2	3

Continued/-

	Column 1 — Method Actually Used			Column 2 — Statement Describes		
	True	False	Some Times	Good Method	Poor Method	Don't Know
24. The teaching seems to be most suitable for the most able pupils.	1	2	3	1	2	3
25. Students' practical work occurs in groups of four or more in the normal lessons.	1	2	3	1	2	3
26. Several teachers take the class, each one teaching a different topic.	1	2	3	1	2	3
27. Homework relevant to teaching and practical lessons is set regularly.	1	2	3	1	2	3
28. The special type of individual work for the 'A' level practical exam is introduced into practical lessons towards the end of the course.	1	2	3	1	2	3
29. The teacher encourages discussion and speculation amongst the students.	1	2	3	1	2	3
30. The whole syllabus will not be completely covered, but the topics taught will have been thoroughly treated.	1	2	3	1	2	3
31. Technical terms are used where appropriate, but otherwise the language is everyday English.	1	2	3	1	2	3
32. Practical work is designed to help the student understand the knowledge from theory lessons.	1	2	3	1	2	3
33. Each topic in the course is studied in depth.	1	2	3	1	2	3
34. The teacher covers the syllabus quickly to leave as much time as possible for revision.	1	2	3	1	2	3
35. Individual or small group practical work takes place each week in a separate practical lesson.	1	2	3	1	2	3

Continued/-

	Column 1 — Method Actually Used			Column 2 — Statement Describes		
	True	False	Some Times	Good Method	Poor Method	Don't Know
36. Students are helped and encouraged to revise for the 'A' level exam in a planned way.	1	2	3	1	2	3
37. Each lesson has an introduction, which tells you what the lesson is about, and a conclusion which summarizes the lesson's content.	1	2	3	1	2	3
38. Regular practice to develop a suitable style in answering exam questions occurs in the second year of the course.	1	2	3	1	2	3
39. All exam revision is done from the students own notes.	1	2	3	1	2	3
40. The whole syllabus will be covered but not all the topics will have been thoroughly treated.	1	2	3	1	2	3

SECTION D: ATTITUDES TO STUDY

Achievements in and attitudes towards academic subjects are believed to depend upon the type of thinking students use as they respond to their lessons and plan their study time. In one of the fifth form questionnaires, you will have completed a 'junior' form of a study attitudes scale. Here, a more comprehensive scale of this type has been developed, which will help to clarify the patterns of your responses in all the previous questionnaires.

Please answer every item, trying to avoid the 'not applicable' category if at all possible. As usual, answer quickly and circle the appropriate code number.

	Agree	Disagree	Not Applicable
1. I find it difficult to organise my study time effectively.	1	2	3
2. New topics interest me so much that I spend extra time trying to find out more about them.	1	2	3
3. I chose my present courses to give me a chance of a really good job later.	1	2	3
4. I enjoy competition: I find it stimulating.	1	2	3

Continued/-

	Agree	Disagree	Not Applicable
5. The continual pressure of work - homework, deadlines and competition - often makes me tense and depressed.	1	2	3
6. I like to be told precisley what to do in essays or other assignments.	1	2	3
7. I tend to do less work here than in the fifth form.	1	2	3
8. My habit of putting off work leaves me with far too much to do at the end of term.	1	2	3
9. I spend too long on certain topics because I get very interested and involved in them.	1	2	3
10. My main reason for taking 'A' levels is that it will eventually help me to get a better job.	1	2	3
11. It's important to me to do really well in my courses.	1	2	3
12. A poor first answer in an exam makes me panic.	1	2	3
13. I prefer courses to be clearly structured and highly organised.	1	2	3
14. My main reason for taking 'A' levels is so that I can learn more about the subjects which really interest me.	1	2	3
15. Distractions make it difficult for me to do much effective work in the evenings.	1	2	3
16. I enjoy the challenge of a difficult new topic in lessons.	1	2	3
17. I generally choose courses more from the way they fit in with career plans than from academic interest.	1	2	3
18. Teachers should tell us exactly how they want us to tackle homework and assignments.	1	2	3
19. Worry about an exam or about work that is overdue often prevents me from sleeping.	1	2	3
20. I'm rather slow at starting work in the evenings.	1	2	3
21. I find that studying academic topics can often be really exciting and gripping.	1	2	3
22. I want really good results all round to give me a flying start with the next stage of my education/career.	1	2	3

Continued/-

	Agree	Disagree	Not Applicable
23. I usually plan my week's work in advance, either on paper on in my head.	1	2	3
24. It is important to me to do things better than my friends, if I possibly can.	1	2	3
25. I tend to learn more effectively by studying along my own lines than through set work.	1	2	3
26. I spend a good deal of my spare time in finding out more about interesting topics which have been discussed in classes.	1	2	3
27. I get very anxious about work which is overdue.	1	2	3
28. If conditions aren't right for me to study, I generally manage to do something to change them.	1	2	3
29. In a sense, I suppose I work hard to please my parents rather than myself.	1	2	3
30. I tend to read very little beyond what's required for completing assignments.	1	2	3
31. I certainly want to pass the next set of exams, but it doesn't really matter if I only just scrape through.	1	2	3
32. Having to speak in lessons and tutorials is quite an ordeal for me.	1	2	3
33. I find academic topics so interesting. I should like to continue with them after I finish this course.	1	2	3
34. My parents expect me to do well and I feel it is up to me not to let them down.	1	2	3
35. I always seem to be late for something or someone.	1	2	3
36. I try to keep up with the suggested reading that goes with the lessons.	1	2	3
37. I'd much prefer more time studying on my own, outside time-tabled classes.	1	2	3
38. I hate admitting defeat, even in trivial matters.	1	2	3
39. I often find that my mind goes blank when I'm faced with a particularly difficult question.	1	2	3
40. I generally go over my lesson notes not long afterwards to make sure they make sense and nothing important has been left out.	1	2	3

/cont

SECTION E

I should like to take this opportunity to thank you for your invaluable assistance in the attitude survey. Fifth form and lower sixth data has been analysed but, of course, the upper sixth results will not be available for some time yet. If you wish to receive a brief report of the survey, plus your own attitude scores, early in 1981, please indicate an address to which these can be sent.

Name .....

Address .....

.....

.....

Please use the rest of this space to expand on your responses to this questionnaire if you wish.

APPENDIX 5.1.1.

THE RESEARCH VARIABLES AND CODE NAMES

The variables in this alphabetical list have been drawn from tables 5.1.1 , 7.9.1 , 7.11.1 and 9.5.2.

Variable	Fifth-form(F) Sixth-form(S) or teacher(T) variable	Section reference	Code name
Academic achievement motivation	S	5.10	
A-level physics examination motivation	S	7.10	
A-level physics grade	S	5.1	
A-level score	S	5.1	
Choosing A-level physics	F	7.11	PHYSCHOICE
Classroom match	F	7.4	MATCH
Classroom match	S	9.4	
Committed physicist	F	5.2	
Competent exam-oriented teaching	T	5.12	TA2
Disciplined, pupil relations	T	5.12	TA7
Easiness (composite)	S	5.9	
Enjoyment	F	5.2	
Enjoyment (composite)	S	5.9	
Entering the sixth-form	F,S	7.11	ALEVEL
Examination	F	7.11	EXAM
Examination preparation match	F	7.8	
Extraversion	F	7.3	EXTRAV
Extrinsic motivation	S	5.10	
Fear-of-failure	S	5.10	
Historical (course)	S	5.9	
Interesting teaching style	F	5.2	ITS
Interest-in-science teaching	T	5.12	TA4
Intrinsic motivation	S	5.10	
Learning-by-experiment	F	5.2	LBE
Learning theory teaching	T	5.12	TA5
Lie	F	7.3	
Modern (course)	S	5.9	
Motivation	F	5.3	MOT
Motivation in physics	F	5.3	PHYSMOT
Neuroticism	F	7.3	NEUROT
Notemaking/syllabus coverage (preference)	S	5.11	NOTESYL (P)
Notemaking/syllabus coverage (experience)	S	5.11	NOTESYL (E)
Number of O-level passes	F	7.8	
O-level physics exam. motivation	F	7.10	IMPORT
O-level physics grade	F	5.1	PERFORM
Organised study habits	S	5.10	
Philosophical (co u rse)	S	5.9	
Physics identification	F	5.2	PHYSID
Physics satisfaction	F	5.5	SAT
Physics slog	F	5.5	SLOG
Planned, experimental lab. teaching	T	5.12	TA6
Planned, 'method' teaching (preference)	S	5.11	PLANMETH (P)

Appendix 5.1.1. (continued)

Variable	Fifth-form(F) Sixth-form(S) or teacher(T) variable	Section reference	Code name
Planned, 'method' teaching (experienced)	S	5.11	PLANMETH (E)
Prestigious (course)	S	5.9	
Problem solving	F	5.2	PROBSOLV
Processes of science teaching	T	5.12	TA1
Pupil-initiative teaching (preference)	S	5.11	PUPINIT (P)
Pupil-initiative teaching (experienced)	S	5.11	PUPINIT (E)
Pupil-oriented teaching	T	5.12	TA3
Sex	F,S	7.11	
Social implications (course)	S	5.9	
Syllabus-boundness	S	5.10	
Study habits	F	5.3	STUDYHAB
Study habits in physics	F	5.3	PHYSHAB
Study orientation	F	5.3	
Varied/teaching-for-understanding (preference)	F	5.4	VARUND (P)
Varied/teaching-for-understanding (experienced)	F	5.4	VARUND (E)
Varied/teaching-for-understanding (mismatch)	F	7.10	VARUND (M)

APPENDIX 5.2.1A

SCHOOLS COUNCIL SCIENCE OPINION POLL (Galton et al., 1975)

THE FIVE SUB-SCALES

Agreement or disagreement with the item is expressed on a five-point scale and scored from one to five so that the most positive attitude received the highest score.

Sub-scale (i) : the fun-factor (Reliability 0.82)

1. I enjoy physics lessons more than other lessons.
2. Two hours of work in a physics laboratory are more fun than a week of work in other subjects.
4. Physics lessons are a waste of time
6. I do well in physics.
11. I look forward to physics lessons.
12. I would enjoy school if there were no physics lessons.
17. I think the school should have more physics periods each week.

Sub-scale (ii) : the practical investigators (Reliability 0.79)

14. Physics is just a load of technical terms which are hard to remember.
18. I find physics difficult to understand.
23. I want to learn for myself why physics experiments turn out the way they do.
24. It is fun to guess the outcome of physics experiments.
26. Working in the physics laboratory is fun.
27. Trying to solve a physics problem is interesting.
28. I would rather work out how to do a physics experiment than be told.
29. I enjoy discussing physics problems raised in class with my friends.

Sub-scale (iii) : the committed physicists (Reliability 0.81)

5. I like to talk with people about new discoveries in physics.

7. I would like to be given a physics book or a piece of physics equipment.

9. I would rather be a member of a pop-group than a member of a physics research team.

13. I should like to belong (or I like belonging) to a physics club.

15. I would like to work with people who make discoveries in physics.

16. I do physics experiments in my spare time.

Sub-scale (iv) : the concrete physicists (Reliability 0.67)

3. You can learn more from a physics text-book than by doing experiments.

21. I would much rather do experiments in physics than read about them.

22. I would rather do a physics experiment than listen to a lecture on the same topic.

25. It is the experiments in physics that make me understand it.

30. Physics experiments demonstrated by teachers are more interesting than ones you do yourself.

Sub-scale (v) : the career physicists (Reliability 0.80)

8. My mother wants me to be a physicist.

10. I would specialise in physics if I had the chance.

19. My father wants me to be a physicist.

20. I should like to become a physicist.

The internal reliabilities of the sub-scales are given by the Cronbach Alpha coefficients.

APPENDIX 5.2.1B

THE ATTITUDE QUESTIONNAIRE

ATITUDES TO SCHOOL PHYSICS

The purpose of this section is to find out what you think about school physics. It contains a number of statements about physics. I want to find out how you feel about them and whether you agree with them or not.
A sample statement to show you how to mark your answers now follows:-

'I would rather read a book than watch television'

1	2	3	(4)	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

The statement is followed by five numbered alternatives which can indicate your measure of agreement or disagreement. If you disagree with the statement, but not strongly, then alternative 4 would be ringed as shown.
Please read the alternatives carefully as well as the statements before deciding upon your response.

1. I enjoy physics lessons more than other lessons.

1	2	3	4	5
Much	Slightly more	About the same	Less	Much less

2. Two hours of work in a physics laboratory are more fun than a week of work in other subjects.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

3. Physics lessons are a waste of time

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

4. I like to talk with people about new discoveries in physics.

1	2	3	4	5
Very much	Much	Some	A little	Not at all

5. Physics lessons give me a feelilng of satisfaction.

1	2	3	4	5
Always	Most of the time	Sometimes	Seldom	Never

6. I would like to be given a physics book or a piece of physics equipment.

1	2	3	4	5
Very much	I would be pleased	It would be all right	I don't think I would like it	Not in the least

7. I would rather be a member of a 'pop group' than a member of a physics research team.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

8. I would specialise in physics if I had the chance.

1	2	3	4	5
Definitely yes	Very likely	Maybe	Not likely	Never

9. I look forward to physics lessons.

1	2	3	4	5
Always	Most of the time	Sometimes	Seldom	Never

10. I would enjoy school more if there were no physics lessons.

1	2	3	4	5
Much more	Slightly more	Just as much	Less	A great deal less

11. I should like to belong (or I like belonging) to a physics club.

1	2	3	4	5
Very much	Some	A little	Not sure	Not at all

12. Physics is just a load of technical terms.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

13. I would like to work with people who make discoveries in physics.

1	2	3	4	5
All the time	Most of the time	Occasionally	Seldom	Never

14. I do physics experiments in my spare time about:

1	2	3	4	5
once a week	once a month	once every 3 months	once a year	never

15. I think the school should have more physics periods each week.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

16. I find physics difficult to understand

1	2	3	4	5
Extremely difficult	Difficult	In-between	Easy	Very easy

17. I would much rather do experiments in physics than read about them.

1	2	3	4	5
Always	Most of the time	Sometimes	Seldom	Never

18. I would rather do a physics experiment than listen to a lectuer on the same topic.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

19. I want to learn for myself why physics experiments turn out the way they do.

1	2	3	4	5
Very much	Much	A little	Not sure	Not at all

20. It is fun to guess the outcome of physics experiments.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

21. It is the experiments in physics that make me understand it.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

22. I am happy when working with equipment in the physics laboratory.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

23. Trying to solve a physics problem is interesting.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

24. I would rather work out how to do a physics experiment by myself than be told.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

25. I enjoy discussing physics problems raised in class with my friends.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

26. You can learn more from a physics text book than by doing experiments.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

27. Physics experiments demonstrated by teachers are more interesting than the ones you do yourself.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

28. The methods used by the physics teacher are interesting in themselves.

1	2	3	4	5
Strongly agree	Agree	Not sure	Disagree	Strongly disagree

The most favourable attitude is indicated by code number 1 for all items <u>except</u> items 3, 7, 10, 12, 16, 26 or 27 when it is replaced by code number 5.

APPENDIX 5.3.1

SECTION B : STUDY ATTITUDES

The following statements cover a wide range of students comments on their general attitudes to studying at school and at home. The statements deliberately follow no logical order. Please work quickly, indicating your agreement or disagreement by circling either "A" or "D". It is most important that you make a definite response to every statement, even though your feelings may be rather indefinite.

1. Background music helps me to study more effectively. A D

2. It is most unusual for me to be late handing in work. A D

3. I try to put off any work that I have to do for as long as possible. A D

4. I enjoy the challenge of a difficult new topic in lessons. A D

5. I find it rather difficult to organise my study time when I am at home. A D

6. I usually tackle the easy things first and leave the more difficult ones until the end. A D

7. I seem to have plenty of free time during the week. A D

8. I enjoy collecting things such as stamps, minerals, plants, etc. A D

9. I don't find much time to study during the holidays. A D

10. It is important to me that I do better than other students, if I can. A D

11. My lesson notes are often difficult to follow afterwards. A D

12. I sometimes wish I could leave school and start work now. A D

13. I usually plan my week's work in advance, if I can, either on paper or in my head. A D

14. I get disheartened and give up easily if something is too difficult for me. A D

15. I find it easy to pick out the main points of a lesson without emphasis by the teacher. A D

16. I can't see any relevance in the work we do here. A D

cont./

17. I need to be in the right mood before I can study effectively. A D

18. I'm a pretty average student: I'll never be particularly good, so there is no point in striving to be something I am not. A D

19. I find it difficult to keep awake during some lessons. A D

20. It is important for me to do very well in my studies. A D

21. There seems to be little point in following up the lesson topics in reference and text-books. A D

22. I hate admitting defeat, even in trivial matters. A D

23. I don't often join in discussion lessons: I prefer to listen. A D

24. I usually hurry all my homework: there seems little point in spending more time. A D

25. I'm rather slow at starting work in the evening. A D

26. My friends always seem to be able to do things better than me. A D

27. It's not often that I can stick at work for more than an hour at a time. A D

28. I like working to a set plan when writing an essay rather than letting my ideas flow out freely. A D

29. I am determined to do my best in all subjects, even in those that least interest me. A D

APPENDIX 5.3.2A

FACTOR STRUCTURE MATRIX OF CORRELATION COEFFICIENTS

	Item	Factor I Study methods (S)	Factor II Academic motivation (MA)	Factor III Self-confident motivation (MS)
1.	Background music helps me to study more effectively	172	044	-016
2.	It is most usual for me to be late handing in work.	313*	118	-137
3.	I try to put off any work that I have to do for as long as possible.	516*	181	-165
4.	I enjoy the challenge of a difficult new topic in lessons.	166	259	-298*
5.	I find it rather difficult to organise my study time when I am at home.	477*	038	-267
6.	I usually tackle the easy things first and leave the more difficult ones to the end.	146	042	-238*
7.	I seem to have plenty of free time during the week.	165	186	-055
8.	I enjoy collecting things such as stamps, minerals plants etc.	143	101	-006
9.	I don't find much time to study during the holidays.	364*	125	-091
10.	It is important to me that I do better than other students, if I can.	075	381*	-079
11.	My lesson notes are difficult to follow afterwards.	296	184	-327*
12.	I sometimes wish I could leave and start work now.	325	307*	-304
13.	I usually plan my week's work in advance, if I can, either on paper or in my head.	256*	121	-017
14.	I get disheartened and give up easily if something is too difficult for me.	310	216	-548*
15.	I find it easy to pick out the main points of a lesson without emphasis by the teacher.	111	105	-429*
16.	I can't see any relevance in the work we do here.	252	333*	-327
17.	I need to be in the right mood before I can study effectively.	278*	-061	-222
18.	I'm a pretty average student : I'll never be particularly good, so there is no point in striving to be something I am not.	295	420	-464*
19.	I find it difficult to keep awake during some lessons.	336*	232	-188
20.	It is important for me to do very well in my studies	226	464*	-087
21.	There seems to be little point in following up the lesson topics in reference and text-books	315	361*	-276
22.	I hate admitting defeat, even in trivial matters.	-016	220*	-017
23.	I don't often join in discussion lessons: I prefer to listen.	-004	024	-334*
24.	I usually hurry all my homework: there seems little point in spending more time.	458*	311	-299
25.	I'm rather slow at starting work in the evening.	464*	-069	-210
26.	My friends always seem to be able to do things better than me.	187	025	-487*
27.	It's not often that I can stick at work for more than an hour at a time.	500*	150	-335
28.	I like working to a set plan when writing an essay rather than letting my ideas flow out freely.	122	039	113
29.	I am determined to do my best in all subjects, even in those that least interest me	315	372*	-071

Decimal points are omitted . An asterisk indicates an item which is allocated to a particular factor.

APPENDIX 5.3.2B

ITEM CORRELATIONS WITH SUB-SCALE SCORES

Item	Correlation with study methods S	Item	Correlation with academic motivation MA	Item	Correlation with self-confident motivation MB
2*	0.44	10	0.53	4	0.49
3	0.57	12	0.55	6	0.41
5	0.59	16	0.49	11*	0.46
9	0.48	20	0.51	14	0.63
13	0.35	21*	0.54	15*	0.55
17	0.39	22	0.42	18	0.57
19	0.47	29	0.51	23*	0.46
24*	0.54			26	0.56
25	0.55				
27*	0.58				

Item	Correlation with motivation M
4	0.45
6	0.33
10	0.37
11*	0.43
12	0.48
14	0.58
15*	0.46
16	0.47
18	0.60
20	0.37
21*	0.46
22	0.25
23*	0.36
26	0.46
29	0.36

*Indicates an item shift from the 'Rowntree' scale

On the combined motivation scale, M, item 22 is retained because of high conceptual rather than statistical validity.

APPENDIX 5.3.3.

MOTIVATION RATING SCALE

Rating	Judged according to this criterion
5	Tries very hard all the time to be successful in his studies.
4	Occasionally quite determined and, in general, makes above average efforts.
3	Shows an average effort all the time.
2	Makes some intermittent efforts but generally below average.
1	Shows no determination and interest whatsoever in school subjects.

APPENDIX 5.3.4A

PHYSICS STUDY HABITS

Responses to the statement:

> My study habits in physics, compared with those in other subjects, are

1 - much less organised 2 - a little less organised 3 - no different
4 - a little more organised 5 - much more organised

weighted the study methods scale score S according to the following formulae:

Statement response code	Weighted study methods calculated from
1	S/3
2	2S/3
3	S
4	2S/3+10/3
5	S/3+20/3

This procedure ensured that the weighted scores would not exceed the maximum score of 10 on scale S while giving a weighted score of exactly S when the response is 'no different'.

APPENDIX 5.3.4B

PHYSICS MOTIVATION

Responses to the statement:

Comparing my determination to do well in physics with that in other subjects, in physics

1. I am much less determined.
2. I am a little less determined.
3. there is no difference.
4. I am a little more determined
5. I am much more determined.

weighted the motivation scale score M according to the following formulae:

Statement response code	Weighted motivation calculated from
1	M/3
2	2M/3
3	M
4	2M/3 + 5
5	M/3 + 10

This procedure ensured that the weighted scores would not exceed the maximum score of 15 on scale M while giving a weighted score of exactly M when the response is 'no difference'.

APPENDIX 5.4.1.

THE 19-ITEM CHECK-LIST ON THE QUESTIONNAIRE

SECTION C: HOW O-LEVEL PHYSICS IS TAUGHT

The way you react to physics depends in part on the way the subject is taught, so I have written out in this section a number of statements that describe aspects of O-level physics teaching.

During the year, your teacher is likely to use most of the methods described. To tell me which methods are most frequently used in your lessons, please ring the appropriate code number in column 1. In column 2 you have the chance to indicate which of all the methods seem to you to be good ones, but don't be afraid to use the "Don't know" response.

		COLUMN 1			COLUMN 2		
		METHOD			STATEMENT DESCRIBES		
		OFTEN USED	SELDOM USED	DON'T KNOW	A GOOD METHOD	A POOR METHOD	DON'T KNOW
1	The teacher talks or writes and shows some experiments	1	2	3	1	2	3
2	The teacher asks us questions as we do some theory or practical work, gives us notes, and generally guides us in the right direction	1	2	3	1	2	3
3	The teacher discusses each new topic with us, then we investigate this by ourselves and draw our own conclusions without further assistance	1	2	3	1	2	3
4	The teacher's methods are varied such as allowing us to experiment, showing films and filmstrips, discussing and explaining with a single demonstration experiment	1	2	3	1	2	3
5	The lessons are planned to make experimental and theory work run smoothly	1	2	3	1	2	3
6	Homework set is linked with the lesson	1	2	3	1	2	3
7	The teaching seems to be most suitable for the most able pupils	1	2	3	1	2	3
8	The teacher uses words rather than mathematical formulae whenever possible	1	2	3	1	2	3
9	We work through a text-book	1	2	3	1	2	3
10	Each topic we study is linked to another one we have previously understood	1	2	3	1	2	3
12	Duplicated notes are issued at the end of each lesson	1	2	3	1	2	3
13	We make our own notes from textbooks or work sheets	1	2	3	1	2	3
14	Groups of pupils make notes on different topics and these notes are circulated around the class	1	2	3	1	2	3
15	Notes are made from dictation by the teacher	1	2	3	1	2	3
16	Notes are made by copying from the board or overhead projector	1	2	3	1	2	3
17	Notes are made by a number of different methods	1	2	3	1	2	3
18	We work together in groups to do investigations and experiments	1	2	3	1	2	3
19	We work individually through worksheets	1	2	3	1	2	3

APPENDIX 5.4.2.

THE RESPONSE DISTRIBUTIONS FOR THE 19 CHECK-LIST ITEMS

ITEM 1 THE TEACHER TALKS OR WRITES AND SHOWS SOME EXPERIMENTS

	Score		
	1	2	3
Intrinsic worth	108	144	489
Use	114	19	608

Matched-pairs Wilcoxon test, Z=3.26, significant at $\ll$1%.

While the teacher talking, showing experiments and writing is a desirable activity, a significant number of pupils are not certain that this, by itself, is a good method.

ITEM 2 THE TEACHER ASKS US QUESTIONS AS WE DO SOME THEORY OR PRACTICAL WORK, GIVES US NOTES, AND GENERALLY GUIDES US IN THE RIGHT DIRECTION

	Score		
	1	2	3
Intrinsic worth	85	158	498
Use	235	60	446

Matched pairs Wilcoxon test, Z=7.37, significant at $\ll$1%

This 'benevolent' teaching style is highly rated by 67.2% of pupils but a significant proportion (31.7%) report that they do not receive such teaching.

ITEM 3 THE TEACHER DISCUSSES EACH NEW TOPIC WITH US, THEN WE INVESTIGATE THIS BY OURSELVES AND DRAW OUR OWN CONCLUSIONS WITHOUT FURTHER ASSISTANCE

	Score		
	1	2	3
Intrinsic worth	380	174	187
Use	611	63	67

Matched-pairs Wilcoxon test, Z=11.26, significant at $\ll$ 1%

This is a poorly rated method with only 25.2% rating it favourably, and in reality only 9% experience such a method in their classroom.

ITEM 4 THE TEACHER'S METHODS ARE VARIED SUCH AS ALLOWING US TO EXPERIMENT, SHOWING FILMS AND FILMSTRIPS, DISCUSSING AND EXPLAINING WITH A SINGLE DEMONSTRATION EXPERIMENT

	Score		
	1	2	3
Intrinsic worth	88	189	464
Use	494	82	165

Matched-pairs Wilcoxon test, Z=17.37, significant at $\ll 1\%$

This desirable teaching style (62.6% rate it favourably) is only rarely met with in the laboratory. Just 22.3% say they experience this method.

ITEM 5 THE LESSONS ARE PLANNED TO MAKE EXPERIMENTAL AND THEORY WORK RUN SMOOTHLY

	Score		
	1	2	3
Intrinsic worth	76	182	483
Use	220	198	323

Matched-pairs Wilcoxon test, Z=10.34, significant at $\ll 1\%$

Significantly fewer report that actual lessons are smooth running.

ITEM 6 HOMEWORK SET IS LINKED WITH THE LESSON

	Score		
	1	2	3
Intrinsic worth	81	50	610
Use	98	38	605

Matched-pairs Wilcoxon test, Z=1.03, not significant

The homework requirement of the pupils is closely matched with what is received.

ITEM 7 THE TEACHING SEEMS TO BE MOST SUITABLE FOR THE MOST ABLE PUPILS

	Score		
	1	2	3
Intrinsic worth	347	243	151
Use	167	233	341

Matched-pairs Wilcoxon test, Z=11.28, significant at $\ll$1%

There is an almost complete reversal on the two scales for this statement. Teaching directed towards the most able is rejected by a ratio of more than two to one, but almost half of the pupils say that this is the type of teaching they get.

ITEM 8 THE TEACHER USES WORDS RATHER THAN MATHEMATICAL FORMULAE WHENEVER POSSIBLE

	Score		
	1	2	3
Intrinsic worth	166	195	380
Use	331	135	275

Matched-pairs Wilcoxon test, Z=9.23, significant at $\ll$1%

A majority of pupils, 51.3%, rate verbal learning favourably but only 37.1% say that this is what they receive.

ITEM 9 WE WORK THROUGH A TEXT-BOOK

	Score		
	1	2	3
Intrinsic worth	354	163	224
Use	435	45	261

Matched-pairs Wilcoxon test, Z=1.05, not significant

Text-books are in minority use (35.2%) almost half the pupils are against a rigid text-book method.

ITEM 10 EACH TOPIC WE STUDY IS LINKED TO ANOTHER ONE WE HAVE PREVIOUSLY UNDERSTOOD

	Score		
	1	2	3
Intrinsic worth	64	147	530
Use	303	129	309

Matched-pairs Wilcoxon test, Z=14.06, significant at $\ll$ 1%

This 'learning-by-understanding' method is highly rated (71.5%) but in the classroom it occurs in only a minority of cases (41.7%).

ITEM 11 THE TEACHER TRIES TO GET US TO UNDERSTAND IDEAS BY EXPLAINING IN SIMPLE TERMS

	Score		
	1	2	3
Intrinsic worth	50	80	611
Use	209	69	463

Matched-pairs Wilcoxon test, Z=11.26, significant at $\ll$ 1%

'Simple explanation' methods are popular, as expected (82.5%). These methods are adopted in the majority of classes but 28.2% report otherwise

ITEM 12 DUPLICATED NOTES ARE ISSUED AT THE END OF EACH LESSON

	Score		
	1	2	3
Intrinsic worth	288	154	299
Use	670	39	32

Matched-pairs Wilcoxon test, Z=16.56, significant at $\ll$ 1%

There is an almost equal split in feeling, here, on the subject of duplicated note issue. The method is very rarely used, although 40% are in favour.

ITEM 13 WE MAKE OUR OWN NOTES FROM TEXTBOOKS OR WORK SHEETS

	Score		
	1	2	3
Intrinsic worth	344	154	243
Use	406	30	305

Matched-pairs Wilcoxon test, Z=0.58, not significant

Although this 'own notes' method is reasonably common and finds favour with 32.8% of the pupils, there is some uncertainty as to its worth.

ITEM 14 GROUPS OF PUPILS MAKE NOTES ON DIFFERENT TOPICS AND THESE NOTES ARE CIRCULATED AROUND THE CLASS

	Score		
	1	2	3
Intrinsic worth	489	189	63
Use	658	67	16

Matched-pairs Wilcoxon test, Z=9.78, significant at $\ll$ 1%

This is a very rarely used method and most unpopular with 66% against its use. A significant proportion (25.5%) are uncertain however.

ITEM 15 NOTES ARE MADE FROM DICTATION BY THE TEACHER

	Score		
	1	2	3
Intrinsic worth	283	140	318
Use	321	32	388

Matched-pairs Wilcoxon test, Z=1.32, not significant

A majority (52.4%) report that this method is used but only 42.9% are sure that it is a good method.

ITEM 16 NOTES ARE MADE BY COPYING FROM THE BOARD OR OVERHEAD PROJECTOR

	Score		
	1	2	3
Intrinsic worth	205	180	356
Use	279	23	439

Matched-pairs Wilcoxon text, Z=0.40, not significant

Again, a majority (59.2%) report that a method is used, but about 11% less are sure of its worth.

ITEM 17 NOTES ARE MADE BY A NUMBER OF DIFFERENT METHODS

	Score		
	1	2	3
Intrinsic worth	163	264	314
Use	332	133	276

Matched-pairs Wilcoxon test, Z=7.11, significant at $\ll$ 1%

The varied notemaking method is used relatively less than the pupils demand

ITEM 18 WE WORK TOGETHER IN GROUPS TO DO INVESTIGATIONS AND EXPERIMENTS

	Score		
	1	2	3
Intrinsic worth	58	80	603
Use	195	29	517

Matched-pairs Wilcoxon test, Z=8.38, significant at $\ll$ 1%

Pupil experimentation, although very common, does not completely satisfy the pupils' desires.

ITEM 19 WE WORK INDIVIDUALLY THROUGH WORKSHEETS

	Score		
	1	2	3
Intrinsic worth	377	184	180
Use	604	61	76

Matched-pairs Wilcoxon test, Z=11.07, significant at $\ll$ 1%.

This is an unpopular method with only 24% of pupils favouring it. Its use is very restricted (10%)

APPENDIX 5.4.3A

MODIFIED FORM OF TEACHING OBSERVATION SCHEDULE

a) TEACHER ASKS QUESTIONS WHICH ARE ANSWERED BY
   1. recall of previously learnt knowledge
   2. description of direct observation
   3. applying previously learnt knowledge to a new theoretical situation
   4. applying previously learnt knowledge to a new practical situation

b) TEACHER MAKES STATEMENTS OF
   1. fact (lower-order knowledge and thought)
   2. an observational nature
   3. theory and hypothesis in a new situation (higher-order skills)
   4. experimental procedure in a new situation

c) TEACHER DIRECTS PUPILS TO SOURCES OF INFORMATION FOR THE PURPOSE OF
   1. acquiring factual knowledge or solving lower-order problems
   2. acquiring observational evidence
   3. constructing theories and hypotheses or solving higher-order problems
   4. considering experimental procedure

d) PUPILS SEEK INFORMATION OR CONSULT FOR THE PURPOSE OF
   1. acquiring factual knowledge or solving lower-order problems
   2. acquiring or confirming observational evidence
   3. constructing theories and hypotheses or solving higher-order problems
   4. discussing experimental procedure

e) PUPILS REFER TO TEACHERS FOR THE PURPOSE OF
   1. acquiring factual knowledge or solving lower-order problems
   2. acquiring or confirming observational evidence
   3. constructing theories and hypotheses or solving higher-order problems
   4. seeking guidance on experimental procedure

f) INFORMATION PRESENTED BY
   1. teacher statement (blackboard or ohp.static mode)
   2. teacher experimental demonstration
   3. pupil experiment
   4. textbook or worksheet
   5. visual device (film, television, filmstrip, filmloop, ohp.dynamic mode)

g) LESSON CONTENT RECORDED BY
   1. teacher dictation
   2. copying from board or ohp.
   3. copying from textbook
   4. copying from worksheets
   5. issue of duplicated notes
   6. composing own notes

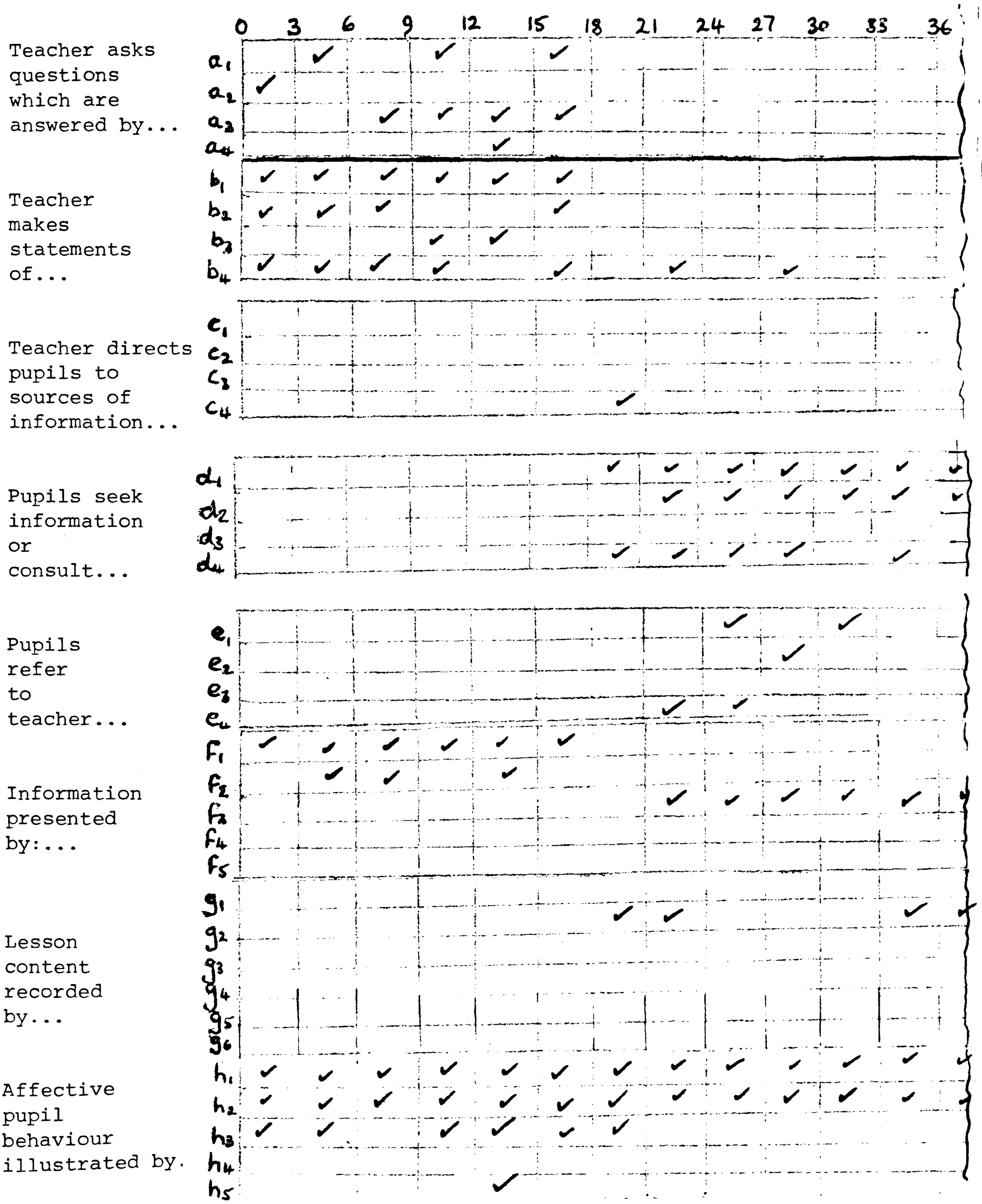
h) AFFECTIVE PUPIL BEHAVIOUR ILLUSTRATED BY

1. willingness to take part passively in lesson
2. controlled attention
3. response to questions when asked
4. willingness to respond to questions without being asked
5. satisfaction in response to questions or course of action

APPENDIX 5.4.3B

AN ACTUAL CLASSROOM RECORD

MODIFIED FORM OF SCIENCE TEACHING OBSERVATION SCHEDULE



APPENDIX 5.4.4. THE FACTOR STRUCTURE MATRIX OF CORRELATION COEFFICIENTS

	ITEM	FACTOR I Teacher-centred, notemaking	FACTOR II Varied, teaching for understanding	FACTOR III Pupil centred, textbook teaching
1	The teacher talks or writes and shows some experiments	-350*	306*	044
2	The teacher asks us questions as we do some theory or practical work, gives us notes, and generally guides us in the right direction	-165	320*	046
3	The teacher discusses each new topic with us, then we investigate this by ourselves and draw our own conclusions without further assistance	339*	103	214*
4	The teacher's methods are varied such as allowing us to experiment, showing films and filmstrips, discussing and explaining with a single demonstration experiment	179*	210*	076
5	The lessons are planned to make experimental and theory work run smoothly	-014	323*	037
6	Homework set is linked with the lesson	-098	432*	142
7	The teaching seems to be most suitable for the most able pupils	-087	022	186*
8	The teacher uses words rather than mathematical formulae whenever possible	-078	286*	-024
9	We work through a text-book	-131	-031	352*
10	Each topic we study is linked to another one we have previously understood	003	363*	-020
11	The teacher tries to get us to understand ideas by explaining in simple terms	-112	444*	178
12	Duplicated notes are issued at the end of each lesson	046	063	224*
13	We make our own notes from text-books or work sheets	048	091	294*
14	Groups of pupils make notes on different topics and these notes are circulated around the class	341*	-146	205*
15	Notes are made from dictation by the teacher	-338*	038	151
16	Notes are made by copying from the board or overhead projector	-306*	044	072
17	Notes are made by a number of different methods	170	337*	051
18	We work together in groups to do investigations and experiments	072	140*	016
19	We work individually through worksheets	060	023	392*

Decimal points are omitted

An asterisk indicates an item which is allocated to a particular factor

APPENDIX 5.5.1.

THE ATTITUDE GRID

In the table below there are 9 possible school subjects. Column A contains 6 possible ways of describing these subjects. Column B gives 6 opposite ways of describing the subjects, for example 'EASY' in Column A and 'DIFFICULT' in Column B. For each of the subjects that you are studying, write 'A' or 'B' depending upon which best expresses your feelings about that subject. If neither 'A' nor 'B' seem suitable, write 'X'. For any subject you are not studying, leave the subject column blank. The first line of the table is just an example.

A	FRENCH	PHYSICS	GEOGRAPHY	BIOLOGY	ENGLISH LITERATURE	CHEMISTRY	MATHS	HISTORY	ENGLISH LANGUAGE	B
SCIENTIFIC	B	A		A	B	A	X	B	B	NOT SCIENTIFIC
DULL										INTERESTING
CONTAINS SUFFICIENT MATERIAL										CONTAINS TOO MUCH MATERIAL
EASY										DIFFICULT
EXCITING										BORING
OUT OF DATE										MODERN
HIGH PRESTIGE										LOW PRESTIGE

APPENDIX 5.5.2.

TEST/RE-TEST RELIABILITY OF THE 'TOO MUCH MATERIAL' SCALE

CONTAINS TOO MUCH MATERIAL (B)			
Test		Re-test	
Subject	z-score	Subject	z-score
History	2.29	Physics	3.62
Biology	- 2.91	History	2.52
Geography	- 3.05	Biology	2.24
English literature	- 3.32	English literature	- 2.71
Chemistry	- 3.43	Geography	- 3.05
Physics	- 3.47	Chemistry	- 3.09
French	- 4.22	French	- 3.57
English language	- 4.37	English language	- 4.67
Mathematics	- 4.82	Mathematics	- 4.82
CONTAINS SUFFICIENT MATERIAL (A)			

The correlation between the two rank orders is 0.73.

APPENDIX 5.6.1. CHOOSING A-LEVEL SUBJECTS

This is the relevant section of the questionnaire which provided data for Sections 4.6. and 7.6. References to other sections have been allowed to remain.

SECTION B: PHYSICS AND OTHER SUBJECTS

This section is to find out which subjects you are studying and how you feel about them.

1 SUBJECTS BEING STUDIED AT O-LEVEL OR C.S.E.

2. THE THREE SUBJECTS BEING STUDIED THAT YOU MOST ENJOY, IN ORDER

Imagine that it is now September and you have done reasonably well in your examinations with a number of passes, including physics.

WOULD YOU THEN GO ON TO STUDY ONE OR MORE A-LEVEL SUBJECTS?

YES OR NO ☐

If your answer is YES, please continue with Section C.
If your answer is NO, but you intend to continue with your education at school/college, please go on to SECTION E.
If your answer is NO, and you do not intend to remain at school/college, please go on to SECTION F.

SECTION C: CHOOSING A-LEVEL SUBJECTS

Your A-level choices may or may not include physics but the reasons for your decision are most important for this survey. In this and the following sections, I should like to find out what these reasons might be and what A-level subjects you might choose.

1. IF YOU HAD A FREE CHOICE AND DID NOT HAVE TO CONSIDER UNIVERSITY OR CAREER REQUIREMENTS, WHICH A-LEVEL SUBJECTS WOULD YOU CHOOSE (IN ORDER OF PREFERENCE)?

2. IN PRACTICE, CAREER REQUIREMENTS MIGHT LIMIT OR DECIDE YOUR CHOICE, SO WHICH A-LEVEL SUBJECTS ARE YOU MOST LIKELY TO CHOOSE?

APPENDIX 5.8.1.

THE EXAMINATION PREPARATION CHECK-LIST

SECTION E: O-LEVEL PHYSICS REVISION

When you expressed your views last year on how O-level physics was taught, it was not sensible to include questions about revision as the examination was, at that time, still several months away. To complete the full description of the O-level course could you mark the statements below as you did before in Unit 1. Column 1 allows you to say whether the revision method was used or not, and Column 2 gives you the chance to say whether you think the method is a good one. Don't be afraid to use the 'Dcn't know' response.

Answer by ringing the appropriate code number.

	Column 1			Column 2		
	Method actually used			Statement describes		
	True	False	Don't know	A good method	A poor method	Don't know
1. We had regular practice in answering O-level examination questions	1	2	3	1	2	3
2. A revision plan was followed by the class in the time before the examination	1	2	3	1	2	3
3. Examination revision was done by using the student's own notes on the course	1	2	3	1	2	3
4. The topics covered in the O-level course were thoroughly treated	1	2	3	1	2	3
5. The O-level syllabus was completely covered	1	2	3	1	2	3
6. All O-level topics covered in the course were revised for the examination	1	2	3	1	2	3
7. The topics covered in the O-level course were restricted to those thought essential for an examination pass	1	2	3	1	2	3

APPENDIX 5.8.2.

RESPONSE DISTRIBUTIONS FOR THE EXAMINATION PREPARATION ITEMS

ITEM 1 WE HAD REGULAR PRACTICE IN ANSWERING O-LEVEL EXAMINATION QUESTIONS

	Score		
	1	2	3
Intrinsic worth	13	12	261
Use	32	12	242

Matched pairs Wilcoxon test, Z = 3.90, significant at << 1%.

This highly popular method (91% rating) is followed by the large majority (85%).

ITEM 2 A REVISION PLAN WAS FOLLOWED BY THE CLASS IN THE TIME BEFORE THE EXAMINATION

	Score		
	1	2	3
Intrinsic worth	30	75	181
Use	115	43	128

Matched pairs Wilcoxon text, Z = 7.58, significant at << 1%.

This is a desirable method for most (63%) but only 45% experience this approach.

ITEM 3 EXAMINATION REVISION WAS DONE BY USING THE STUDENT'S OWN NOTES ON THE COURSE

	Score		
	1	2	3
Intrinsic worth	45	107	134
Use	44	22	220

Matched pairs Wilcoxon test, Z = 5.03, significant at << 1%

Just 47% think this is a good method, but 77% report its use.

ITEM 4 THE TOPICS COVERED IN THE O-LEVEL COURSE WERE THOROUGHLY TREATED

	Score		
	1	2	3
Intrinsic worth	48	68	170
Use	91	80	115

Matched pairs Wilcoxon test, Z = 6.45, significant at << 1%

A majority of 59% desire this approach, but only 40% experience it in practice.

ITEM 5 THE O-LEVEL SYLLABUS WAS COMPLETELY COVERED

	Score		
	1	2	3
Intrinsic worth	53	97	136
Use	136	69	81

Matched pairs Wilcoxon test, Z = 8.21, significant at << 1%.

Just 28% report that the syllabus is completely covered: 48% think it should be

ITEM 6 ALL O-LEVEL TOPICS CCVERED IN THE COURSE WERE REVISED FOR THE EXAMINATION

	Score		
	1	2	3
Intrinsic worth	35	57	194
Use	102	35	149

Matched pairs Wilcoxon test, Z = 7.17, significant at << 1%

Some 68% desire this comprehensive revision but only 52% experience this method.

ITEM 7 THE TOPICS COVERED IN THE O-LEVEL COURSE WERE RESTRICTED TO THOSE THOUGHT ESSENTIAL FOR AN EXAMINATION PASS

	Score		
	1	2	3
Intrinsic worth	135	77	74
Use	134	63	89

Matched pairs Wilcoxon test, Z = 0.84, not significant

APPENDIX 5.9.1. THE ATTITUDE SCALE

SECTION D : THE A-LEVEL PHYSICS COURSE

After two months or so, your feelings about A-level physics, which would have been partly expressed in your answers to SECTION B, can now be more definitely judged. The attitude scales below are an extension of the ones you answered in an earlier Unit, and they will allow attitudes towards different courses to be compared.

To answer the scales, judge the course on each one in turn.

e.g. MODERN 1 2 3 4 5 6 7 OUT OF DATE

If you think that your course is modern, but not extremely so, then ring number 2 or 3 depending upon the degree of your feelings. An extremely out of date course would be rated "7". Ring number 4 if you think the words are unsuitable or if you can't decide in favour of one extreme or the other.

As usual, when answering attitude scales, work as quickly as you can, giving first natural replies.

SATISFYING	1 2 3 4 5 6 7	FRUSTRATING
EARLY THEORIES LINKED TO PRESENT DAY THEORIES	1 2 3 4 5 6 7	PRESENT DAY THEORIES ARE CONSIDERED ONLY
REQUIRES HARD WORK	1 2 3 4 5 6 7	REQUIRES LITTLE WORK
INTERESTING	1 2 3 4 5 6 7	DULL
LOATHSOME	1 2 3 4 5 6 7	ENJOYABLE
LOW PRESTIGE	1 2 3 4 5 6 7	HIGH PRESTIGE
PLEASANT	1 2 3 4 5 6 7	UNPLEASANT
SOCIAL IMPLICATIONS NEVER CONSIDERED	1 2 3 4 5 6 7	SOCIAL IMPLICATIONS ALWAYS CONSIDERED
CONTAINS TOO MUCH MATERIAL	1 2 3 4 5 6 7	CONTAINS SUFFICIENT MATERIAL
DOES NOT AFFECT YOUR PERSONAL VIEWS	1 2 3 4 5 6 7	MAKES YOU THINK DEEPLY ABOUT YOUR PERSONAL VIEWS
MATHEMATICAL	1 2 3 4 5 6 7	NON-MATHEMATICAL
BORING	1 2 3 4 5 6 7	EXCITING
MODERN	1 2 3 4 5 6 7	OUT OF DATE
DIFFICULT	1 2 3 4 5 6 7	EASY

Now go on to SECTION E

APPENDIX 5.10.1.

THE APPEARANCE OF THE S.S.R.C. SCALES ON THE UPPER SIXTH-FORM QUESTIONNAIRE

SECTION D: ATTITUDES TO STUDY

Achievements in and attitudes towards academic subjects are believed to depend upon the type of thinking students use as they respond to their lessonsand plan their study time. In one of the fifth-form questionnaires, you will have completed a 'junior' form of a study attitudes scale. Here, a more comprehensive scale of this type has been developed, which will help to clarify the patterns of your responses in all the previous questionnaires.

Please answer every item, trying to avoid the 'not applicable' category if at all possible. As usual, answer quickly and circle the appropriate code number.

		Agree	Disagree	Not Applicable
1	I find it difficult to organise my study time effectively	1	2	3
2	New topics interest me so much that I spend extra time trying to find out more about them	1	2	3
3	I chose my present courses to give me a chance of a really good job later	1	2	3
4	I enjoy competition: I find it stimulating	1	2	3
5	The continual pressure of work - homework, deadlines and competition - often makes me tense and depressed	1	2	3
6	I like to be told precisely what to do in essays or other assignments	1	2	3
7	I tend to do less work here than in the fifth form	1	2	3
8	My habit of putting of work leaves me with far too much to do at the end of term	1	2	3
9	I spend too long on certain topics because I get very interested and involved in them	1	2	3
10	My main reason for taking 'A' levels is that it will eventually help me to get a better job	1	2	3
11	It's important to me to do really well in my courses	1	2	3
12	A poor first answer in an exam makes me panic	1	2	3
13	I prefer courses to be clearly structured and highly organised	1	2	3

	Agree	Disagree	Not Applicable
14 My main reason for taking 'A' levels is so that I can learn more about the subjects which really interest me	1	2	3
15 Distractions make it difficult for me to do much effective work in the evenings	1	2	3
16 I enjoy the challenge of a difficult new topic in lessons	1	2	3
17 I generally choose courses more from the way they fit in with career plans than from academic interest	1	2	3
18 Teachers should tell us exactly how they want us to tackle homework and assignments	1	2	3
19 Worry about an exam or about work that is overdue often prevents me from sleeping	1	2	3
20 I'm rather slow at starting work in the evenings	1	2	3
21 I find that studying academic topics can often be really exciting and gripping	1	2	3
22 I want really good results all round to give me a flying start with the next stage of my education/career	1	2	3
23 I usually plan my week's work in advance, either on paper or in my head	1	2	3
24 It is important to me to do things better than my friends if I possibly can	1	2	3
25 I tend to learn more effectively by studying along my own lines than through set work	1	2	3
26 I spend a good deal of my spare time in finding out more about interesting topics which have been discussed in classes	1	2	3
27 I get very anxious about work which is overdue	1	2	3
28 If conditions aren't right for me to study, I generally manage to do something to change them	1	2	3
29 In a sense, I suppose I work hard to please my parents rather than myself	1	2	3
30 I tend to read very little beyond what's required for completing assignments	1	2	3

	Agree	Disagree	Not applicable
31 I certainly want to pass the next set of exams, but it doesn't really matter if I only just scrape through	1	2	3
32 Having to speak in lessons and tutorials is quite an ordeal for me	1	2	3
33 I find academic topics so interesting. I should like to continue with them after I finish this course	1	2	3
34 My parents expect me to do well and I feel it is up to me not to let them down	1	2	3
35 I always seem to be late for something or someone	1	2	3
36 I try to keep up with the suggested reading that goes with the lessons	1	2	3
37 I'd much prefer more time studying on my own, outside time-tabled classes	1	2	3
38 I hate admitting defeat, even in trivial matters	1	2	3
39 I often find that my mind goes blank when I'm faced with a particularly difficult question	1	2	3
40 I generally go over my lesson notes not long afterwards to make sure they make sense and nothing important has been left out	1	2	3

APPENDIX 5.10.2. ITEM STATISTICS FOR THE S.S.R.C. SCALES

ACADEMIC ACHIEVEMENT MOTIVATION

	ITEM	Correlation with scale total		
		SSRC total	SSRC science	U6 physics
4	I enjoy competition: I find it stimulating	0.65	0.61	0.56
11	It's important to me to do really well in my courses	0.59	0.58	0.66
16	I enjoy the challenge of a difficult new topic in lessons	0.41	0.51	0.56
24	It is important to me to do things better than my friends, if I possibly can	0.64	0.61	0.65
31	I certainly want to pass the next set of exams, but it doesn't really matter if I only just scrape through	-0.55	-0.54	-0.53
38	I hate admitting defeat, even in trivial matters	0.53	0.58	0.50
	Mean item correlation (after Z' transformation)	0.57	0.57	0.58

Cronbach Alpha for the U6 physics scores is 0.59

ORGANISED STUDY HABITS

	ITEM	Correlation with scale total		
		SSRC total	SSRC science	U6 physics
1	I find it difficult to organise my study time effectively	-0.64	-0.58	-0.69
7	I tend to do less work here than in the fifth form	-0.48	-0.54	-0.50
8	My habit of putting off work leaves me with far too much to do at the end of term	-0.66	-0.60	-0.58
15	Distractions make it difficult for me to do much effective work in the evenings	-0.60	-0.59	-0.54
20	I'm rather slow at starting work in the evenings	-0.66	-0.67	-0.67
23	I usually plan my week's work in advance, either on paper or in my head	0.56	0.52	0.55
28	If conditions aren't right for me to study I generally manage to do something to change them	0.51	0.50	0.60
35	I always seem to be late for something or someone	-0.48	-0.46	-0.41
36	I try to keep up with the suggested reading that goes with the lessons	0.52	0.52	0.50
40	I generally go over my lesson notes not long afterwards to make sure they make sense and nothing important has been left out	0.47	0.63	0.52
	Mean item correlation (after Z'transformation)	0.56	0.56	0.56

Cronbach Alpha for the U6 physics scores is 0.75

FEAR-OF-FAILURE

	ITEM	Correlation with scale total		
		SSRC total	SSRC science	U6 physics
5	The continual pressure of work - homework, deadlines and competition - often makes me tense and depressed	0.66	0.62	0.58
12	A poor first answer in an exam makes me panic	0.64	0.60	0.58
19	Worry about an exam or about work that is overdue often prevents me from sleeping	0.65	0.67	0.57
27	I get very anxious about work which is overdue	0.66	0.65	0.55
32	Having to speak in lessons and tutorials is quite an ordeal for me	0.57	0.57	0.45
39	I often find that my mind goes blank when I'm faced with a particularly difficult question	0.58	0.58	0.63
	Mean item correlation (after Z' transformation)	0.63	0.62	0.56

Cronbach Alpha for the U6 physics scores is 0.56

SYLLABUS - BOUNDNESS

	ITEM	Correlation with scale total		
		SSRC total	SSRC science	U6 physics
6	I like to be told precisely what to do in essays or other assignments	0.67	0.61	0.75
13	I prefer courses to be clearly structured and highly organised	0.54	0.30	0.41
18	Teachers should tell us exactly how they want us to tackle homework and assignments	0.57	0.53	0.60
25	I tend to learn more effectively by studying along my own lines than through set work	-0.53	-0.52	-0.53
30	I tend to read very little beyond what's required for completing assignments	0.54	0.56	0.52
37	I'd much prefer more time studying on my own, outside time-tabled classes	-0.45	-0.43	-0.52
	Mean item correlation (after Z' transformation)	0.55	0.50	0.57

Cronbach Alpha for the U6 physics scores is 0.56

EXTRINSIC MOTIVATION

ITEM		Correlation with scale total		
		SSRC total	SSRC science	U6 physics
3	I chose my present courses to give me a chance of a really good job later	0.77	0.78	0.57
10	My main reason for taking 'A' levels is that it will eventually help me to get a better job	0.75	0.74	0.54
17	I generally choose courses more from the way they fit in with career plans than from academic interest	0.69	0.66	0.66
22	I want really good results all round to give me a flying start with the next stage of my education/career	0.60	0.53	0.33
29	In a sense, I suppose I work hard to please my parents rather than myself	0.42	0.48	0.38
34	My parents expect me to do well and I feel it is up to me not to let them down	0.54	0.49	0.67
	Mean item correlation (after Z' transformation)	0.64	0.63	0.54

Cronbach Alpha for the U6 physics scores is 0.49

INTRINSIC MOTIVATION

ITEM		Correlation with scale total		
		SSRC total	SSRC science	U6 physics
2	New topics interest me so much that I spend extra time trying to find out more about them	0.65	0.66	0.59
9	I spend too long on certain topics because I get very interested and involved in them	0.61	0.64	0.63
14	My main reason for taking 'A' levels is so that I can learn more about the subjects which really interest me	0.67	0.64	0.66
21	I find that studying academic topics can often by really exciting and gripping	0.71	0.69	0.65
26	I spend a good deal of my spare time in finding out more about interesting topics which have been discussed in classes	0.63	0.65	0.48
33	I find academic topics so interesting. I should like to continue with them after I finish this course	0.70	0.68	0.69
	Mean item correlation (after Z' transformation)	0.66	0.66	0.62

Cronbach Alpha for the U6 physics scores is 0.68

RECENT CRONBACH ALPHA VALUES FOR THE SCALES

[Entwistle et al., 1979]

Scale	Alpha
Academic achievement motivation	0.59
Organised study habits	0.72
Fear-of-failure	0.69
Syllabus boundness	0.53
Extrinsic motivation	0.70
Intrinsic motivation	0.74

APPENDIX 5.11.1

THE 40-ITEM CLASSROOM ENVIRONMENT CHECK-LIST ON THE UPPER SIXTH-FORM QUESTIONNAIRE

SECTION C: HOW THE A-LEVEL PHYSICS COURSE IS TAUGHT

Your feelings about the course have most meaning if I know how the course is taught. Accordingly, in this section there are a number of statements that describe aspects of A-level physics teaching. Some of the methods you will be familiar with from your own lessons, others you may have only heard about.

Indicate which methods are used in your course by circling the appropriate code number is column 1. In column 2, express your own feelings about each method by circling the appropriate number.

	Column 1			Column 2		
	Method actually used			Statement describes		
	True	False	Some-times	Good method	Poor method	Don't know
1 Teaching is by lectures with experimental demonstrations	1	2	3	1	2	3
2 Learning is by finding out by oneself after each new topic has been introduced by the teacher	1	2	3	1	2	3
3. The class works through a text-book	1	2	3	1	2	3
4. The teacher guides you in your learning, acting as a source of information, asking questions and using experimental demonstrations to help	1	2	3	1	2	3
5. Part of the course is devoted to an individual student project	1	2	3	1	2	3
6 Individual homework and practical accounts are assessed and discussed by the teacher	1	2	3	1	2	3
7 The teacher uses words rather than mathematices in explanations whenever possible	1	2	3	1	2	3
8 The teacher order appears logical	1	2	3	1	2	3
9 The teacher anticipates the students' problems and sees the subject from their point of view	1	2	3	1	2	3
10 The teaching style encourages the interest of the student	1	2	3	1	2	3

	Column 1			Column 2		
	Method actually used			Statement describes		
	True	False	Some times	Good method	Poor method	Don't know
11 To help you understand, films, filmstrips and filmloops are used as well as experimental demonstrations	1	2	3	1	2	3
12 Students' practical work is related to recent taching lessons	1	2	3	1	2	3
13 The lessons are planned to make experimental and theory work run smoothly	1	2	3	1	2	3
14 Visits to outside events are sometimes arranged to broaden your knowledge of physics	1	2	3	1	2	3
15 The teacher uses lesson material from outside the examination syllabus when it is felt necessary	1	2	3	1	2	3
16 You are encouraged to work as an individual rather than as part of a large group of 4 or more	1	2	3	1	2	3
17 All students make their own notes and records of work covered in lessons	1	2	3	1	2	3
18 Some students make notes and circulate them to others	1	2	3	1	2	3
19 Notes are made from dictation by the teacher	1	2	3	1	2	3
20 Notes are made by copying from the board or overhead projector	1	2	3	1	2	3
21 Duplicated lesson notes are issued on a short loan	1	2	3	1	2	3
22 Notes are made by a number of different methods	1	2	3	1	2	3
23 The teaching relates each new idea to a previously understood one	1	2	3	1	2	3
24 The teaching seems to be most suitable for the most able pupils	1	2	3	1	2	3
25 Students' practical work occurs in groups of four or more in the normal lessons	1	2	3	1	2	3

	Column 1			Column 2		
	Method actually used			Statement describes		
	True	False	Some times	Good method	Poor method	Don't know
26 Several teachers take the class, each one teaching a different topic	1	2	3	1	2	3
27 Homework relevant to teaching and practical lessons is set regularly	1	2	3	1	2	3
28 The special type of individual work for the A-level practical exam is introduced into practical lessons towards the end of the course	1	2	3	1	2	3
29 The teacher encourages discussion and speculation amongst the students	1	2	3	1	2	3
30 The whole syllabus will not be completely covered, but the topics taught will have been thoroughly treated	1	2	3	1	2	3
31 Technical terms are used where appropriate, but otherwise the language is everyday English	1	2	3	1	2	3
32 Practical work is designed to help the student understand the knowledge from theory lessons	1	2	3	1	2	3
33 Each topic in the course is studied in depth	1	2	3	1	2	3
34 The teacher covers the syllabus quickly to leave as much time as possible for revision	1	2	3	1	2	3
35 Individual or small group practical work takes place each week in a separate practical lesson	1	2	3	1	2	3
36 Students are helped and encouraged to revise for the A-level exam in a planned way	1	2	3	1	2	3
37 Each lesson has an introduction, which tells you what the lesson is about, and a conclusion which summarises the lesson's content	1	2	3	1	2	3
38 Regular practice to develop a suitable style in answering exam questions occurs in the second year of the course	1	2	3	1	2	3

	Column 1			Column 2		
	Method actually used			Statement describes		
	True	False	Some times	Good method	Poor method	Don't know
39 All exam revision is done from the students own notes	1	2	3	1	2	3
40 The whole syllabus will be covered but not all the topics will have been thoroughly treated	1	2	3	1	2	3

APPENDIX 5.11.2. THE RESPONSE DISTRIBUTION FOR THE 40- CHECK-LIST ITEMS

STATEMENT 1 Teaching is by lectures with experimental demonstrations.

	SCORE		
	1	2	3
Intrinsic worth	13	41	89
Use	36	76	31

Matched-pairs Wilcoxon test, $Z = 6.57$, significant at $\ll 1\%$.

Only a modest use of this popular method is reported.

STATEMENT 2 Learning is by finding out by oneself after each new topic has been introduced by the teacher.

	SCORE		
	1	2	3
Intrinsic worth	51	33	59
Use	81	42	20

Matched-pairs Wilcoxon test, $Z = 6.01$, significant at $\ll 1\%$.

Opinion is almost equally divided on this infrequently used method.

STATEMENT 3. The class works through a text-book

	SCORE		
	1	2	3
Intrinsic worth	71	32	40
Use	64	31	48

Matched-pairs Wilcoxon test, $Z = 1.33$, not significant.

On the whole, text-book teaching is unpopular but there is no significant mis-match.

STATEMENT 4 The teacher guides you in your learning, acting as a source of information, asking questions and using experimental demonstrations to help

	SCORE		
	1	2	3
Intrinsic worth	4	19	120
Use	15	49	79

Matched-pairs Wilcoxon test, Z = 5.91 , significant at $\ll$ 1%.

A high proportion, some 84%, rate this a most desirable method, but a significant number doubt that they are exposed to such an approach in reality.

STATEMENT 5 Part of the course is devoted to an inidividual student project

	SCORE		
	1	2	3
Intrinsic worth	36	64	43
Use	142	0	1

Matched-pairs Wilcoxon test, Z = 8.76 , significant at $\ll$ 1%.

Opinions are equally divided on the suitability of project work which is almost totally absent from the survey schools.

STATEMENT 6 Individual homework and practical accounts are assessed and discussed by the teacher

	SCORE		
	1	2	3
Intrinsic worth	8	16	119
Use	22	42	79

[redacted] 4 , significant at $\ll$ 1%

Teacher feedback is strongly desired by 83% of the students but there is a significant short-fall in its provision.

STATEMENT 7. The teacher uses words rathern than mathematics in explanations whenever possible

	SCORE		
	1	2	3
Intrinsic worth	20	34	89
Use	34	57	52

Matched-pairs Wilcoxon test, $Z = 4.12$, significant at $\ll 1\%$.

Although a majority of students welcome a verbal approach this is not always realised.

STATEMENT 8 The teaching order appears logical

	SCORE		
	1	2	3
Intrinsic worth	4	17	122
Use	26	48	69

Matched-pairs Wilcoxon Test, $Z = 6.43$, significant at $\ll 1\%$.

It is unsurprising that a logical teaching order is thought highly desirable, but only 48% of the students feel that this is achieved in practice.

STATEMENT 9. The teacher anticipates the students' problems and sees the subject from their point of view.

	SCORE		
	1	2	3
Intrinsic worth	9	13	121
Use	28	81	34

Matched-pairs Wilcoxon test Z = 7.89 , significant at $\ll$ 1%.

A highly significant mis-match appears here with only 24% reporting that their teachers seem able to identify with their needs.

STATEMENT 10. The teaching style encourages the interest of the student

	SCORE		
	1	2	3
Intrinsic worth	6	12	125
Use	45	66	32

Matched-pairs Wilcoxon test, Z = 8.46 , significant at $\ll$1%.

For the large majority (87%) an attractive teaching style is looked for but, in reality, is rather uncommon (22%).

STATEMENT 11. To help you understand, films, filmstrips, and film loops are used as well as experimental demonstrations

	SCORE		
	1	2	3
Intrinsic worth	17	36	90
Use	79	48	16

[illegible] significant at $\ll$ 1%

Just 11% report the use of multi-media techniques despite the attractiveness of this approach.

STATEMENT 12. Students' practical work is related to recent teaching lessons

	SCORE		
	1	2	3
Intrinsic worth	2	7	134
Use	15	39	89

Matched-pairs Wilcoxon test, $Z = 5.84$, significant at $\ll 1\%$.

This method is endorsed almost unanimously, yet 38% are uncertain that such a procedure is followed in their classes.

STATEMENT 13. The lessons are planned to make experimental and theory work run smoothly

	SCORE		
	1	2	3
Intrinsic worth	4	18	121
Use	24	60	59

Matched-pairs Wilcoxon test, $Z = 6.84$, significant at $\ll 1\%$.

A significant mis-match is reported in the provision of smooth running lessons.

STATEMENT 14. Visits to outside events are sometimes arranged to broaden your knowledge of physics

	SCORE		
	1	2	3
Intrinsic worth	13	36	94
Use	88	34	21

Matched-pairs Wilcoxon test, $Z = 8.65$, significant at $\ll 1\%$.

Outside visits are supported by the majority (66%) although their occurrence is rare (15%).

STATEMENT 15. The teacher uses lesson material from outside the examination syllabus when it is felt necessary

	SCORE		
	1	2	3
Intrinsic worth	28	34	81
Use	39	57	47

Matched-pairs Wilcoxon test, $Z = 3.84$, significant at $\ll 1\%$.

There is support here for teachers to review any excessive 'examination syllabus syndrome'.

STATEMENT 16. You are encouraged to work as an individual rather than as part of a large group of four or more.

	SCORE		
	1	2	3
Intrinsic worth	12	36	95
Use	20	39	84

Matched-pairs Wilcoxon test, $Z = 1.99$, significant at $< 5\%$.

The students welcome teaching oriented towards individual rather than co-operative efforts, and, for the most part, this is received

STATEMENT 17. All students make their own notes and records of work covered in lessons.

	SCORE		
	1	2	3
Intrinsic worth	34	43	66
Use	57	24	62

Matched-pairs Wilcoxon test, Z = 2.72 , significant at < 1%.

Although there is some doubt as to the worth of this notemaking method it tends to be used less often than anticipated.

STATEMENT 18. Some students make notes and circulate them to others.

	SCORE		
	1	2	3
Intrinsic worth	121	14	8
Use	125	11	7

Matched-pairs Wilcoxon Test, Z = 0.52 , not significant.

This method is highly unpopular and rarely practised.

STATEMENT 19 Notes are made from dictation by the teacher

	SCORE		
	1	2	3
Intrinsic worth	46	39	58
Use	38	55	50

0.02, not significant

No firm opinions emerge on the worth and use of the dictation method.

STATEMENT 20. Notes are made by copyong from the board or overhead projector

	SCORE		
	1	2	3
Intrinsic worth	26	51	66
Use	22	56	65

Matched-pairs Wilcoxon test, $Z = 0.32$, not significant.

Despite the uncertainty, there is a strong feeling (46%) that this is a good method and this matches its degree of use.

STATEMENT 21. Duplicated lesson notes are issued on a short loan

	SCORE		
	1	2	3
Intrinsic worth	75	39	29
Use	120	19	4

Matched pairs Wilcoxon test, $Z = 6.14$, significant at $\ll 1\%$.

This rarely used method is not favoured by the majority (52%) although a significant proportion are uncertain or disagree.

STATEMENT 22. Notes are made by a number of different methods

	SCORE		
	1	2	3
Intrinsic worth	14	51	78
Use	46	30	67

Matched-pairs Wilcoxon test, $Z = 3.95$, significant at $\ll 1\%$.

A varied note-making style is not practised in the classrooms as much as the students like.

STATEMENT 23. The teaching relates each new idea to a previously understood one

	SCORE		
	1	2	3
Intrinsic worth	3	16	124
Use	16	90	37

Matched-pairs Wilcoxon test, Z = 7.70 , significant at $\ll$1%.

The development of learning through concept hierarchies is strongly supported but only 26% of the students are certain that this does occur.

STATEMENT 24. The teaching seems to be most suitable for the most able pupils

	SCORE		
	1	2	3
Intrinsic worth	75	46	22
Use	52	44	47

Matched-pairs Wilcoxon-test, Z = 3.72 , significant at $\ll$1%.

This form of ability-oriented teaching is unpopular but significantly more of it occurs than is desired.

STATEMENT 25. Students' practical work occurs of groups of four or more in the normal lessons

	SCORE		
	1	2	3
Intrinsic worth	123	9	11
Use	108	22	13

Matched-pairs Wilcoxon Test, Z = 1.89 , not significant.

The students are strongly against this form of practical work organisation and are unlikely to meet up with it to any degree.

STATEMENT 26. Several teachers take the class, each one teaching a different topic.

	SCORE		
	1	2	3
Intrinsic worth	71	29	43
Use	95	15	33

Matched-pairs Wilcoxon test, Z = 2.94 , significant at $\ll 1\%$.

Although only 23% of the students are in multi-teacher classes, there is some evidence here that more would like to be. There are mixed feelings on the worth of the multi-teacher approach, but, overall, it tends to be disliked.

STATEMENT 27. Homework relevant to teaching and practical lessons is set regularly

	SCORE		
	1	2	3
Intrinsic worth	4	7	132
Use	21	34	88

Matched pairs Wilcoxon test, Z = 5.47 , significant at $\ll 1\%$.

This highly desirable characteristic of classes is not always displayed. Just 62% of the students report that relevant homework is set.

STATEMENT 28. The special type of individual work for the A-level practical exam is introduced into practical lessons towards the end of the course

	SCORE		
	1	2	3
Intrinsic worth	36	19	88
Use	61	11	71

Matched-pairs Wilcoxon test, Z = 3.67 , significant at $\ll 1\%$.

This preparation for the practical examination is generally popular (62% of students) but 43% of students report that it is not supplied.

STATEMENT 29. The teacher encourages discussion and speculation amongst the students

	SCORE		
	1	2	3
Intrinsic worth	5	17	121
Use	26	60	57

Matched-pairs Wilcoxon test, $Z = 6.87$, significant at $\ll 1\%$.

Only 40% of the students report that teacher-student discussions occur.

STATEMENT 30. The whole syllabus will not be completely covered, but the topics taught will have been thoroughly treated

	SCORE		
	1	2	3
Intrinsic worth	69	20	54
Use	45	51	47

Matched-pairs Wilcoxon test, $Z = 1.46$, not significant.

There is no firm consensus view on the relative worths of syllabus coverage and depth.

STATEMENT 31. Technical terms are used where appropriate, but otherwise the language is everyday English

	SCORE		
	1	2	3
Intrinsic worth	6	21	115
Use	12	23	108

Matched-pairs Wilcoxon test, Z = 2.00 , significant at $< 5\%$.

Technical or 'jargon' oriented teaching is not favoured and, for the most part, is not experienced.

STATEMENT 32. Practical work is designed to help the student understand the knowledge from theory lessons.

	SCORE		
	1	2	3
Intrinsic worth	4	6	133
Use	12	27	104

Matched-pairs Wilcoxon test, Z = 4.67 , significant at $\ll 1\%$.

The students agree on this aim of practical work, although a significant proportion are not certain that this aim is achieved.

STATEMENT 33. Each topic in the course is studied in depth

	SCORE		
	1	2	3
Intrinsic worth	17	40	86
Use	29	68	46

Matched-pairs Wilcoxon test, $Z = 4.70$, significant at $\ll 1\%$.

Some 60% of the students would like an in-depth treatment of all topics. In practice, 32% experience such an approach.

STATEMENT 34. The teacher covers the syllabus quickly to leave as much time as possible for revision

	SCORE		
	1	2	3
Intrinsic worth	66	47	30
Use	79	16	48

Matched-pairs Wilcoxon test, $Z = 0.42$, not significant.

There are no firm opinions here but 46% of students think that rapid syllabus coverage is undesirable.

STATEMENT 35. Individual or small group practical work takes place each week in a separate lesson

	SCORE		
	1	2	3
Intrinsic worth	8	17	118
Use	23	21	99

Matched pairs-Wilcoxon test, $Z = 3.94$, significant at $\ll 1\%$

The large majority of students, some 83% express a demand for this type of practical provision but this is realised inonly 69% of cases.

STATEMENT 36. Students are helped and encouraged to revise for the A level exam in a planned way

	SCORE		
	1	2	3
Intrinsic worth	9	20	114
Use	39	35	69

Matched-pairs Wilcoxon test, $Z = 5.84$, significant at $\ll 1\%$.

Help with revision is welcomed by 80% of the students. In reality, just 48% of students say they get such help.

STATEMENT 37. Each lesson has an introduction, which tells you what the lesson is about, and a conclusion which summarises the lesson's content

	SCORE		
	1	2	3
Intrinsic worth	20	58	65
Use	110	28	5

Matched-pairs Wilcoxon test, $Z = 9.04$, significant at $\ll 1\%$.

A clearly structured lesson is recognised as desirable by 46% of students, but in practice, a serious mis-match arises.

STATEMENT 38. Regular practice to develop a suitable style in answering exam questions occurs in the second year of the course.

	SCORE		
	1	2	3
Intrinsic worth	2	10	131
Use	30	35	78

Matched-pairs Wilcoxon test, $Z = 6.50$, significant at $\ll 1\%$.

This aspect of examination preparation fails significantly to satisfy the students.

STATEMENT 39. All exam revision is done from the students own notes.

	SCORE		
	1	2	3
Intrinsic worth	82	39	22
Use	67	32	44

Matched-pairs Wilcoxon test, $Z = 3.54$, significant at $\ll 1\%$.

This is not a popular means of revision being disliked by 57% of students, although it is adopted in a number of classes.

STATEMENT 40. The whole syllabus will be covered by not all the topics will have been thoroughly treated

	SCORE		
	1	2	3
Intrinsic worth	65	45	33
Use	57	18	68

Matched-pairs Wilcoxon test, $Z = 3.30$, significant at $< 1\%$.

Almost half the students (48%) report that this method is used but only 23% find this satisfactory.

APPENDIX 5.11.3. INTERVIEW SCHEDULE 1979 NO.

1 Subjects being studied (indicate level)

2 Career intention 1st choice 2nd

3 How important is it that you do well in A-level physics?

1. D or above	2. Any pass	3. Pass not essential but hope to get one
4. Pass not essential and not bothered		

4 Why was physics chosen at A-level?

a)

1. O-level interest	2. O-level easy	3. O-level grade	4. You had to (career)
5. A-level interests	If 5.is yes have the expectations been fulfilled?		

5 What has been the best aspect of your A-level physics course?

Interesting	Historical	Mathematical	Modern	Experimental work

6. What has been the worst aspect of your A-level physics course?

Dullness	Mathematical	Lack of experimental work	Notemaking
Too difficult	Not enough time	Inadequate organisation	

7 Should physics lessons (a) just give you the facts and explain physical principles

or (b) give you something more and show the underlying themes and threads that link physics together?

8 What have been the easiest topics in the A-level course?

Why do you think this (these) have been the easiest?

9 What have been the most difficult topics in the A-level course?

Why do you think this(these) have been most difficult?

10 How many teachers take your class?

(i) If ONE is this a good arrangement or do you think there would be advantages if other teacher(s were involved)

(ii) If MORE THAN ONE:is this a good arrangement or do you think there would be advantages if just one teacher was involved?

11 i) If an explanation of a physical event can be given in both mathematical (involving formulae) and non-mathematical (descriptive words) ways, which would you prefer?

ii) Again, given that both approaches are equally possible, which do you think students should receive? (Mathematical, non-mathematical, mixture)

12 i) Are you upset if you know that your teacher sometimes deals with ideas that seem outside the examination syllabus?

ii) Do you read and learn about physics from other sources than your lessons and text-books?
If YES, what are these cources?
(Library fiction/non-fiction, SF, Scientific hobbies, TV documentaries)

13 How important is it to you that the teacher

	V.Imp.	Imp.	Not imp.
a) asks you questions			
b) encourages you and your fellow students to ask questions			
c) encourages you and your fellow students to join in discussions?			

14 a) Do you make notes of your lessons?
b) Why do you think students make notes during their A-level course?
c) Have you a preference for any one system of note-making?
d) How do you feel about the issue and loan of duplicated notes?

15 a) How much of the time in the physics course is devoted to student practical work?
b) What do you think is the purpose of this practical work?
c) Do you think that you need more or less of this practical work?
d) Do you feel that A-level physics is allocated sufficient time for syllabus coverage anyway?

16 Should the teacher help you plan your revision for the examination?
If YES, in what particular way should the teacher help?

APPENDIX 5.11.4

UPPER SIXTH-FORM CLASSROOM PREFERENCE CHECK-LIST
THE FACTOR STRUCTURE MATRIX OF CORRELATION COEFFICIENTS

Statement	F A C T O R		
	1 (Scale 1)	2 (Scale 2)	3 (Scale 3)
1	269*	-027	068
2	024	164	475*
3	061	114	077
4	033	-012	-012
5	-042	078	-025
6	300*	-139	069
7	090	225	161
8	612*	-078	005
9	053	009	-095
10	331*	-221	111
11	242*	060	-100
12	263*	133	-042
13	307*	-020	-101
14	372*	-045	-021
15	027	169	290*
16	-118	089	-010
17	-002	-021	487*
18	-086	466*	-001
19	052	338*	-156
20	112	271*	-486*
21	-061	328*	-060
22	-083	204	265*
23	093	042	262*
24	000	168	002
25	060	467*	213
26	-069	299*	145
27	000	-116	322*
28	097	402*	042
29	478*	107	171
30	158	-004	-095
31	105	100	012
32	322*	-017	158
33	128	057	004
34	-052	332*	049
35	142*	072	028
36	318*	085	286*
37	334*	-074	036
38	200	142	-032
39	114	249*	036
40	064	299*	037

Decimal points are omitted

An asterisk indicates the allocation of a statement to a factor for summation. The decision to allocate low loading items such as statements 1 and 35 was made after calculating the corresponding scale total scores (Appendix 5.11.5).

APPENDIX 5.11.5.

ITEM-WHOLE CORRELATIONS FOR THE THREE FACTOR SCALES

STATEMENT	SCALE		
	1	2	3
1	0.40*	0.00	0.01
2	0.02	0.07	0.62*
3	-0.01	0.08	0.05
4	0.09	0.01	-0.01
5	-0.01	0.09	-0.02
6	0.43*	-0.06	0.07
7	0.05	0.14	0.09
8	0.54*	-0.03	-0.06
9	0.07	0.03	-0.07
10	0.33*	-0.12	0.03
11	0.48*	0.05	-0.07
12	0.25*	0.09	-0.05
13	0.41*	-0.04	-0.09
14	0.50*	-0.04	-0.06
15	-0.02	0.13	0.48*
16	-0.11	-0.09	0.06
17	-0.02	-0.02	0.62*
18	-0.05	0.45*	0.08
19	0.02	0.50*	-0.13
20	0.04	0.43*	-0.56*
21	-0.07	0.44*	-0.07
22	-0.05	0.12	0.43*
23	0.10	-0.02	0.31*
24	-0.02	0.12	0.03
25	-0.01	0.47*	0.16
26	-0.03	0.42*	0.15
27	0.02	-0.12	0.41*
28	0.06	0.48*	0.03
29	0.49*	0.06	0.09
30	0.08	-0.04	-0.13
31	0.03	0.12	0.02
32	0.31*	-0.04	0.08
33	0.05	0.05	0.02
34	-0.09	0.45*	-0.07
35	0.34*	-0.01	0.01
36	0.40*	0.13	-0.37*
37	0.55*	-0.05	-0.05
38	0.09	0.11	-0.03
39	0.05	0.41*	0.03
40	0.01	0.43*	0.02

A correlation coefficient of $\pm$ 0.16 is significantly different from zero at the 5% level.

An asterisk indicates the allocation of a statement to a particular scale.

APPENDIX 5.12.1.

ATTITUDES TO PHYSICS PROJECT

QUESTIONNAIRE RATING EFFECTIVE SCIENCE TEACHING

Directions

The following statements are related to Effective Science Teaching and have been developed after discussion with science teachers. Will you please read each statement and give your opinion on the extent to which a statement is an attribute of an Effective Science Teacher.

Give your opinion by using the following scale on which the method expressed by the statement is rated:

1, if unimportant
2, if it has a few good points in its favour
3, if generally desirable
4, if of considerable importance
5, if essential

Please place a circle around the appropriate number at the end of each statement. For example:

Can adjust the pace of his lesson
to the needs and abilities of his students 1 2 3 4 (5)

PLEASE CHECK THAT YOU HAVE RATED EVERY STATEMENT

QUESTIONNAIRE RATING EFFECTIVE SCIENCE TEACHING

1. Gives pupils some responsibility for the care of laboratory equipment and materials. 1 2 3 4 5
2. Takes refresher courses in his science subject. 1 2 3 4 5
3. Knows how to proceed if there is a serious problem of discipline. 1 2 3 4 5
4. Develops interest in science in his pupils. 1 2 3 4 5
5. Is willing to try new methods and procedures in the classroom or laboratory. 1 2 3 4 5
6. Uses audio-visual materials in his teaching. 1 2 3 4 5
7. Uses laboratory equipment to show pupils how to verify facts and principles. 1 2 3 4 5
8. Can point out links between his subject and related subjects. 1 2 3 4 5
9. Has a genuine interest in science and believes in the academic and practical use of the subject 1 2 3 4 5
10. Can manage the class so that accidents in the laboratory or incidents requiring disciplinary measures seldom arise. 1 2 3 4 5

11.	Has patience in his dealing with pupils.	1 2 3 4 5
12.	Works towards a planned objective or objectives in each lesson but is flexible with lesson plans as circumstances permit.	1 2 3 4 5
13.	Is willing to change an opinion or conclusion because of later evidence.	1 2 3 4 5
14.	Uses various methods of evaluating pupils.	1 2 3 4 5
15.	Uses pupils to carry out routine duties such as giving out books, cleaning the blackboard etc.	1 2 3 4 5
16.	Can devise experiments which involve pupil participation in learning.	1 2 3 4 5
17.	Explains to pupils how to break up large problems into a number of small problems.	1 2 3 4 5
18.	Takes refresher courses in teaching and general educational matters.	1 2 3 4 5
19.	Has useful information in subjects other than, but related to, his teaching subject.	1 2 3 4 5
20.	Has studied the philosophy and psychology of education	1 2 3 4 5
21.	Is constructive and helpful in his criticism of pupils.	1 2 3 4 5
22.	Is a competent performer of any skills which are needed in teaching.	1 2 3 4 5
23.	Quickly learns to identify the pupils by name.	1 2 3 4 5
24.	Relates new learning to natural phenomena within the experience of the pupil in order to develop meaningful associations.	1 2 3 4 5
25.	Helps students to develop an appreciation of the benefits and misuses of science.	1 2 3 4 5
26.	Is consistently fair and emotionally calm when enforcing rules.	1 2 3 4 5
27.	Changes curriculum and methods to keep up to date with developments in his subject and methods for teaching it.	1 2 3 4 5
28.	Is clear and unequivocal in his personal relationships with pupils.	1 2 3 4 5
29.	Can evaluate textbooks and laboratory manuals.	1 2 3 4 5
30.	Is skilful in the use of apparatus in the school laboratory.	1 2 3 4 5
31.	Encourages and helps pupils to write their own notes.	1 2 3 4 5
32.	Encourages pupils to bring appropriate materials and specimens to class.	1 2 3 4 5
33.	Can evaluate benefits derived from field trips or visits to industry.	1 2 3 4 5
34.	Invites pupils to help in practical demonstrations.	1 2 3 4 5

35. Can interpret the results of diagnostic instruments used in schools (I.Q., Aptitude and Achievement tests) 1 2 3 4 5

36. Helps pupils to prepare for a career in science or technology. 1 2 3 4 5

37 Tries to stimulate pupils to think for themselves about science. 1 2 3 4 5

38. Can apply his knowledge of the psychology of learning to the teaching of his subject. 1 2 3 4 5

39. Is confident and at ease when teaching 1 2 3 4 5

40. Can help pupils differentiate between hypothesis, facts, superstition and theory as well as encourage pupils to suspend judgement when faced with inadequate scientific evidence. 1 2 3 4 5

41. Can relate in his teaching both the historical and the principles of science to everyday life situations when appropriate to do so. 1 2 3 4 5

42. Never threatens punishment without being prepared to enforce it if necessary. 1 2 3 4 5

43. Willingly consults colleagues in case of professional difficulties. 1 2 3 4 5

44. Sees that there is an adequate supply of textbooks, laboratory manuals, reference materials and the common tools of science for use in his teaching. 1 2 3 4 5

45. Tries to build up his work from known interests of the pupils. 1 2 3 4 5

46. Can locate sources for free and inexpensive science teaching material. 1 2 3 4 5

47. Frequently revises earlier work. 1 2 3 4 5

48. Encourages pupils to set themselves goals according to their abilities. 1 2 3 4 5

49. Encourages a pupil's self-initiated work. 1 2 3 4 5

50. Affects his pupils so that they wish to take more advanced courses in science. 1 2 3 4 5

51. Plans the direction of his teaching with examinations, internal and external, always in mind. 1 2 3 4 5

52. Has personal respect for each pupil as an individual. 1 2 3 4 5

53. Teaches for understanding rather than reproduction of learned material. 1 2 3 4 5

54. Explains why subject matter is important to pupils. 1 2 3 4 5

55. Assesses the work of pupils regularly. 1 2 3 4 5

56. Makes tests that require known principles to be applied in new situations 1 2 3 4 5

57. Is willing to initiate experimentation and inquiry beyond the goals of the syllabus. 1 2 3 4 5

58.	Encourages open-ended discussions.	1 2 3 4 5
59.	Designs examinations so that they provide information about the success of his teaching	1 2 3 4 5
60.	Shows pupils how to make deductions from facts	1 2 3 4 5
61.	Considers that his function as a teacher extends beyond just the teaching of his subject.	1 2 3 4 5
62.	Organises a regular revision schedule for the pupils to follow before an external examination	1 2 3 4 5
63.	Makes pupils aware of the broad linking concepts that run through science.	1 2 3 4 5
64.	Tries to link teaching material to laboratory practical work.	1 2 3 4 5
65.	Whenever possible, relates new concepts to already learnt ones by an experimental rather than a mathematical presentation	1 2 3 4 5
66.	Has an understanding of the limitations of scientific theories in general	1 2 3 4 5
67.	Knows of sources of information and references about his subject and the teaching and learning of it.	1 2 3 4 5
68.	Strives to produce tests and examinations which are a valid and reliable measure of his educational objectives.	1 2 3 4 5
69.	Tries always to consider the pupils' viewpoints.	1 2 3 4 5
70.	Gives each lesson a clear introduction and conclusion to introduce and summarise the lesson material.	1 2 3 4 5

APPENDIX 5.12.2.

THE SEVEN TEACHER SCALES

Correlations are between an item score and a scale score less that item.

Scale 1	Expansive teaching of the processes of science	Item correlation
63.	Makes pupils aware of the broad linking concepts that run through science.	0.77
25.	Helps students to develop an appreciation of the benefits and misuses of science.	0.65
60.	Shows pupils how to make deductions from facts	0.64
40.	Can help pupils differentiate between hypothesis, facts, superstition and theory as well as encourage pupils to suspend judgement when faced with inadequate scientific evidence.	0.63
41.	Can relate in his teaching both the historical and the principles of science to everyday life situations when appropriate to do so.	0.61
66.	Has an understanding of the limitations of scientific theories in general.	0.60
64.	Tries to link teaching material to laboratory practical work.	0.60
61.	Considers that his function as a teacher extends beyond just the teaching of his subject.	0.58
57.	Is willing to initiate experimentation and inquiry beyond the goals of the syllabus.	0.56
56.	Makes tests that require known principles to be applied in new situations.	0.55
13.	Is willing to change an opinion or conclusion because of later evidence.	0.52
62.	Organises a regular revision schedule for the pupils to follow before an external examination.	0.48
19.	Has useful information in subjects other than, but related to, his teaching subject.	0.46

Scale reliability 0.89

Scale 2	Competent, exam-oriented science teaching	Item Correlation
22.	Is a competent performer of any skills which are needed in teaching.	0.52
59.	Designs examinations so that they provide information about the success of his teaching.	0.49
30.	Is skilful in the use of apparatus in the school laboratory.	0.48
29.	Can evaluate textbooks and laboratory manuals.	0.46
68.	Strives to produce tests and examinations which are a valid and reliable measure of his educational objectives.	0.44
43.	Willingly consults colleagues in case of professional difficulties.	0.42
36.	Helps pupils to prepare for a career in science or technology.	0.39
51.	Plans the direction of his teaching with examinations, internal and external, always in mind.	0.32

Scale reliability 0.74

Scale 3	Pupil-oriented science teaching	
58.	Encourages open-ended discussion	0.64
45.	Tries to build up his work from known interests of the pupils.	0.63
2.	Takes refresher courses in his science subject	0.60
31.	Encourages and helps pupils to write their own notes.	0.60
46.	Can locate sources for free and inexpensive science teaching material.	0.56
47.	Frequently revises earlier work.	0.55
49.	Encourages a pupil's self-initiated work.	0.55
32.	Encourages pupils to bring appropriate materials and specimens to class.	0.51
54.	Explains why subject matter is important to pupils	0.48
5.	Is willing to try new methods and procedures in the classroom or laboratory.	0.39

Scale reliability 0.85

Scale 4	Interest-in-science teaching through understanding	Item correlation
37.	Tries to stimulate pupils to think for themselves about science	0.72
24.	Relates new learning to natural phenomena within the experience of the pupil in order to develop meaningful associations	0.55
11.	Has patience in his dealing with pupils	0.51
69.	Tries always to consider the pupils' viewpoints	0.49
4.	Develops interests in science in his pupils.	0.48
8.	Can point out links between his subject and related subjects.	0.47
67.	Knows of sources of information and references about his subject and the teaching and learning of it.	0.47
9.	Has a genuine interest in science and believes in the academic and practical use of the subject.	0.40
53.	Teaches for understanding rather than reproduction of learned material.	0.34

Scale reliability - 0.80

Scale 5.	Learning theory based teaching	
20.	Has studied the philosophy and psychology of education.	0.65
38.	Can apply his knowledge of the psychology of learning to the teaching of his subject.	0.64
33.	Can evaluate benefits derived from field trips or visits to industry.	0.60
6.	Uses audio-visual materials in his teaching.	0.57
18.	Takes refresher courses in teaching and general educational matters	0.57
14.	Uses various methods of evaluating pupils	0.53
35.	Can interpret the results of diagnostic instruments used in schools (I.Q., Aptitude and Achievement tests).	0.52
48.	Encourages pupils to set themselves goals according to their abilities.	0.49
17.	Explains to pupils how to break up large problems into a number of small problems	0.40
12.	Works towards a planned objective or objectives in each lesson but is flexible with lesson plans as circumstances permit	0.33

Scale reliability 0.84

Scale 6	Learning in a planned, experimental laboratory	Item correlation
16.	Can devise experiments which involve pupil participation in learning	0.74
65.	Whenever possible, relates new concepts to already learnt ones by an experimental rather than a mathematical presentation	0.63
27.	Changes curriculum and methods to keep up to date with developments in his subject and methods for teaching it.	0.56
44.	Sees that there is an adequate supply of text books, laboratory manuals, reference materials and the common tools of science for use in his teaching	0.48
70.	Gives each lesson a clear introduction and conclusion to introduce and summarise the lesson material.	0.42

Scale reliability 0.78

Scale 7	Desirable, disciplined pupil relationships	
39.	Is confident and at ease when teaching.	0.59
28.	Is clear and unequivocal in his personal relationships with pupils.	0.50
23.	Quickly learns to identify the pupils by name	0.49
52.	Has personal respect for each pupil as an individual	0.47
55.	Assesses the work of pupils regularly.	0.47
21.	Is constructive and helpful in his criticism of pupils.	0.44
42.	Never threatens punishment without being prepared to enforce it if necessary.	0.43
34.	Invites pupils to help in practical demonstrations.	0.42
10.	Can manage the class so that accidents in the laboratory or incidents requiring disciplinary measures seldom arise.	0.41
26.	Is consistently fair and emotionally calm when enforcing rules	0.37
3.	Knows how to proceed if there is a serious problem of discipline.	0.37

Scale reliability 0.79

APPENDIX 5.12.3.

ITEM-SCALE CORRELATIONS

	S C A L E						
ITEM	1	2	3	4	5	6	7
1	07	05	11	-03	16	19	08
2	36	14	60*	14	31	38	00
3	25	44	17	23	27	32	37*
4	22	13	21	48*	18	08	11
5	25	05	39*	39	38	28	32
6	40	06	40	45	57*	40	35
7	01	24	-10	09	07	15	14
8	38	24	15	47*	20	-10	22
9	18	02	32	40*	07	02	25
10	19	23	12	36	12	01	41*
11	38	02	18	51*	28	-07	27
12	27	-03	29	37	33*	23	12
13	52*	09	37	25	44	32	25
14	52	22	34	19	53*	18	28
15	07	18	19	20	18	11	21
16	27	25	38	05	46	74*	35
17	31	34	25	14	40*	25	26
18	32	15	53	09	57*	59	21
19	46*	24	35	44	52	01	35
20	16	04	31	21	65*	24	21
21	30	31	22	50	40	23	44*
22	20	52*	12	20	26	22	43
23	30	29	37	27	20	13	49*
24	44	31	45	55*	34	33	34
25	65*	30	44	47	40	07	28
26	-01	03	-04	14	24	27	37*
27	28	15	58	11	32	56*	17
28	39	-02	30	13	18	26	50*
29	48	46*	36	22	41	33	44
30	22	48*	19	13	22	13	30
31	31	01	60*	12	48	40	32
32	44	02	51*	41	41	11	42
33	55	27	57	35	60*	50	40
34	45	34	31	29	28	16	42*
35	26	29	45	17	52*	45	11
36	19	39*	29	35	06	07	20
37	37	18	32	72*	26	13	25
38	44	20	27	28	64*	24	37
39	24	37	32	38	28	09	59*
40	63*	24	44	35	39	19	14
41	61*	20	44	30	34	16	30
42	04	33	10	11	17	24	43*
43	21	42*	18	30	15	-02	27
44	34	29	30	07	37	48*	41
45	39	11	63*	32	46	45	16

	SCALE						
ITEM	1	2	3	4	5	6	7
46	38	25	56*	23	35	22	23
47	41	38	55*	18	24	26	40
48	50	23	32	14	49*	36	40
49	56	37	55*	32	30	36	34
50	11	18	14	06	-02	-16	19
51	-18	32*	-24	-08	-20	-16	07
52	22	19	29	24	24	-01	47*
53	34	07	21	34*	24	18	18
54	52	29	48*	29	45	45	36
55	20	21	25	00	29	45	47*
56	55*	44	45	47	37	27	55
57	56*	15	50	37	35	33	13
58	62	16	64*	31	45	37	14
59	31	49*	18	14	25	39	15
60	64*	42	46	40	38	40	36
61	58*	-01	48	31	46	18	31
62	48*	34	30	11	35	20	21
63	77*	31	60	54	43	30	28
64	60*	27	49	27	32	31	35
65	34	09	32	07	40	63*	12
66	60*	18	31	34	30	27	30
67	36	43	30	47*	29	06	32
68	36	44*	29	31	23	20	25
69	30	28	19	49*	23	01	38
70	08	08	26	09	42	42*	12

Decimal points omitted

An item which contributes to a scale score is indicated by an asterisk. Such an item is excluded from the summation of the scale score when the correlation coefifcient is calculated.

APPENDIX 6.3.1.

AN ATTEMPT TO RELATE ACHIEVEMENT OUTCOMES TO TEACHER STEREOTYPE

Achievement in the O-level physics examination can be analysed by teacher stereotype with co-variate controls in an attempt to isolate the most effective type of teaching behaviour. The result of one of these analyses of variance is shown below and overpage.

It appears that teachers of type 3 (B_2- the science intuition teachers) bring about the highest achievement in their pupils and teachers of type 1 (A - interest-in-science teachers) bring about the worst results. However, the research design for the fifth-form did not permit any pre-test measures of physics ability. The variation in 0-level physics achievement between teacher-stereotypes could be due to uncontrolled variation in prior achievement. This is another major source of error, which has to be added to the uncertainty of whether teacher expressed attitudes are accompanied by the corresponding actions within the classroom.

ANALYSING THE VARIANCE IN O-LEVEL PHYSICS GRADE SCORES
BY TEACHER-STEREOTYPE

* * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * *

O-level PHYSICS GRADE
BY STEREOTYPE
WITH PHYSICS EXAM. MOTIVATION
LEARNING-BY-EXPERIMENT
MOTIVATION IN PHYSICS
SLOG
EXTRAVERSION

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
COVARIATES	204.840	5	40.968	26.733	.001
PHYSICS EXAM. MOTIVATION	7.260	1	7.260	4.737	.030
LEARNING-BY-EXPERIMENT	5.351	1	5.351	3.491	.062
MOTIVATION IN PHYSICS	42.361	1	42.361	27.642	.001
SLOG	37.251	1	37.251	24.307	.001
EXTRAVERSION	22.696	1	22.696	14.810	.001
MAIN EFFECTS	37.561	6	6.260	4.085	.001
STEREOTYPE	37.561	6	6.260	4.085	.001
EXPLAINED	242.401	11	22.036	14.379	.001
RESIDUAL	660.506	431	1.532		
TOTAL	902.907	442	2.043		

/cont.

MULTIPLE CLASSIFICATION ANALYSIS

GRAND MEAN = 3.05

VARIABLE + CATEGORY	N	UNADJUSTED DEV'N	UNADJUSTED ETA	ADJUSTED FOR INDEPENDENTS DEV'N	ADJUSTED FOR INDEPENDENTS BETA	ADJUSTED FOR INDEPENDENTS + COVARIATES DEV'N	ADJUSTED FOR INDEPENDENTS + COVARIATES BETA
STEREOTYPE							
1 (A)	17	.66				.61	
2 (B_1)	114	.34				.36	
3 (B_2)	42	-.48				-.55	
4 (B_3)	27	-.16				-.19	
5 (B_4)	150	-.08				-.08	
6 (C)	31	-.21				-.23	
7 (D)	62	-.11				-.07	
			.19				.20
MULTIPLE R SQUARED							.268
MULTIPLE R							.518

In this analysis, grade A was scored 1, grade B was scored 2 etc

APPENDIX 7.3.1.

MEAN SCORES ANALYSED BY LIE SCORE

Lie score	Size of Sub-group	Mean score (standard deviation) Extraversion	Neuroticism	S	M	MS
0	61	15.23(3.42)	11.98(3.99)	3.74(2.38)	8.80(3.09)	12.54(4.96)
1	124	14.73(4.00)	11.58(3.98)	3.99(2.17)	9.44(2.59)	13.43(3.89)
2	151	13.44(4.31)	10.82(4.06)	4.76(2.10)	9.99(3.00)	14.75(4.36)
3	160	13.63(3.98)	10.86(3.98)	4.84(2.32)	10.11(3.06)	14.95(4.67)
4	116	12.35(4.74)	10.66(4.74)	5.35(2.41)	10.13(2.85)	15.48(4.52)
5	65	12.03(4.10)	9.77(3.79)	5.77(2.41)	10.40(2.41)	16.17(3.53)
6	30	12.00(4.13)	9.00(4.63)	5.53(2.35)	10.27(2.99)	15.80(4.77)
7	16	9.75(3.92)	9.38(3.03)	6.44(1.79)	10.69(2.06)	17.13(3.28)
8	3	10.00(5.20)	9.67(8.08)	6.33(1.53)	12.67(1.16)	19.00(2.65)
9	0	-	-	-	-	-

APPENDIX 7.3.2. CHARACTERISICS OF WELL MOTIVATED EXTRAVERTS

Variable	Mean scores (standard deviation)	
	Well motivated extraverts (N = 214)	Rest of Sample (N = 515)
Study methods (S)	5.21 (2.14)**	4.66 (2.39)
Motivation (M)	11.74 (1.38)**	9.16 (3.31)
Extraversion	16.57 (2.18)**	12.08 (4.94)
Neuroticism	9.90 (3.98)**	11.17 (4.27)
Lie	2.44 (1.56)**	2.92 (1.78)

** p < 1% (t-test)

The significantly better study methods of the well motivated extraverts supports the hypothesis put forward in Section 7.3.5 , that extraverts can display good study methods under favourable motivational conditions.

APPENDIX 7.4.1.

A SEX DIFFERENCE ON THE VARIED/TEACHING FOR UNDERSTANDING SCALE

Scale	Mean score (standard deviation) Boys (N = 537)	Girls (N = 204)
Varied/ teaching-for-understanding (preference)	25.14 (3.07)	26.28 (2.51)**
Varied/ teaching-for-understanding (reality)	21.91 (3.81)	22.12 (3.62)
Teacher centred/notemaking (preference)	12.95 (2.34)	13.46 (2.00)**
Teacher centred/notemaking (reality)	15.03 (2.16)	14.99 (2.19)
Pupil centred/text-book (preference)	12.45 (2.66)	12.05 (2.40)
Pupil centred/text book (reality)	10.66 (2.46)	10.77 (2.48)

** p < 1% (t-test)

Girls show a greater preference for varied/teaching-for-understanding than the boys.

The significant sex difference shown on the teacher centred/notemaking scale should be treated with caution because of the lack of reliability of this scale.

APPENDIX 7.5.1.

THE ATTITUDES OF PUPILS CHOOSING PHYSICS

TABLE A RANK-ORDERS FOR SUBJECT CONTENT

CONTAINS TOO MUCH MATERIAL (B)			
Boys		Girls	
Subject	z-score	Subject	z-score
History	4.21	History	2.31
Geography	-5.92	Geography	-2.69
English literature	-6.60	Physics	-3.28
French	-6.77	Chemistry	-3.70
Biology	-7.21	Biology	-3.78
Chemistry	-7.32	English literature	-3.90
Physics	-9.98	French	-4.58
English language	-10.77	English language	-5.07
Mathematics	-11.76	Mathematics	-5.82
CONTAINS SUFFICIENT MATERIAL (A)			

TABLE B RANK-ORDERS FOR 'BORING'

BORING (B)			
Boys		Girls	
Subject	z-score	Subject	z-score
English literature	7.86	English 1	2.68
French	7.61	English literature	2.66
English language	5.84	French	2.59
Geography	4.87	History	1.73
History	3.61	Physics	-2.16
Biology	-6.18	Geography	-2.31
Mathematics	-6.55	Mathematics	-3.13
Chemistry	-7.47	Chemistry	-3.55
Physics	-8.16	Biology	-3.78
EXCITING (A)			

TABLE C RANK-ORDERS FOR 'MODERN'

MODERN (B)			
Boys		Girls	
Subject	z-score	Subjecty	z-score
Mathematics	11.89	Mathematics	4.47
Physics	11.73	Chemistry	4.17
Chemistry	10.63	Biology	4.10
Biology	8.99	French	3.97
English language	8.23	Physics	3.88
Geography	8.19	English language	3.58
French	6.61	Geography	3.27
(History)	(3.61)	English literature	2.19
English literature	-7.07	(History)	(1.73)
OUT OF DATE (A)			

TABLE D RANK-ORDERS FOR 'PRESTIGE'

LOW PRESTIGE (B)			
Boys		Girls	
Subject	z-score	Subject	z-score
French	5.18	Geography	1.73
English literature	5.11	History	-1.44
History	3.37	English literature	-2.19
Geography	-4.62	English language	-2.68
Biology	-6.28	French	-2.90
English language	-8.44	Biology	-3.29
Chemistry	-9.76	Physics	-4.47
Mathematics	-11.28	Mathematics	-4.62
Physics	-11.73	Chemistry	-4.63
HIGH PRESTIGE (A)			

APPENDIX 7.6.1.

CHOOSING A-LEVEL SUBJECTS BY CHANCE

Data for boys taking art is shown as an illustration.

Number studying art at O-level 54

Number choosing art freely as an A-level subject..20

Free choice preference (table 7.6.5) $\frac{20}{54}$ x 100 = 37.0%

Number intending to study one or more A-levels....29

These 29 boys are then classified in terms of the number of A-level subjects chosen and the number of suitable qualifying O-level or C.S.E. subjects being studied. In calculating the latter figure, the subjects which did not naturally lead to a progression to A-level study, e.g. C.S.E. English or O-level English language, were omitted.

TABLE A CALCULATING THE RANDOM ART FREQUENCY

Number of boys	Number of A-levels chosen	Number of fifth form qualifying subjects	Chance of choosing any one subject	Random art choice frequency
1	1	8	1/8	1 x 1/8
1	2	6	2/6	1 x 2/6
1	3	4	3/4	1 x 3/4
2	3	5	3/5	2 x 3/5
7	3	6	3/6	7 x 3/6
12	3	7	3/7	1 2 x 3/7
4	3	8	3/8	4 x 3/8
1	3	9	3/9	1 x 3/9
29				12.8 (13)

The table illustrates how a random art choice frequency of 13 is obtained. This value is then compared

with the observed choice freqwuency of 20 by means of the ψ^2- statistic, which reaches a magnitude of 5.9 to indicate a significant difference at the 5% level between the two frequences.

Some subjects can be taken up at A-level without the necessity of a qualifying O-level subject; economics, sociology and applied mathematics are examples. This means that the random choice frequencies calculated in the final column of table A are maximum values. It is not easy to calculate minimum random choice frequencies without a knowledge of the options (economics, sociology etc.) available to each pupil. Even so, as long as the random choice frequency is <u>less</u> than the observed value, the ψ^2- statistic gives a valid test of significance of difference.

If it is assumed that each art pupil can make an A-level choice from a range of three additional subjects plus the fifth form qualifying subjects, the random art choice frequency falls to nine. This technique could be applied to all the subjects in tables 7.6.5. and 7.6.6. to determine unpopular as well as popular choices.

APPENDIX 7.6.2.

FRUSTRATING THE BIOLOGY CHOICE

Pupils who opt to study biology in free choice conditions but change their minds when a career constraint is applied, choose instead the subjects in table A which are accompanied by '+' signs in the 'shift' column.

TABLE A. SUBJECT CHANGES ACCOMPANYING THE CONSTRAINT ON THE BIOLOGY CHOICE

Boys (N = 22)				Girls (N = 17)			
	Choice condition				Choice condition		
Subject	Free	Bound	Shift	Subject	Free	Bound	Shift
Art	1	1	0	Art	4	3	-1
Biology	22	0	-22	Biology	17	0	-17
Chemistry	7	8	+1	Chemistry	5	6	+1
Economics	2	4	+2	Economics	1	2	+1
English literature	6	9	+3	English literature	2	4	+2
French	1	1	0	French	3	2	-1
Geography	6	6	0	Further mathematics	0	1	+1
G.M.D.	1	1	0	Geology	0	1	+1
History	1	2	+1	Geography	4	3	-1
Mathematics	9	14	+5	German	0	1	+1
Physics	9	15	+6	History	2	2	0
Political studies	0	1	+1	Mathematics	9	14	+5
Sociology	1	1	0	Physics	4	9	+5
No choice	0	3	+3	No choice	0	3	+3

The major shift is seen to be towards mathematics and physics. If there is a pattern to the shifts in choice, it is seen most often as a movement into the traditional mathematics-chemistry-physics grouping.

APPENDIX 7.6.3. G.C.E. STATISTICS - SAMPLE SCHOOOLS

		Boys	Girls
1	Number of pupils intending to start A-level physics	220	45
2	Number of pupils taking O-level physics	375	128
3	Number of pupils passing O-level physics	255 (+5 C.S.E. '1')	95
4	Number of pupils passing O-level physics in group (1)	173 (+2 C.S.E. '1')	40
5	Number of pupils passing O-level physics and leaving	27 (+2 C.S.E. '1')	4
6	A-level physics take-up proportion (4) ÷ (3)	67%	45%
7	O-level physics pass-rate (3) ÷ (2)	68%	74%
8	National O-level physics pass-rate (D.E.S., 1979)	60%	63%

APPENDIX 7.7.1.

FACTOR STRUCTURE MATRIX FOR THE 16 CHOICE STATEMENTS

Statement	Factor 1C	2C	3C	4C	5C	6C
1	135	297	590*	-010	097	243
2	136	-071	543*	025	103	-004
3	-028	246	021	041	009	233
4	243	-100	-064	190	-142	-028
5	005	151	023	057	582*	-034
6	193	083	159	148	426*	068
7	545*	078	282	-041	196	315*
8	047	-072	041	078	-007	316*
9	146	235	078	623*	096	123
10	792*	-094	188	057	026	-053
11	793*	023	212	275	140	012
12	143	099	-038	522*	159	117
13	297	195	-076	232	071	039
14	089	585*	-015	214	180	-037
15	-034	531*	048	079	179	-024
16	-029	103	-162	309*	238	238

Decimal points are omitted. An asterisk indicates a defining statement for that particular factor.

APPENDIX 7.7.2.

FACTOR INTER-CORRELATIONS - CHOOSING PHYSICS

		Factor				
		2C	3C	4C	5C	6C
	1C	0.00	0.16*	0.22**	0.06	0.04
	2C		0.04	0.15*	0.20**	0.10
Factor	3C			-0.12	0.11	0.09
	4C				0.13*	0.12
	5C					0.07

** p < 1%; * p < 5%

APPENDIX 7.7.3.

FACTOR STRUCTURE MATRIX FOR THE 16 REJECTION STATEMENTS

	Factor				
Statement	1R	2R	3R	4R	5R
1	070	-517*	-138	299	-058
2	131	-614*	-127	029	-100
3	026	124	027	027	650*
4	059	086	-150	001	382*
5	473*	-177	-015	-030	-031
6	544*	-071	-246	363	182
7	326	-455*	-062	042	-123
8	256	-181	-778*	200	056
9	485*	-095	-203	058	031
10	147	-031	-223	653*	065
11	117	-208	-115	647*	-008
12	658*	-121	-297	201	238
13	478*	-154	-221	324	000
14	430*	-042	-255	265	323
15	350*	-012	-036	140	311
16	200	-133	-771*	210	127

Decimal points are omitted. An asterisk indicates a defining statement for that particular factor.

APPENDIX 7.7.4.

DIFFERENCES BETWEEN BOYS AND GIRLS

TABLE A CHOOSING PHYSICS

Statement	Number responding: Boys (N=220)	Girls (N=45)	χ^2
1. You have a high O-level physics grade	133	24	
2. You have a better grade in physics than in most other subjects	75	17	
3. University and/or career requirements	197	39	
4. It is not a main subject but it was decided by school/college timetable	6	2	
5. The O-level course was interesting	161	28	
6. You have heard that the A- level course is interesting	76	15	
7. The O-level course was easy	42	1**	6.63
8. Physics allows you to use your mathematical ability	113	24	
9. You are attracted by the amount of student experimental work in physics	68	8	
10. Not so much hard work is expected in A-level physics as in other subjects	10	1	
11. You have heard that it is easier to pass in A-level physics than in most other subjects	17	1	
12. You are attracted by the A-level teaching methods in physics	17	7	
13. You are attracted by the type of exams in A-level physics	12	1	
14. You have heard that it is more difficult to pass in A-level physics than in most other subjects but you are confident that you can manage	62	10	
15. More hard work is expected than in some other subjects but you think you can manage	83	21	
16. To improve your understanding of science in the world today	135	28	

With 1 degree of freedom, a value for χ^2 of 3.84 indicates a difference significant at the 5% level. If no χ^2 value is given, then there is no significant difference at this level between the boys' and girls' responses.

TABLE B REJECTING PHYSICS

Statement	Number responding: Boys (N=143)	Girls (N=106)	γ^2
1. You have a low O-level physics grade	73	59	
2. Your physics grade is lower than the grades in most other subjects	75	58	
3. University and/or career requirements mean other subjects must be studied	59	28	5.27
4. It would not have been a main subject and it could not be fitted into school/college timetable	26	6	7.44
5. The O-level course was not interesting	69	50	
6. You have heard that the A-level course is not interesting	28	7	7.49
7. The O-level course was difficult	104	77	
8. The O-level course was too mathematical	46	18	6.57
9. There was not enough student experimental work in the O-level course	63	23	10.20
10. You have heard that you must work much harder in A-level physics than in most other subjects	38	20	
11. You have heard that it is more difficult to pass at A-level in physics than in most other subjects	52	36	
12. You are not attracted by the teaching methods of the A-level physics course	32	15	
13. You are not attracted by the type of A-level physics exams	45	24	
14. A-level physics will not allow your personal opinions to be expressed	34	20	
15. A-level physics is too narrow and specialist to be useful for you	43	23	
16. The A-level course seems to have too much mathematics in it	48	19	6.80

With 1 degree of freedom, values for γ^2 of 3.84 and 6.63 indicate differences significant at the 5% and 1% levels respectively. If no value of γ^2 is given, then there is no significant difference between the boys' and girls' responses.

APPENDIX 7.9.1.

THE FACTOR STRUCTURE MATRIX FOR THE 'CLASS' ANALYSIS

The correlation coefficients are for the respective variables and factor scores.

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
TA1	-117	769	-140	256	-176
TA2	-178	396	241	488	-363
TA3	-325	882	157	322	020
TA4	051	455	-143	445	146
TA5	-157	853	037	-159	-046
TA6	059	658	-098	240	050
TA7	-347	564	-086	789	177
IMPORT	610	-189	-268	-121	238
ITS	379	017	-838	-216	-021
EXTRAV	-747	-028	464	098	-120
NEUROT	044	-071	183	-004	509
PERFORM	390	-091	-097	258	216
PHYSID	671	-098	-585	-146	288
LBE	-045	115	-321	160	421
SLOG	-292	019	349	-268	270
STUDYHAB	723	020	-210	-110	002
MOT	794	-132	-132	136	-114
PHYSHAB	809	-141	-423	011	-098
PHYSMOT	773	-455	-288	072	-247
VARUND (E)	311	-066	-865	161	-014
MATCH	305	067	-783	083	-081

Decimal points are omitted

APPENDIX 7.9.2.

THE DISCRIMINANT FUNCTIONS FOR THE'CLASS' ANALYSIS

	Discriminant function				
Variable	1	2	3	4	5
TA1	321	604	259	388	140
TA2	541	023	094	177	027
TA3	551	565	-011	406	248
TA4	265	135	152	062	739
TA5	615	487	079	244	194
TA6	319	703	165	138	025
TA7	125	232	306	588	401
IMPORT	-185	017	009	-491	268
ITS	-339	291	402	-278	071
EXTRAV	-001	-220	-261	593	-158
NEUROT	-275	164	-558	-020	166
PERFORM	-090	072	065	-429	151
PHYSID	-286	134	314	-519	246
LBE	-481	181	111	092	627
SLOG	-052	189	-698	163	-007
STUDYHAB	-004	357	-062	-617	-031
MOT	087	223	170	-817	047
PHYSHAB	-223	213	325	-597	001
PHYSMOT	-239	-001	325	-740	-194
VARUND (E)	-420	241	459	-134	-029
MATCH	-188	278	416	-113	153
Variance accounted for	36.6%	27.5%	20.0%	12.8%	3.1%

Correlations between the variables and the respective functions are shown.
Decimal points are omitted

APPENDIX 7.10.1

THE FACTOR STRUCTURE MATRIX FOR FIFTH-FORM LEAVERS

Variable	Correlation Coefficient					
	Factor 1L	Factor 2L	Factor 3L	Factor 4L	Factor 5L	Factor 6L
PERFORM	242	-052	-042	-012	079	-572*
PHYSID	515	247	415	403	-123	-505*
STUDYHAB	422	305	808*	087	134	-255
MOT	755*	171	289	262	248	-427
EXTRAV	-009	-099	-390*	018	304*	055
NEUROT	-137	-200	-158	-179	-726*	098
LIE	107	064	398*	210	105	031
LBE	-126	-345*	-201	-045	004	069
ITS	239	622*	339	119	-059	269
PHYSHAB	558	417	808*	192	134	-354
PHYSMOT	890*	176	303	319	231	-430
VARUND (P)	131	-022	041	550*	065	-144
VARUND (E)	116	575*	233	667*	284	-048
MATCH	197	757*	-240	-033	350*	-120
SAT	393	403	228	219	-110	-483*
SLOG	-272	-168	-183	-2899	019	571*
IMPORT	568*	188	103	008	-009	-218

Decimal points are omitted
An asterisk indicates a variable which can be allocated to that factor.

APPENDIX 7.10.2

THE FACTOR STRUCTURE MATRIX FOR A-LEVEL PHYSICS CHOOSERS

Variable	Correlation coefficient								
	Factor 1C	Factor 2C	Factor 3C	Factor 4C	Factor 5C	Factor 6C	Factor 7C	Factor 8C	Factor 9C
PERFORM	-191	-114	170	338*	-306*	-284	-120	-064	-120
PHYSID	326	236	214	307	-326	-187	-574*	134	121
STUDYHAB	903*	057	-113	353	-151	-210	-067	-058	-137
MOT	292	054	065	957*	-135	-073	-078	-038	-066
EXTRAV	-043	-016	003	-064	100	774*	083	029	084
NEUROT	-255	127	003	-118	051	-137	-047	118	077
LIE	184	009	-135	092	-144	-280*	067	-108	062
LBE	-106	044	027	-044	-021	037	-020	146	508*
ITS	074	406*	-001	041	063	-122	-366*	-021	-112
PHYSHAB	814*	044	004	385	-212	-185	-270	033	-075
PHYSMOT	283	062	119	829*	-179	-045	-206	-012	046
VARUND (P)	-025	250	-173	003	194	024	100	063	183
VARUND (E)	007	826*	-031	-019	-079	-112	-108	136	112
MATCH	008	592*	-014	094	-037	058	-162	097	045
SAT	025	129	072	080	-036	-017	-523*	134	-012
SLOG	005	048	-306*	-281	117	184	408	140	169
IMPORT	123	052	104	164	-052*	-161	-140	125	-038
REASON 1C	-115	-117	881*	-003	084	069	-029	169	052
REASON 2C	-066	060	087	-003	-126	000	-016	544*	008
REASON 3C	-241	-112	300*	-005	-019	023	-157	240	-075
REASON 4C	034	117	049	055	065	042	-204	374*	154
REASON 5C	-052	129	266	011	155	031	-359*	310	067
REASON 6C	-059	016	619*	244	-164	002	-277	039	-077
REASON 7C	-025	014	004	028	-299*	-001	-091	278	-329*

Decimal points are omitted

An asterisk indicates a variable which can be allocated to that factor.

APPENDIX 7.10.3

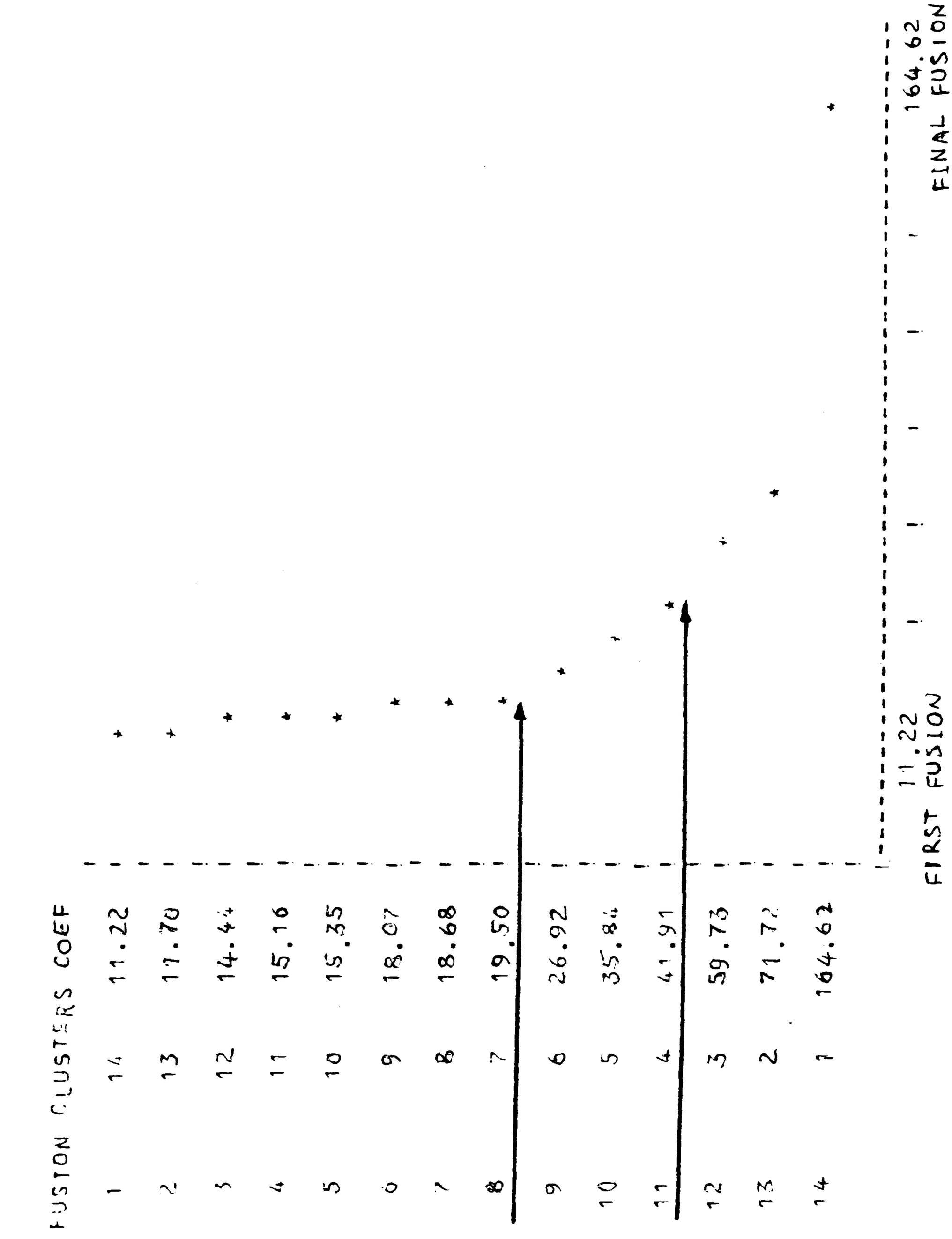
THE FACTOR STRUCTURE MATRIX FOR A-LEVEL PHYSICS REJECTORS

Variable	Correlation coefficient						
	Factor 1R	Factor 2R	factor 3R	Factor 4R	Factor 5R	Factor 6R	Factor 7R
PERFORM	-080	108	-254	-072	290	193	-486*
PHYSID	-618*	375	-311	-124	500	131	-210
STUDYHAB	059	203	-961*	-093	391	046	-328
MOT	-063	143	-303	-112	881*	096	-275
EXTRAV	291	-190	391*	-155	-017	211	163
NEUROT	-284	-007	294	-111	-259	-044	373*
LIE	006	132	-375*	160	117	-043	-223
LBE	-073	032	093	-024	049	638*	107
ITS	-224	515*	-222	-044	240	-079	013
PHYSHAB	-206	329	-797*	-094	379	-012	-404
PHYSMOT	-395	361	-331	-188	792*	-004	-325
VARUND (P)	-122	345*	-081	-177	071	-140	-045
VARUND (E)	-089	772*	-158	-188	164	-007	-048
MATCH	-025	686*	-218	-083	124	010	-095
SAT	-474*	405	-166	-330	258	-004	-256
SLOG	215	-147	264	104	-220	-017	390*
IMPORT	-568*	042	-099	033	194	038	-131
REASON 1R	239	-312	057	713*	-166	021	115
REASON 2R	048	-069	236	259	-215	-085	622*
REASON 3R	-082	-076	060	471*	-122	188	225
REASON 4R	-157	-108	096	307*	-187	-101	201
REASON 5R	037	-109	-123	129	076	333*	-176

Decimal points are omitted

An asterisk indicates a variable which can be allocated to that factor.

APPENDIX 7.11.1 THE CLUSTER FUSION PLOT



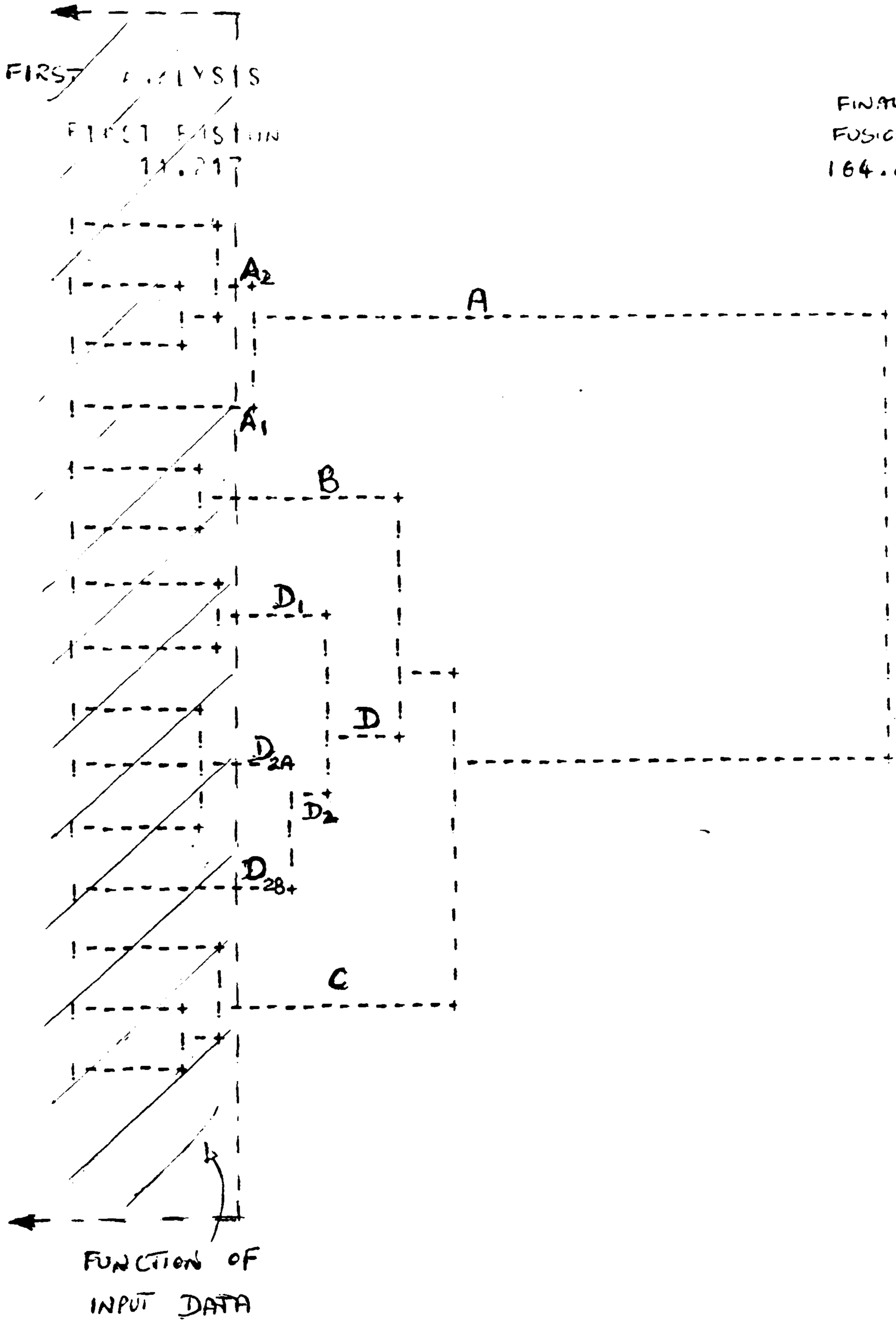
APPENDIX 7.11.2

THE FOUR GROUP SOLUTION

Variable	Cluster mean scores (standardised)			
	A	B	C	D
PERFORM	0.51**	0.06	-0.67**	-0.28**
PHYSID	0.74**	-0.29**	-1.02**	-0.22*
STUDYHAB	0.36**	-0.06	-0.87**	0.03
MOT	0.58**	-0.06	-1.12**	-0.10
EXTRAV	-0.31**	0.08	0.41**	0.12
NEUROT	-0.07	-0.02	0.12	0.04
LIE	0.19*	-0.11	-0.25	-0.04
LBE	-0.03	-0.05	0.25	-0.06
ITS	0.40**	-0.98**	-0.39**	0.17*
PHYSHAB	0.52**	-0.14	-1.24**	0.05
PHYSMOT	0.63**	-0.09	-1.45**	0.00
VARUND (P)	0.20**	0.40**	-0.86**	0.00
VARUND (E)	0.41**	-1.30**	-0.60**	0.39**
VARUND (M)	-0.26**	1.53**	0.01	-0.38**
MATCH	0.38**	-1.12**	-0.42**	0.26**
SAT	0.53**	-0.47**	-0.92**	0.04
SLOG	-0.55**	0.11	0.60**	0.29**
IMPORT	0.58**	-0.10	-0.85**	-0.21**
EXAM	-0.36**	-0.09	1.38**	-0.19**
SEX	-0.22**	0.36**	-0.11	0.14
ALEVEL	0.48**	0.09	-0.73**	-0.24**
PHYSCHOICE	1.01**	-0.15	-0.78**	-0.69**

A single asterisk indicates that the cluster mean is significantly different from the mean of the remaining scores at the 5% level : a double asterisk indicates that the difference is significant at the 1% level.

APPENDIX 7.11.3 DENDROGRAM OF THE CLUSTER ANALYSIS



APPENDIX 7.11.4.

DIFFERENCES BETWEEN CLUSTERS A_1 AND A_2

In table A, a direct comparison is made between the cluster mean scores by either the t-test or chi-squared test as appropriate. This gives a sharper analysis of the differences between clusters A_1 and A_2 than is permitted by the comparison of mean scores with remanent sample scores as in table 7.11.3.

TABLE A DIFFERENCES BETWEEN THE MAJOR PHYSICS CHOOSING GROUPS

Variable	Raw mean scores (standard deviation)			
	Group A_1 (N = 86)		Group A_2 (N = 120)	
PERFORM	4.37	(1.28)	4.55	(1.08)
PHYSID	68.76	(8.96)	75.34	(8.99)**
STUDYHAB	3.86	(1.49)	6.59	(1.53)**
MOT	10.11	(2.31)	12.48	(1.48)**
EXTRAV	12.59	(3.79)	11.4	(4.23)*
NEUROT	12.52	(3.50)	9.56	(3.47)**
LIE	2.28	(1.28)	3.31	(1.51)**
ENJOY	30.71	(3.56)	33.19	(3.66)**
COMMIT	20.50	(4.40)	23.57	(4.78)**
LBE	22.34	(3.26)	21.37	(4.01)
PROBSOLV	17.55	(2.74)	18.58	(2.40)**
ITS	3.44	(0.71)	3.51	(0.78)
PHYSHAB	4.66	(1.81)	7.27	(1.52)**
PHYSMOT	11.73	(2.13)	13.40	(1.12)**
VARUND (P)	26.13	(2.42)	26.38	(1.98)
VARUND (E)	24.52	(2.88)	23.21	(2.83)**
VARUND (M)	1.61	(2.96)	3.18	(2.78)**
MATCH	11.16	(3.17)	11.28	(3.30)
SAT	10.62	(1.48)	11.03	(1.23)*
SLOG	3.95	(1.30)	3.33	(1.23)**
IMPORT	3.49	(0.63)	3.56	(0.58)
EXAM	81 G.C.E. :	5 C.S.E.	116 G.C.E. :	4 C.S.E.
SEX	65 boys,	21 girls	110 boys,	10 girls**
ALEVEL	All pupils intend to go into sixth-form			
PHYSCHOICE	81 choose :	5 reject	111 choose :	9 reject

** p < 1%; * p < 5%

In the table, the composite variable PHYSID is split into its highly inter-correlated sub-scales of

a) ENJOY - enjoyment of physics lessons;

b) COMMIT - commitment to physics for further study and a likely career;

c) PROBSOLV - physics seen as a problem solving activity rather than a block of knowledge. (Section 5.2.5.)

A_2-type pupils are seen to be superior on the enjoyment and commitment sub-scales and to a lesser degree on the problem-solving scale. The motivation and study habits of these pupils are also undoubtedly the better. Although A_1-type find the subject significantly more difficult, the difference in attainment does not reach the 5% significance level.

As well as the anxiety displayed by group A_1 pupils it is also clear that these pupils are more extraverted than those of group A_2. With the two groups being of significantly different sex composition, there is the danger that the personality differences between the groups are due entirely to the relative numbers of girls. To investigate this, the personality variables were analysed according to sex and cluster.

TABLE B CLUSTER DIFFERENCES BROKEN DOWN BY SEX

	Cluster A_1		Cluster A_2	
Variable	boys (N = 65)	girls (N = 21)	boys (N = 119)	girls (N = 10)
EXTRAV	12.92 (3.79)+	11.57 (3.74)	11.42 (4.23)+	11.70 (4.42)
NEUROT	12.09 (3.48)+*	13.86 (3.29)+*	9.38 (3.26)+*	11.90 (4.49)+*
LIE	2.20 (1.31)+	2.52 (1.17)+	3.26 (1.49)+	3.99 (1.66)+

* $p < 5\%$ (sex difference within the cluster)
+ $p < 5\%$ (difference between clusters)

It is clear from table B that the relative

contributions of the girls do not distort the overall differences between the groups. Indeed, the girls tend to score similarly on the extraversion scale and it is the dominating proportions of boys which determines the significant difference. The tendency for girls to score higher than boys on the neuroticism scale in both clusters is the normal population attribute (Eysenck and Eysenck, 1964).

APPENDIX 7.11.5.

DIFFERENCES BETWEEN HIGH AND LOW VARUND (P) SCORERS : TYPE D_1 PUPILS

Variable	Raw mean scores for pupils with VARUND (P) score of 26 or more (N = 39)		VARUND (P) score of 25 or less (N = 27)	
PERFORM	3.00	(1.64)	3.11	(1.40)
PHYSID	63.90	(10.34)	61.19	(10.87)
STUDYHAB	5.05	(2.47)	5.04	(2.08)
MOT	10.10	(2.15)	9.59	(1.89)
EXTRAV	14.44	(3.68)	14.33	(3.48)
NEUROT	8.21	(3.83)	8.30	(3.17)
LIE	2.87	(1.47)	3.22	(1.60)
LBE	21.03	(2.97)	21.44	(3.13)
ITS	3.62	(0.59)	3.41	(0.75)
PHYSHAB	5.54	(2.30)	5.85	(2.05)
PHYSMOT	11.62	(1.97)	10.89	(2.19)
VARUND (P)	27.13	(1.26)	23.04	(1.48)**
VARUND (E)	23.97	(2.97)	21.33	(3.29)**
VARUND (M)	3.15	(2.74)	1.70	(3.12)*
MATCH	11.05	(3.29)	9.63	(2.91)
SAT	10.15	(1.86)	10.41	(1.60)
SLOG	4.05	(1.26)	4.30	(1.44)
IMPORT	2.95	(0.72)	3.04	(0.76)
EXAM	26 G.C.E. :	13 C.S.E.	20 G.C.E. :	7 C.S.E.
SEX	36 boys :	3 girls	26 boys :	1 girl
ALEVEL	1 choose :	38 reject	1 choose :	26 reject
PHYSCHOICE	0 choose :	39 reject	0 choose :	27 reject
PROBSOLV	16.08	(2.71)	14.63	(2.59)*

Standard deviations are shown in brackets
** p < 1%: * p < 5% (t-test)

Variable PROBSOLV measures the pupil's perception of physics as a problem-solving activity. It is a sub-scale of the enjoyment and subject identification variable PHYSID (Section 5.2.5). Low VARUND (P) scorers thus see physics more superficially,which might contribute to its higher difficulty rating (although this fails to reach a statistically significant level). There is some tentative support for the hypothesis that the low VARUND (P) scorers enjoy physics less than do the other D_1-type pupils.

APPENDIX 7.11.6.

CLASSIFYING THE PUPILS INTO GROUPS - INFORMATION FROM ALL FUNCTIONS

Actual group	Number of pupils	Predicted group membership (%)						
		A_1	A_2	B	C	D_1	D_{2A}	D_{2B}
A_1	86	70.9	1.2	1.2	1.2	14.0	8.1	3.5
A_2	120	4.2	77.5	0	0	9.2	1.7	7.5
B	65	0	0	93.8	3.1	3.1	0	0
C	64	0	0	4.7	87.5	1.6	4.7	1.6
D_1	66	9.1	10.6	1.5	3.0	54.5	12.1	9.1
D_{2A}	70	12.9	0	0	7.1	4.3	75.7	0
D_{2B}	76	1.3	7.9	1.3	1.3	9.2	2.6	76.3

APPENDIX 7.12.1

DIFFERENCES BETWEN HIGH AND LOW LIE SCORERS

Variable	Mean score (standard deviation)	
	Lie score of 5 or more (N = 90)	Lie score of 4 or less (N = 457)
PERFORM	3.78 (1.53)	3.81 (1.43)
PHYSID	66.54 (11.89)	63.58(12.53)*
STUDYHAB	5.93 (2.01)	4.92 (2.25)**
MOT	10.62 (2.27)	10.34 (2.70)
EXTRAV	11.21 (4.10)	13.42 (4.25)**
NEUROT	9.52 (4.01)	10.98 (4.15)**
LIE	5.61 (0.83)	2.26 (1.22)**
LBE	21.91 (3.78)	21.81 (3.66)
ITS	3.18 (1.00)	3.12 (0.94)
PHYSHAB	6.06 (2.37)	5.16 (2.47)**
PHYSMOT	11.30 (2.79)	10.84 (3.31)
VARUND (P)	25.79 (2.42)	25.76 (2.66)
VARUND (E)	22.49 (3.45)	21.99 (3.81)
VARUND (M)	3.30 (3.39)	3.77 (3.95)
MATCH	10.07 (3.83)	9.69 (3.44)
SAT	9.48 (2.02)	9.64 (2.12)
SLOG	4.48 (1.34)	4.32 (1.40)
IMPORT	3.14 (0.68)	3.10 (0.75)
EXAM	72 G.C.E. : 18 C.S.E.	382 G.C.E. : 75 C.S.E.
SEX	66 boys : 24 girls	335 boys : 122 girls
ALEVEL	73 choose : 17 reject	369 choose : 88 reject
PHYSCHOICE	36 choose : 54 reject	194 choose : 263 reject

** p < 1%; * p < 5% (t-test)

The four dichotomous variables SEX, ALEVEL, PHYSCHOICE and EXAM were tested by means of the χ^2-statistic.

APPENDIX 7.12.2

CORRELATION BETWEEN LIE AND NEUROTICISM

Eysenck and Eysenck (1975) have suggested that the criterion of a negative correlation between neuroticism and lie scores might be taken as indication that the lie scale is measuring faked responses. A value for the correlation coefficient as high as 0.5, they recommend, should be taken as the lie interpretation criterion. Table A shows the correlations for the fifth-form pupil clusters.

TABLE A LIE NEUROTICISM CORRELATIONS

Cluster	N	Correlation between Neuroticism and Lie
A_1	86	0.17
A_2^1	120	-0.09
B^2	65	0.08
C	64	-0.18
D_1	66	-0.21
D_{2A}^1	70	0.28*
D_{2B}	76	0.10
All	547	-0.16**

**p < 1%; * p < 5%

None of the correlations reach the moderate values demanded by Eysenck and Eysenck. Looking at the natural clusters, only for group D_{2A} is the correlation significant, but then this is positive rather than negative. Indeed, D_{2A} pupils have the lowest lie scores of all.

APPENDIX 9.2.1.

PRE-TEST/POST-TEST DIFFERENCES ON THE COMPOSITE SCALES (REDUCED SAMPLE)

	Mean score			
	Boys (N = 92)		Girls (N = 32)	
Composite scale	Pre-test	Post-test	Pre-test	Post-test
Enjoyment	24.97 (5.41)	22.42** (6.03)	23.44 (4.68)	23.56 (4.86)
Easiness	11.30 (3.18)	11.85 (3.99)	9.25 (2.62)	10.41* (2.67)

Standard deviations are shown in brackets
**p < 1% (t-test,deterioration)
* p < 5% (t-test,improvement)

APPENDIX 9.2.2. ANALYSING THE VARIANCE IN POST-TEST 'ENJOYMENT' SCORES

* * * * * * * * ANALYSIS OF VARIANCE * * * * * * * *

ENJOYMENT (post-test)
BY GCE BOARD
SEX
WITH FIFTH-FORM ENJOYMENT
O-LEVEL PHYSICS ATTAINMENT

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
COVARIATES	238.179	2	119.089	3.939	.022
FIFTH-FORM ENJOYMENT	96.606	1	96.606	3.195	.077
O-LEVEL PHYSICS ATTAINMENT	117.373	1	117.373	3.882	.051
MAIN EFFECTS	397.968	5	79.594	2.633	.027
GCE BOARD	366.064	4	91.516	3.027	.021
SEX	61.212	1	61.212	2.025	.158
2-WAY INTERACTIONS	20.546	3	6.849	.227	.878
GCE BOARD SEX	20.546	3	6.849	.227	.878
EXPLAINED	656.693	10	65.669	2.172	.024
RESIDUAL	3416.428	113	30.234		
TOTAL	4073.121	123	33.115		

124 CASES WERE PROCESSED.
0 CASES (0 PCT) WERE MISSING.

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MULTIPLE CLASSIFICATION ANALYSIS

GRAND MEAN = 22.72

VARIABLE + CATEGORY	N	UNADJUSTED DEV'N	UNADJUSTED ETA	ADJUSTED FOR INDEPENDENTS DEV'N	ADJUSTED FOR INDEPENDENTS BETA	ADJUSTED FOR INDEPENDENTS + COVARIATES DEV'N	ADJUSTED FOR INDEPENDENTS + COVARIATES BETA
GCE BOARD							
0 AEB	27	-2.27				-2.25	
1 CAMBRIDGE	23	-.76				-.53	
2 JMB	17	.87				1.15	
3 LONDON	14	2.93				3.93	
4 OXFORD	43	.54				-.04	
			.27				.31
SEX							
0 BOYS	92	-.29				-.45	
1 GIRLS	32	.84				1.29	
			.09				.13
MULTIPLE R SQUARED							.156
MULTIPLE R							.395

APPENDIX 9.2.3. ANALYSING THE VARIANCE IN POST-TEST 'EASINESS' SCORES

* * * * * * * * ANALYSIS OF VARIANCE * * * * * * * *

EASINESS (post-test)
BY GCE BOARD
SEX
WITH FIFTH FORM ENJOYMENT
O-LEVEL PHYSICS ATTAINMENT

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
COVARIATES	39.423	2	19.712	1.623	.202
FIFTH-FORM ENJOYMENT	.482	1	.482	.040	.842
O-LEVEL PHYSICS ATTAINMENT	37.562	1	37.562	3.101	.081
MAIN EFFECTS	209.434	5	41.887	3.449	.006
GCE BOARD	141.648	4	35.412	2.915	.024
SEX	99.852	1	99.852	8.221	.005
2-WAY INTERACTIONS	97.553	3	32.518	2.677	.050
GCE BOARD SEX	97.553	3	32.518	2.677	.050
EXPLAINED	346.411	10	34.641	2.852	.003
RESIDUAL	1372.516	113	12.146		
TOTAL	1718.927	123	13.975		

124 CASES WERE PROCESSED.
0 CASES (0 PCT) WERE MISSING.

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MULTIPLE CLASSIFICATION ANALYSIS

GRAND MEAN = 11.48

VARIABLE + CATEGORY	N	UNADJUSTED DEV"N	UNADJUSTED ETA	ADJUSTED FOR INDEPENDENTS DEV"N	ADJUSTED FOR INDEPENDENTS BETA	ADJUSTED FOR INDEPENDENTS + COVARIATES DEV"N	ADJUSTED FOR INDEPENDENTS + COVARIATES BETA
GCE BOARD							
0 AEB	27	-1.36				-1.41	
1 CAMBRIDGE	23	-.26				-.22	
2 JMB	17	.94				.56	
3 LONDON	14	-1.19				-1.42	
4 OXFORD	43	1.01				1.25	
			.28				.30
SEX							
0 BOYS	92	.37				.37	
1 GIRLS	32	-1.07				-1.65	
			.17				.25
MULTIPLE R SQUARED							.145
MULTIPLE R							.380

APPENDIX 9.2.4. ANALYSING THE VARIANCE IN POST-TEST 'SOCIAL IMPLICATIONS ALWAYS CONSIDERED' SCORES

* * * * * * * * ANALYSIS OF VARIANCE * * * * * * * *

'SOCIAL IMPLICATIONS ALWAYS CONSIDERED'
BY GCE BOARD
SEX
WITH FIFTH-FORM ENJOYMENT
O-LEVEL PHYSICS ATTAINMENT

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
COVARIATES	.808	2	.404	.170	.844
FIFTH-FORM ENJOYMENT	.614	1	.614	.259	.613
O-LEVEL PHYSICS ATTAINMENT	.269	1	.269	.113	.737
MAIN EFFECTS	14.878	5	2.976	1.250	.291
GCE BOARD	4.644	4	1.161	.488	.745
SEX	9.453	1	9.453	3.971	.049
2-WAY INTERACTIONS	4.037	3	1.346	.565	.639
GCE BOARD SEX	4.037	3	1.346	.565	.639
EXPLAINED	19.724	10	1.972	.829	.602
RESIDUAL	269.010	113	2.381		
TOTAL	288.734	123	2.347		

124 CASES WERE PROCESSED.
0 CASES (0 PCT) WERE MISSING.

cont. overpage

MULTIPLE CLASSIFICATION ANALYSIS

GRAND MEAN = 3.71

VARIABLE + CATEGORY	N	UNADJUSTED DEV'N	UNADJUSTED ETA	ADJUSTED FOR INDEPENDENTS DEV'N	ADJUSTED FOR INDEPENDENTS BETA	ADJUSTED FOR INDEPENDENTS + COVARIATES DEV'N	ADJUSTED FOR INDEPENDENTS + COVARIATES BETA
GCE BOARD							
0 AEB	27	-.06				-.05	
1 CAMBRIDGE	23	.38				.40	
2 JMB	17	-.31				-.18	
3 LONDON	14	-.10				-.02	
4 OXFRD	43	-.01				-.10	
			.13				.13
SEX							
0 BOYS	92	-.15				-.18	
1 GIRLS	72	.44				.51	
			.17				.20

MULTIPLE R SQUARED .054
MULTIPLE R .233

APPENDIX 9.2.5. ANALYSING THE VARIANCE IN POST-TEST 'OUT-OF-DATE' SCORES

* * * * * * * * ANALYSIS OF VARIANCE * * * * * * * *

'OUT-OF-DATE' (post-test)
BY GCE BOARD
SEX
WITH FIFTH-FORM ENJOYMENT
O-LEVEL PHYSICS ATTAINMENT

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
COVARIATES	3.585	2	1.793	1.214	.301
FIFTH-FORM ENJOYMENT	2.483	1	2.483	1.681	.197
O-LEVEL PHYSICS ATTAINMENT	.781	1	.781	.529	.468
MAIN EFFECTS	21.376	5	4.275	2.896	.017
GCE BOARD	15.493	4	3.873	2.623	.038
SEX	9.678	1	9.678	6.555	.012
2-WAY INTERACTIONS	4.884	3	1.628	1.103	.351
GCE BOARD SEX	4.884	3	1.628	1.103	.351
EXPLAINED	29.845	10	2.985	2.021	.037
RESIDUAL	166.832	113	1.476		
TOTAL	196.677	123	1.599		

124 CASES WERE PROCESSED.
0 CASES (0 PCT) WERE MISSING.

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MULTIPLE CLASSIFICATION ANALYSIS

GRAND MEAN = 3.27

VARIABLE + CATEGORY	N	UNADJUSTED DEV"N	UNADJUSTED ETA	ADJUSTED FOR INDEPENDENTS DEV"N	ADJUSTED FOR INDEPENDENTS BETA	ADJUSTED FOR INDEPENDENTS + COVARIATES DEV"N	ADJUSTED FOR INDEPENDENTS + COVARIATES BETA
GCE BOARD							
0 AEB	27	-.13				-.14	
1 CAMBRIDGE	23	-.10				-.14	
2 JMB	17	.31				.20	
3 LONDON	14	-.63				-.87	
4 OXFORD	43	.21				.36	
			.22				.30
SEX							
0 BOYS	92	.12				.18	
1 GIRLS	32	-.34				-.51	
			.16				.24
MULTIPLE R SQUARED							.127
MULTIPLE R							.356

APPENDIX 9.2.6. ANALYSING THE VARIANCE IN A-LEVEL PHYSICS GRADE SCORES

* * * * * * * * ANALYSIS OF VARIANCE * * * * * * * *

A-LEVEL PHYSICS GRADE
BY GCE BOARD
SEX
WITH FIFTH-FORM ENJOYMENT
O-LEVEL PHYSICS ATTAINMENT

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
COVARIATES	117.884	2	58.942	33.296	.001
FIFTH-FORM ENJOYMENT	.118	1	.118	.067	.797
O-LEVEL PHYSICS ATTAINMENT	115.787	1	115.787	65.407	.001
MAIN EFFECTS	66.490	5	13.298	7.512	.001
GCE BOARD	66.485	4	16.621	9.389	.001
SEX	2.069	1	2.069	1.169	.282
2-WAY INTERACTIONS	12.835	3	4.278	2.417	.070
GCE BOARD SEX	12.835	3	4.278	2.417	.070
EXPLAINED	197.210	10	19.721	11.140	.001
RESIDUAL	200.040	113	1.770		
TOTAL	397.250	123	3.230		

124 CASES WERE PROCESSED.
0 CASES (0 PCT) WERE MISSING.

cont. overpage

MULTIPLE CLASSIFICATION ANALYSIS

GRAND MEAN = 4.25

VARIABLE + CATEGORY		N	UNADJUSTED DEV'N	UNADJUSTED ETA	ADJUSTED FOR INDEPENDENTS DEV'N	ADJUSTED FOR INDEPENDENTS BETA	ADJUSTED FOR INDEPENDENTS + COVARIATES DEV'N	ADJUSTED FOR INDEPENDENTS + COVARIATES BETA
GCE BOARD								
0	AEB	27	1.19				1.16	
1	CAMBRIDGE	23	-.21				-.28	
2	JMB	17	.10				.24	
3	LONDON	14	.96				.44	
4	OXFORD	43	-.99				-.82	
				.49				.42
SEX								
0	BOYS	92	.10				-.08	
1	GIRLS	32	-.28				.24	
				.09				.08
MULTIPLE R SQUARED								.464
MULTIPLE R								.681

In this analysis, grade A was scored 1, grade B was scored 2 etc.. This is the reverse of the procedure which gives the mean scores of table

APPENDIX 9.2.7. ANALYSING THE VARIANCE IN ENJOYMENT RESIDUALS

* * * * * * * * ANALYSIS OF VARIANCE * * * * * * * *

ENJOYMENT RESIDUAL
BY GCE BOARD
SEX
WITH O-GRADE PHYSICS
EASINESS
PLANNED 'METHOD' TEACHING (given)

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
COVARIATES	396.278	3	132.093	7.578	.001
O-GRADE PHYSICS	59.402	1	59.402	3.408	.068
EASINESS	121.861	1	121.861	6.991	.009
PLANNED 'METHOD' TEACHING (given)	136.492	1	136.492	7.830	.006
MAIN EFFECTS	410.656	5	82.131	4.712	.001
GCE BOARD	351.543	4	87.886	5.042	.001
SEX	122.039	1	122.039	7.001	.009
2-WAY INTERACTIONS	108.556	3	36.185	2.076	.107
GCE BOARD SEX	108.556	3	36.185	2.076	.107
EXPLAINED	915.490	11	83.226	4.774	.001
RESIDUAL	1952.375	112	17.432		
TOTAL	2867.865	123	23.316		

cont overpage

MULTIPLE CLASSIFICATION ANALYSIS

GRAND MEAN = -.00

VARIABLE + CATEGORY	N	UNADJUSTED DEV'N	UNADJUSTED ETA	ADJUSTED FOR INDEPENDENTS DEV'N	ADJUSTED FOR INDEPENDENTS BETA	ADJUSTED FOR INDEPENDENTS + COVARIATES DEV'N	ADJUSTED FOR INDEPENDENTS + COVARIATES BETA
GCE BOARD							
0 AEB	27	-1.69				-.68	
1 CAMBRIDGE	23	-.50				-.82	
2 JMB	17	-.12				.17	
3 LONDON	14	2.84				4.94	
4 OXFORD	43	.51				-.81	
			.27				.37
SEX							
0 BOYS	92	-.53				-.66	
1 GIRLS	32	1.52				1.89	
			.19				.23
MULTIPLE R SQUARED							.281
MULTIPLE R							.530

APPENDIX 9.2.8. ANALYSING THE VARIANCE IN EASINESS RESIDUALS

* * * * * * * * ANALYSIS OF VARIANCE * * * * * * * *

EASINESS RESIDUAL
BY GCE BOARD
SEX
WITH EXTRAVERSION
FEAR OF FAILURE

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
COVARIATES	116.303	2	58.151	6.152	.003
EXTRAVERSION	72.114	1	72.114	7.629	.007
FEAR OF FAILURE	58.594	1	58.594	6.199	.014
MAIN EFFECTS	97.838	5	19.568	2.070	.074
GCE BOARD	97.693	4	24.423	2.584	.041
SEX	4.754	1	4.754	.503	.480
2-WAY INTERACTIONS	20.583	3	6.861	.726	.539
GCE BOARD SEX	20.583	3	6.861	.726	.539
EXPLAINED	234.723	10	23.472	2.483	.010
RESIDUAL	1068.090	113	9.452		
TOTAL	1302.813	123	10.592		

cont overpage

MULTIPLE CLASSIFICATION ANALYSIS

GRAND MEAN = .00

VARIABLE + CATEGORY	N	UNADJUSTED DEV'N	UNADJUSTED ETA	ADJUSTED FOR INDEPENDENTS DEV'N	ADJUSTED FOR INDEPENDENTS BETA	ADJUSTED FOR INDEPENDENTS + COVARIATES DEV'N	ADJUSTED FOR INDEPENDENTS + COVARIATES BETA
ECE BOARD							
0 AEB	27	-1.52				-1.30	
1 CAMBRIDGE	23	-.14				-.18	
2 JMB	17	.94				.92	
3 LONDON	14	-.95				-.95	
4 OXFORD	43	.96				.86	
			.32				.28
SEX							
0 BOYS	92	.06				.12	
1 GIRLS	32	-.18				-.35	
			.03				.06

MULTIPLE R SQUARED	.164
MULTIPLE R	.405

* * * * * * * * ANALYSIS OF VARIANCE * * * * * * * *

ATTAINMENT RESIDUAL
BY GCE BOARD
SEX
WITH EXTRAVERSION
EASINESS
INTRINSIC MOTIVATION
NOTEMAKING SYLLABUS COVERAGE TEACHING(given)
PHYSICS EXAM. MOTIVATION

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
COVARIATES	65.962	5	13.192	8.299	.001
EXTRAVERSION	12.994	1	12.994	8.175	.005
EASINESS	8.137	1	8.137	5.119	.026
INTRINSIC MOTIVATION	10.646	1	10.646	6.697	.011
NOTEMAKING SYLLABUS COVERAGE TEACHING(given)	6.672	1	6.672	4.197	.043
PHYSICS EXAM MOTIVATION	8.691	1	8.691	5.468	.021
MAIN EFFECTS	31.171	5	6.234	3.922	.003
GCE BOARD	30.158	4	7.539	4.743	.001
SEX	2.597	1	2.597	1.634	.204
2-WAY INTERACTIONS	7.498	3	2.499	1.572	.200
GCE BOARD SEX	7.498	3	2.499	1.572	.200
EXPLAINED	104.630	13	8.048	5.063	.001
RESIDUAL	174.853	110	1.590		
TOTAL	279.483	123	2.272		

cont overpage

MULTIPLE CLASSIFICATION ANALYSIS

GRAND MEAN = .00

VARIABLE + CATEGORY	N	UNADJUSTED DEV'N	UNADJUSTED ETA	ADJUSTED FOR INDEPENDENTS DEV'N	ADJUSTED FOR INDEPENDENTS BETA	ADJUSTED FOR INDEPENDENTS + COVARIATES DEV'N	ADJUSTED FOR INDEPENDENTS + COVARIATES BETA
GCE BOARD							
0 AEB	27	1.14				.94	
1 CAMBRIDGE	23	-.28				-.27	
2 JMB	17	.22				.19	
3 LONDON	14	.27				.02	
4 OXFORD	43	-.74				-.52	
			.47				.37
SEX							
0 BOYS	92	-.00				-.10	
1 GIRLS	32	.00				.27	
			.00				.11

MULTIPLE R SQUARED		.348
MULTIPLE R		.590

APPENDIX 9.2.10

PRE-TEST AND POST-TEST ENJOYMENT SCORES BY COURSE-TYPE

Board	N	Mean 'enjoyment' score (standard deviation) Pre-test	Post-test
A.E.B.	27	23.59 (4.89)	20.44 (6.96)*
Cambridge	23	24.30 (5.37)	21.96 (5.66)*
J.M.B.	17	26.24 (3.40)	23.59 (5.14)
London	14	24.71 (5.38)	25.64 (3.25)
Oxford	43	24.63 (5.98)	23.26 (5.46)

* p < 5% (correlated t-test)

APPENDIX 9.3.1.

MULTIPLE REGRESSION WITH S.S.R.C. SCALES

a) BOYS (N = 108)

Variable	Beta-weight	Simple correlation between variable and attainment
Academic achievement motivation	0.23*	0.29*
Organised study habits	0.44	0.25*
Intrinsic motivation	0.13	0.24*
Fear-of-failure	-0.11	-0.12
Extrinsic motivation	-0.09	-0.05
Syllabus-boundness	-0.04	-0.16

Multiple correlation with A-level attainment = 0.39

* p < 5%

b) GIRLS (N = 35)

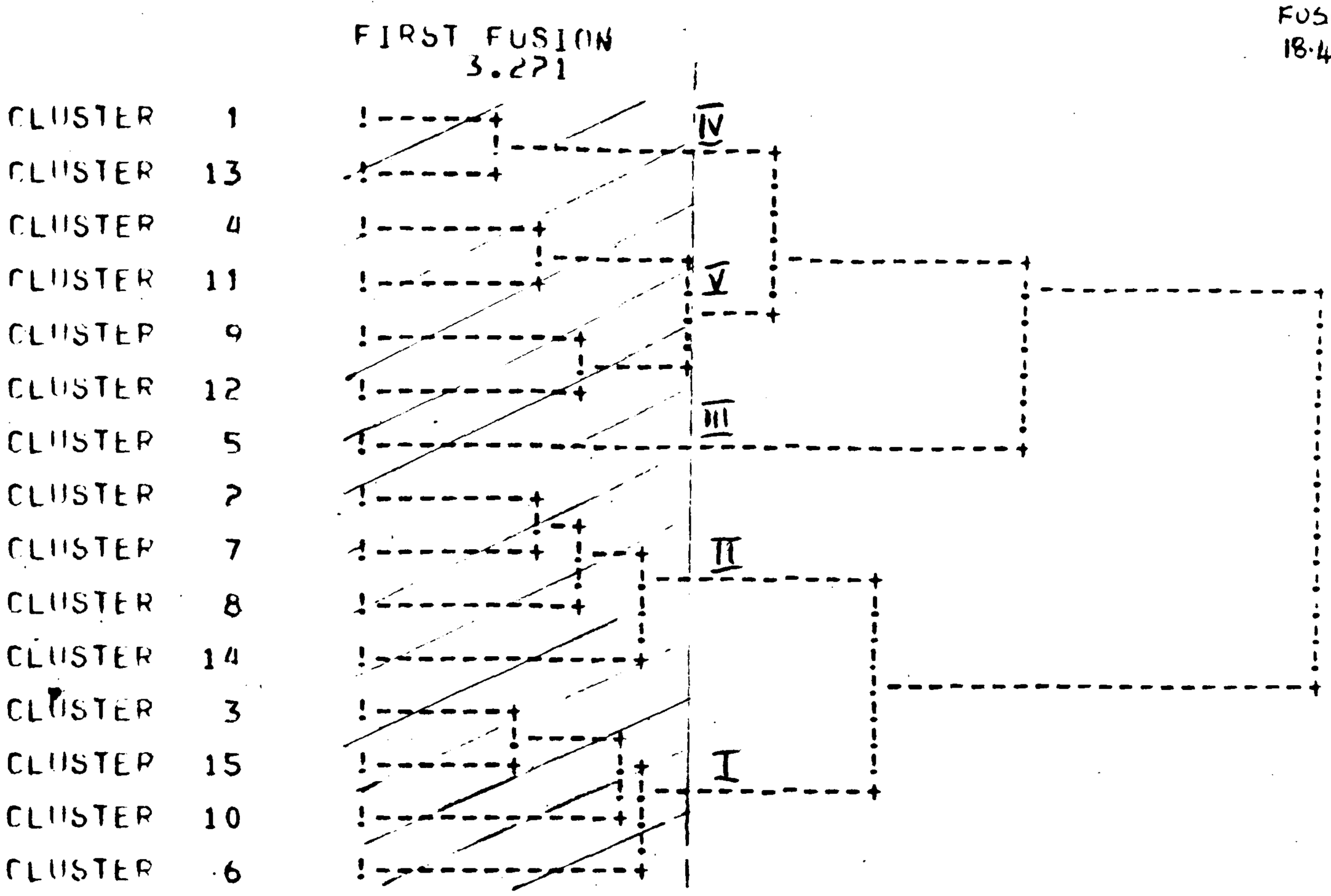
Variable	Beta-weight	Simple correlation between variable and attainment
Fear-of-failure	-0.56*	-0.52*
Extrinsic motivation	-0.38*	-0.26
Academic achievement motivation	0.21	0.23
Syllabus-boundness	0.16	0.06
Organised study habits	0.07	0.11
Intrinsic motivation	-	-0.13

Multiple correlation with A-level attainment = 0.66

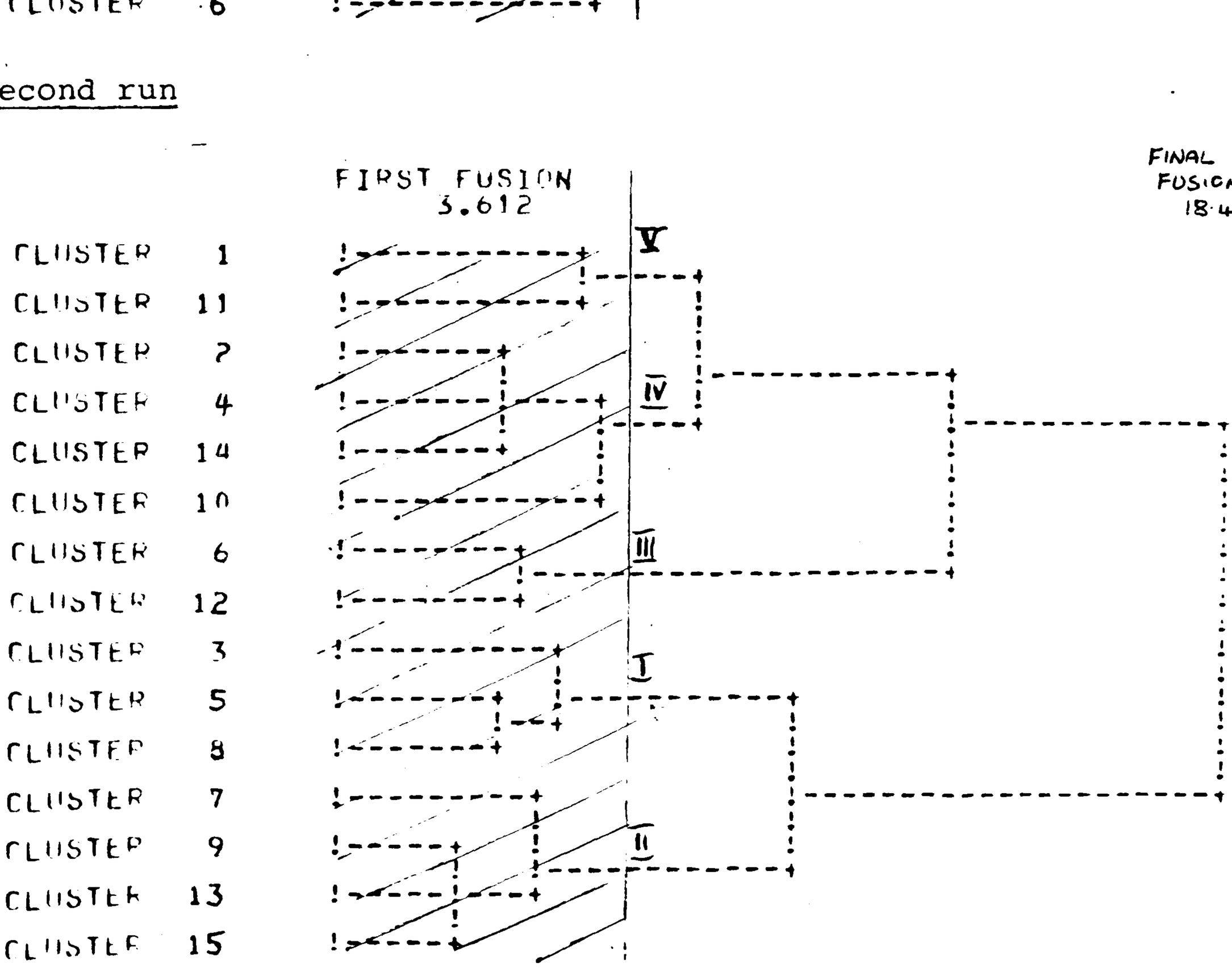
* p < 5%

APPENDIX 9.5.1 CLUSTER ANALYSIS DENDROGRAMS

First run



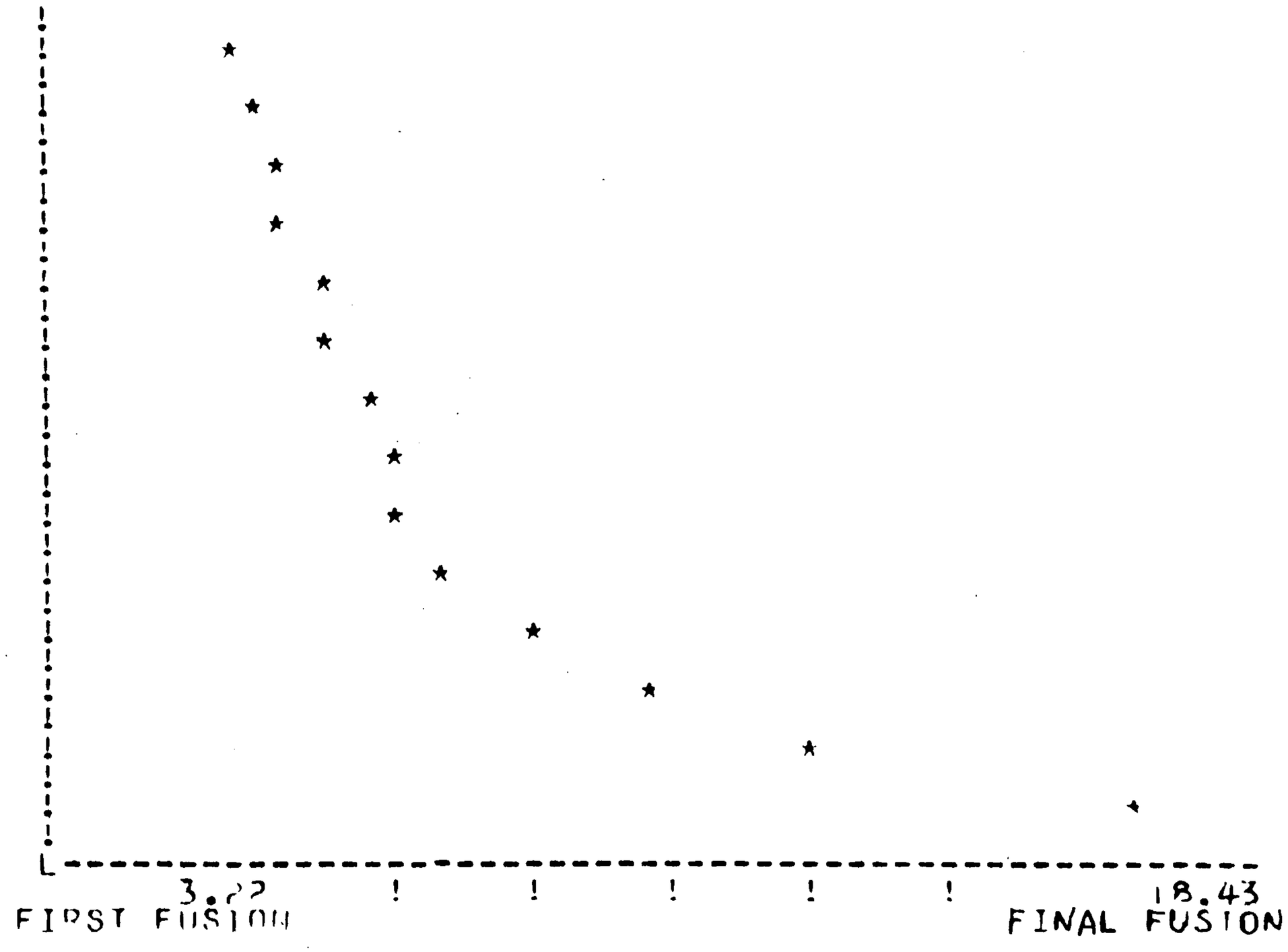
Second run



APPENDIX 9.5.2 CLUSTER FUSION PLOTS

FIRST RUN

FUSION	CLUSTERS	COEF
1	14	3.22
2	13	3.69
3	12	3.81
4	11	4.11
5	10	4.62
6	9	4.69
7	8	5.49
8	7	5.85
9	6	5.85
10	5	6.54
11	4	8.20
12	3	10.12
13	2	12.96
14	1	18.43



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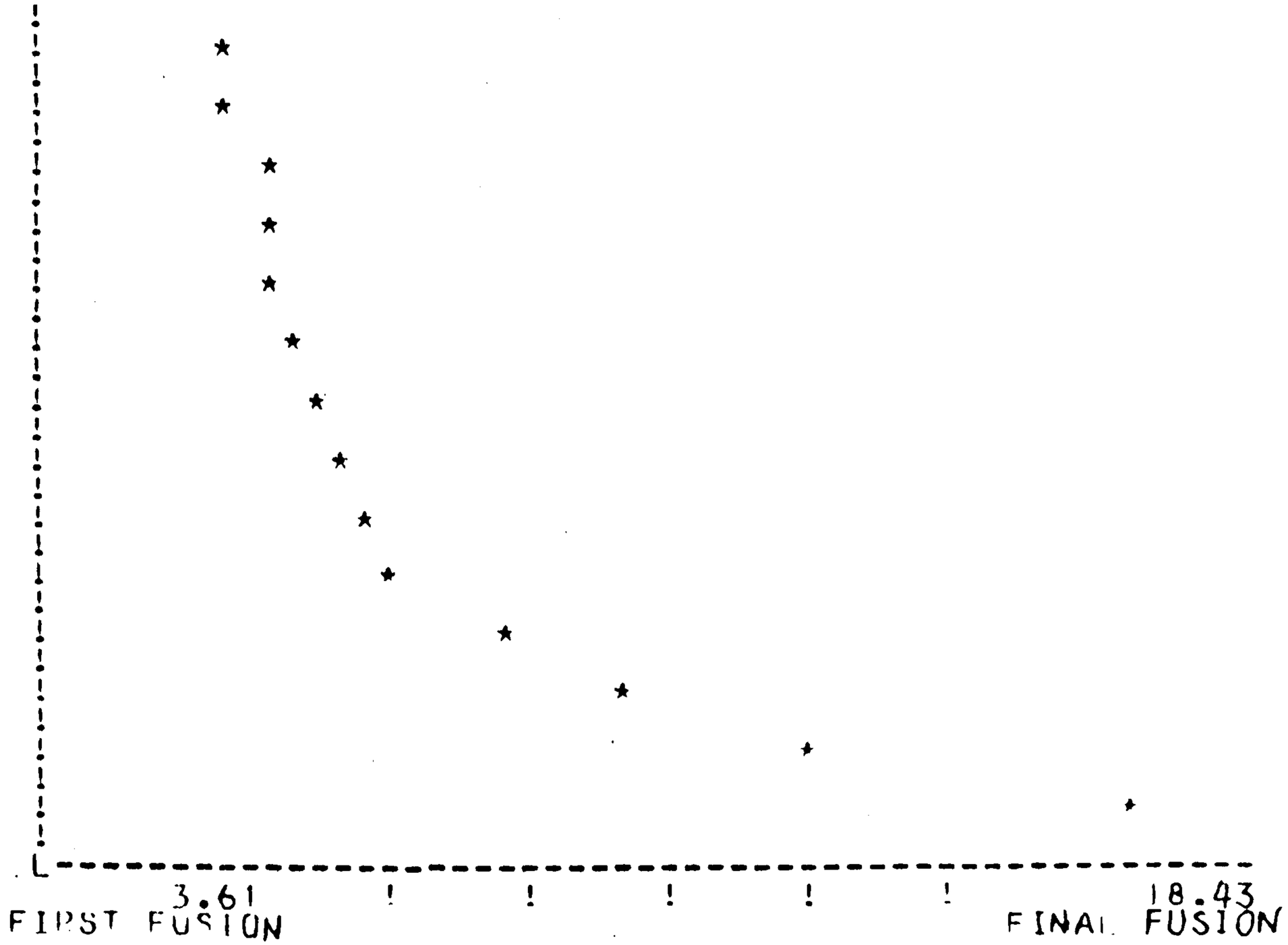
APPENDIX 9.5.2 CLUSTER FUSION PLOTS

SECOND RUN

FUSION	CLUSTERS	COEF
1	14	3.61
2	13	3.67
3	12	4.21
4	11	4.15
5	10	4.29
6	9	4.58
7	8	5.19
8	7	5.49
9	6	5.82
10	5	6.14
11	4	8.20
12	3	10.12
13	2	13.23
14	1	18.43



APPENDIX 9.5.3.

DISCRIMINATING BETWEEN GROUPS I AND IV

THE VARIABLES COMPRISING THE DISCRIMINANT FUNCTION

Variable		Standardised discriminant function
Attainment	A-grade physics	530
	O-grade physics	565
	Number of O-level passes	-408
Post-test attitude	Philosophical	330
Sixth-form study and motivation	Fear of failure	-645
	Syllabus boundness	299
	Intrinsic motivation	303
	Academic motivaton	586
	A-level physics exam motivation	316
Personality	Extraversion	-289
	Neuroticism	325
A-level teaching methods	NOTESYL (P)	-513
	NOTESYL (E)	-221
	PUPINIT (P)	-462
	Matched to pupil needs	-299
O-level attitudes	Physics identification	262

Decimal points omitted

The single function which is most effective at separating the type I and type IV students measures academic achievement and motivation in physics accompanied by a degree of detachment from the classroom environment.

Figure A displays the results of re-classifying all the students making up groups I and IV by simply using the discrimination function itself.

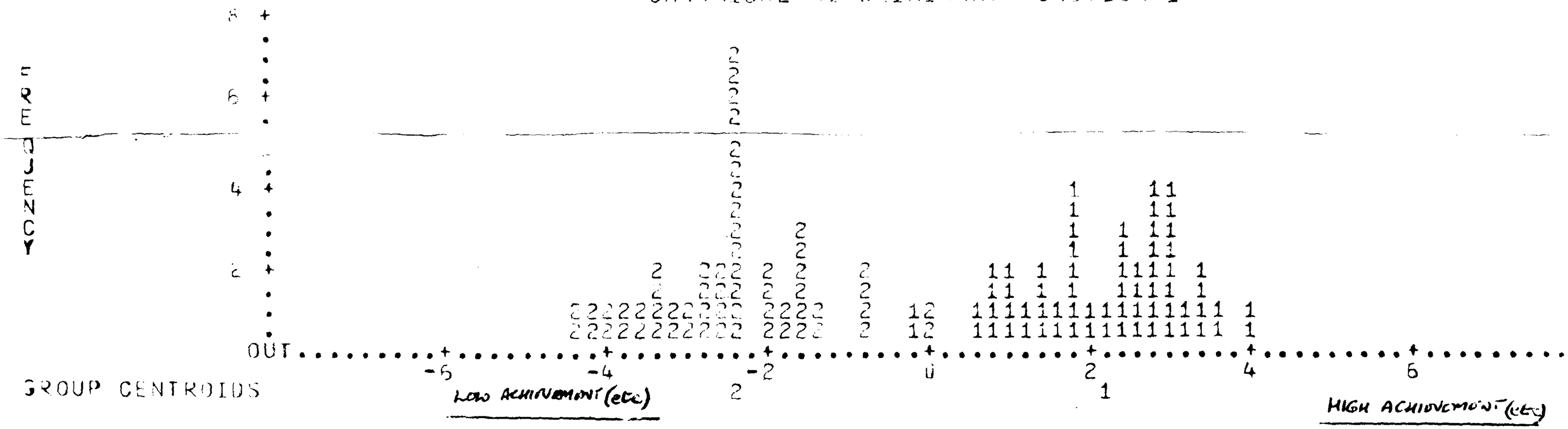
FIG. A CLASSIFYING TYPE I AND IV STUDENTS

SYMBOLS USED IN PLOTS

SYMBOL	GROUP	GROUP CENTROID (MEAN) SCORE
1	I	2·17
2	IV	-2·46

ALL-GROUPS STACKED HISTOGRAM

-- CANONICAL DISCRIMINANT FUNCTION 1 --



GROUP CENTROIDS

CLASSIFICATION RESULTS -

ACTUAL GROUP	NO. OF CASES	PREDICTED GROUP MEMBERSHIP I	IV
GROUP I	34	33 97.1	1 2.9
GROUP IV	30	1 3.3	29 96.7

PERCENT OF GROUPED CASES CORRECTLY CLASSIFIED - 96.88

APPENDIX 9.5.4.

SOME DIFFERENCES BETWEEN SUTDENTS PASSING AND FAILING A-LEVEL PHYSICS IN CLUSTER V

A-level physics teaching methods variable	Mean scores for type V students			
	passing A-level physics (N = 3)		failing A-level physics (N = 16)	
PLANMETH (P)	27.00	(4.36)	34.94	(3.09)**
PLANMETH (E)	25.33	(1.53)	23.63	(3.42)
NOTESYL (P)	21.00	(3.61)	18.13	(2.94)
NOTESYL (E)	18.67	(7.02)	17.06	(1.84)
PUPINIT (P)	18.33	(3.51)	17.88	(2. 47)
PUPINIT (E)	17.00	(1.00)	15.75	(2.21)
Matched to pupil needs	21.33	(7.51)	13.38	(4.24)*

Standard deviations are shown in brackets
**p < 1% (t-test) * p < 5% (t-test)

APPENDIX 9.5.5.

TEACHING METHOD PREFERENCES : STEREOTYPE DIFFERENCES

TABLE A RESPONSES TO PREFERENCE STATEMENT 2 : 'LEARNING IS BY FINDING OUT BY ONESELF...'

	Preference rating		
Student type	Poor method	Don't know	Good method
I	18	8	8
II	5	4	11

χ^2 = 6.54, with 2 degrees of freedom, significant at 5% level

TABLE B RESPONSES TO PREFERENCE STATEMENT 17 'STUDENTS MAKES OWN NOTES'

	Preference rating		
Student type	Poor method	Don't know	Good method
IV	2	8	20
All others	27	30	37

χ^2 = 8.76, with 2 degrees of freedom, significant at 5% level

TABLE C RESPONSES TO PREFERENCE STATEMENT 19 : 'TEACHER DICTATION'

	Preference rating		
Student type	Poor method	Don't know	Good method
I	18	9	7
All others	23	25	42

χ^2 = 9.85, with 2 degrees of freedom, significant at the 1% level

TABLE D RESPONSES TO PREFERENCE STATEMENT 22 : 'VARIED NOTEMAKING'

	Preference rating		
Student type	Poor method	Don't know	Good method
IV	0	6	24
All others	11	38	45

χ^2 = 10.97, with 2 degrees of freedom, significant at the 1% level

TABLE E RESPONSES TO STATEMENT 24 : 'TEACHING FOR THE MOST ABLE'

	Preference rating		
Student type	Poor method	Don't know	Good method
V	16	1	2
All others	50	41	14

χ^2 = 8.92, with 2 degrees of freedom, significant at the 5% level

TABLE 5 RESPONSES TO STATEMENT 36 : 'PLANNED REVISION'

	Preference rating		
Student type	Poor method	Don't know	Good method
IV	0	1	29
All others	7	16	71

χ^2 = 7.11, with 2 degrees of freedom, significant at the 5% level

APPENDIX 9.5.6 THE FOUR FUNCTIONS WHICH DISCRIMINATE BETWEEN THE STUDENT GROUPS

Variable		Standardised coefficient			
		Function 1	Function 2	Function 3	Function 4
Attainment	A-level score	-135	268	-233	696
	A-grade physics	-337	404	151	-380
	O-grade physics	-284	-301	216	-111
	Number of O-level passes	-150	-063	-225	-260
Post-test attitudes	Historical	-005	-305	37	079
	Prestige	-133	-210	254	-149
	Philosophical	-274	-386	149	194
	Modern	-050	-311	-181	-071
	Enjoyment	-186	137	-386	-247
	Easiness	-114	-022	367	-391
Sixth form study and motivation	Fear-of-failure	008	115	-469	018
	Study-methods	-298	-016	-358	051
	Intrinsic motivation	-311	126	-148	186
	Extrinsic motivation	216	272	-039	-457
	Academic motivation	-151	-290	369	-041
	A-level physics motivation	-447	214	240	350
Personality	Neuroticism	-234	-177	175	240
	Lie	-131	-328	037	101
A-level teaching methods	PLANMETH(P)	-126	-037	-165	-332
	PLANMETH(E)	032	-212	-370	-104
	NOTESYL (E)	251	-469	-045	-411
	PUPINIT (P)	255	-168	-257	-120
	PUPINIT (E)	-020	-376	067	-048
O-level attitude	Physics identification	-120	-661	565	120

Decimal points omitted

APPENDIX 9.5.7 DISCRIMINATING BETWEEN PAIRS OF CLUSTERS

In every case, a single function is able to discriminate between the individual members of all the cluster pairs.

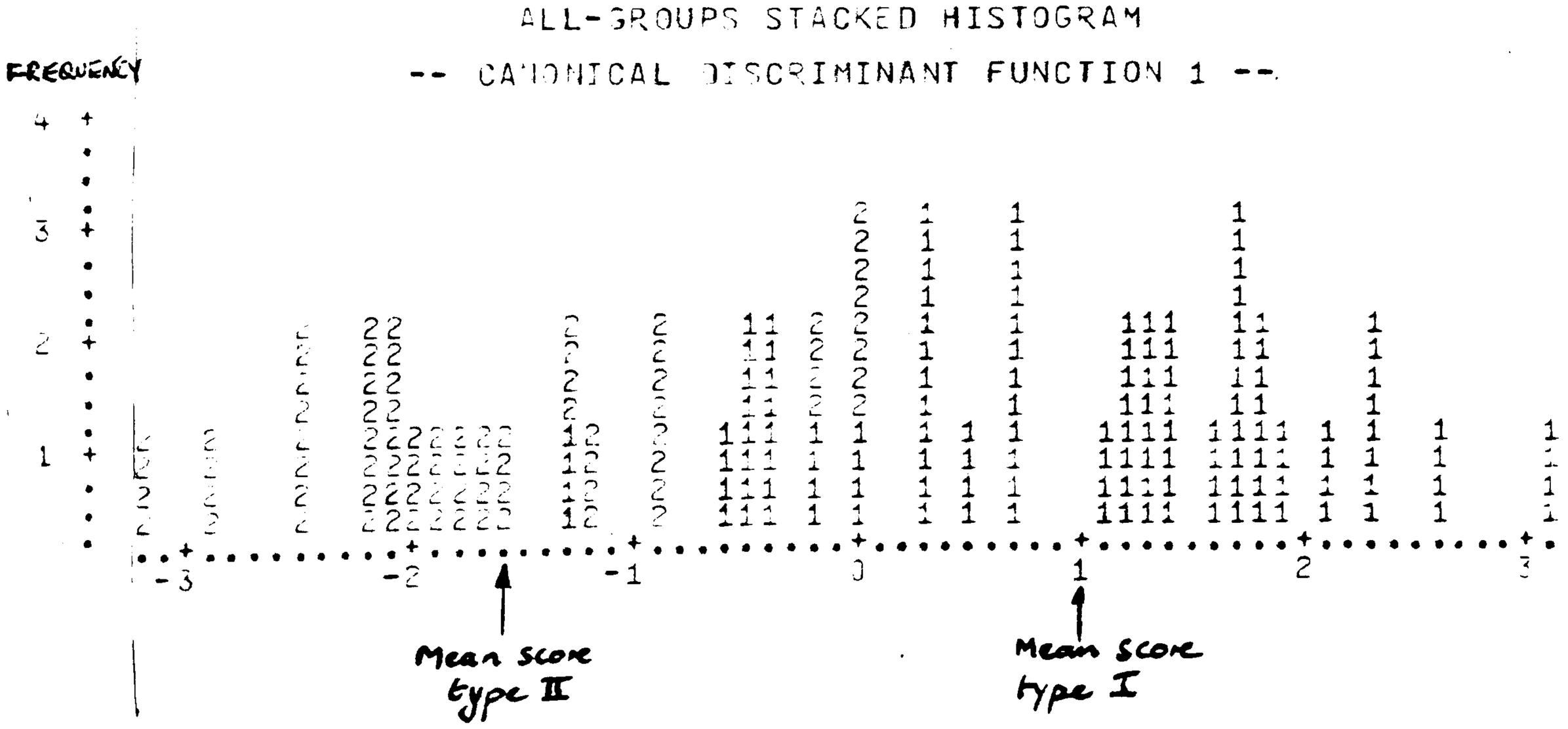
(a) CLUSTERS I AND II

TABLE A THE VARIABLES COMPRISING THE DISCRIMINANT FUNCTION

	Variable	Standardised discriminant function coefficient
Attainment	O-Grade physics	-0.221
Post-test attitudes	Philosophical	-0.293
	Easiness	0.561
Sixth-form study and motivation	Fear-of-failure	-0.571
	Study methods	-0.421
	Extrinsic motivation	0.330
Personality	Neuroticism	-0.231
A-level teaching methods	PLANMETH(E)	-0.399
	PUPINIT (E)	-0.301

FIGURE A CLASSIFYING TYPES I AND II

83% reclassification



(b) CLUSTERS I AND III

TABLE 8 THE VARIABLES COMPRISING THE DISCRIMINANT FUNCTION

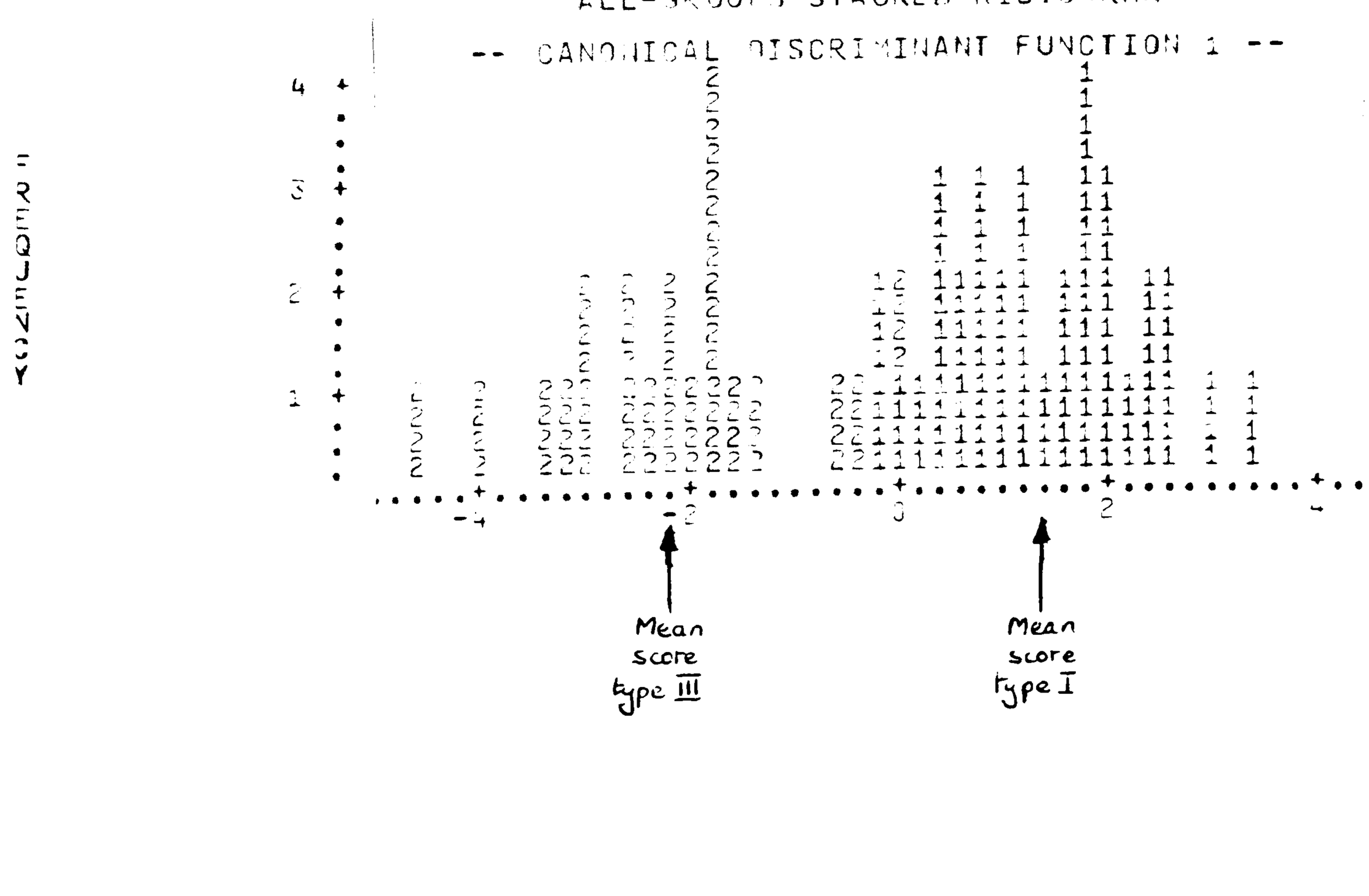
	Variable	Standardised discriminant function coefficient
Attainment	O-grade physics	0.608
Post-test	Historical	0.321
attitudes	Philosophical	0.419
	Easiness	0.286
Sixth-form study	Syllabus boudndness	0.337
and motivation	Academic motivation	0.243
Personality	Neuroticism	0.358
A-level	PLANMETH(E)	-0.382
teaching	NOTESYL (P)	-0.473
methods	PUPINIT (P)	-0.467
O-level attitudes	Physics identification	0.974

FIGURE 8 CLASSIFYING TYPES I AND III

93% reclassification

SYMBOLS USED IN PLOTS

SYMBOL	GROUP
1	I
2	III



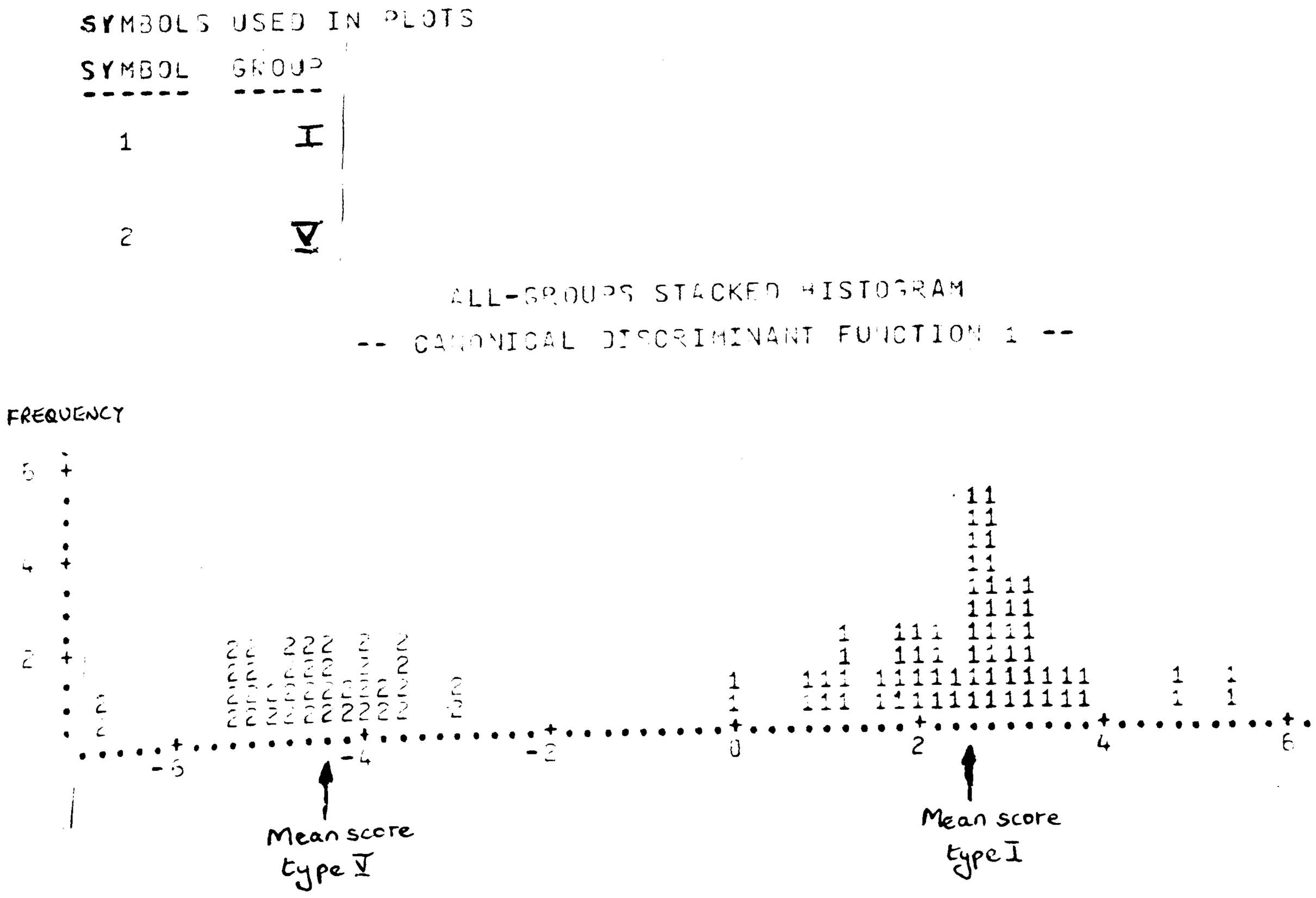
(c) CLUSTERS I AND V

TABLE C THE VARIABLES COMPRISING THE DISCRIMINANT FUNCTION

Variable		Standardised discriminant function coefficient
Attainment	A-level score	-0.908
	A-Grade physics	1.183
	O-grade physics	0.626
Post-test attitudes	Philosophical	0.416
	Modern	0.268
	Enjoyment	0.291
Sixth-form study and motivation	Fear-of-failure	-0.400
	Intrinsic motivation	0.353
	Extrinsic motivation	-0.327
	Academic motivation	0.565
	Physics examination motivation	0.624
A-level physics teaching methods	NOTESYL (P)	-0.690
	PUPINIT (P)	-0.224
	Matched to pupils needs	-0.301
O-level attitudes	Physics identification	0.285

100% reclassification

FIGURE C CLASSIFYING TYPES I AND V



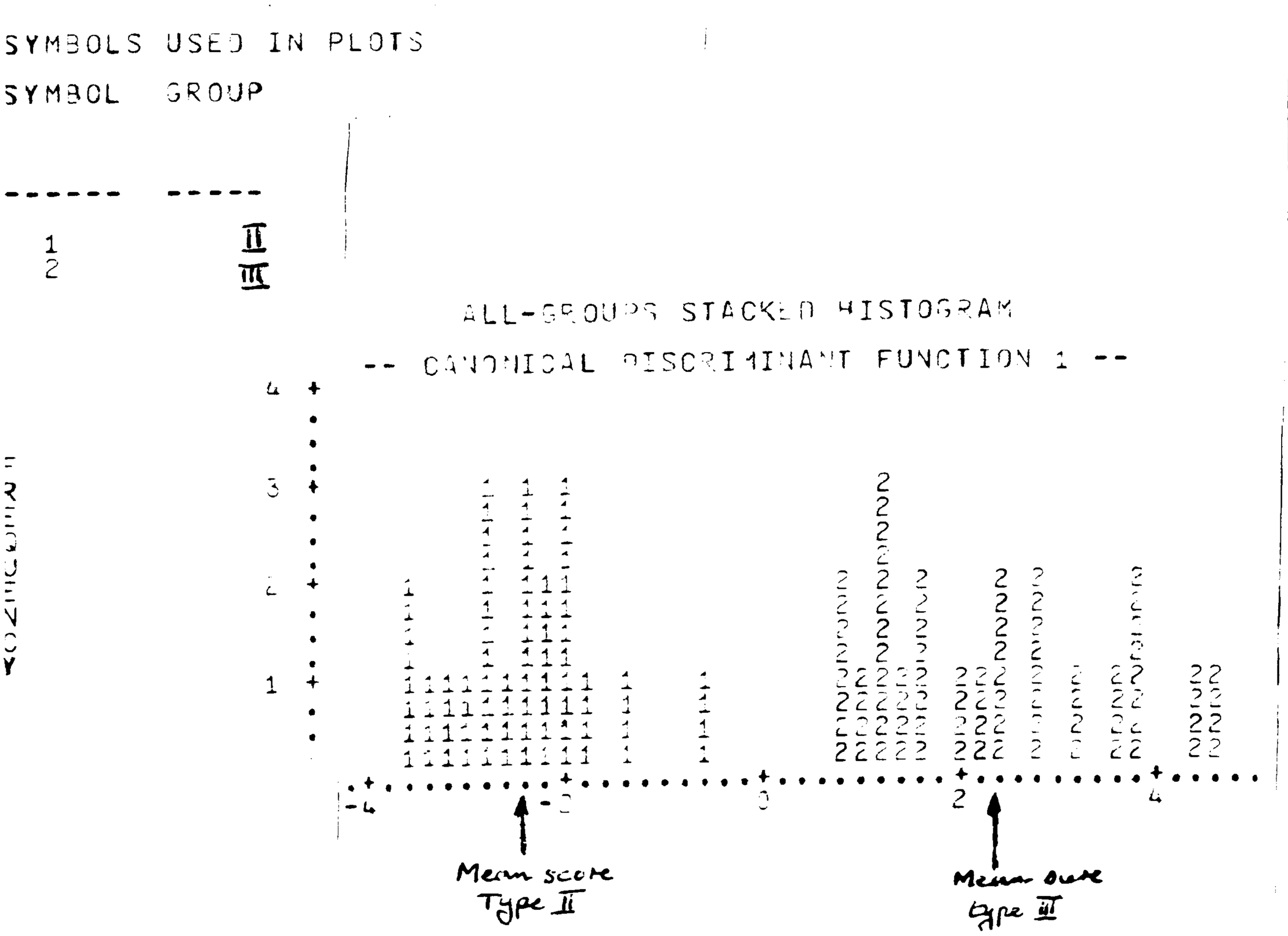
(d) CLUSTERS II AND III

TABLE D THE VARIABLES COMPRISING THE DISCRIMINANT FUNCTION

	Variable	Standardised discriminant function coefficient
Attainment	Number of O-level passes	-0.439
Post-test attitudes	Prestige	-0.441
	Modern	-0.572
Sixth-form study and motivation	Syllabus boundness	-0.351
	Study methods	-0.676
	Intrinsic motivation	-0.839
	Extrinsic motivation	0.512
	Academic motivation	-0.476
Personality	Lie	-0.665
A-level reaching methods	PLANMETH(E)	-0.336
O-level attitudes	Physics identification	-0.617

FIGURE D CLASSIFYING TYPES II AND III

100% reclassification



(e) CLUSTERS II AND IV

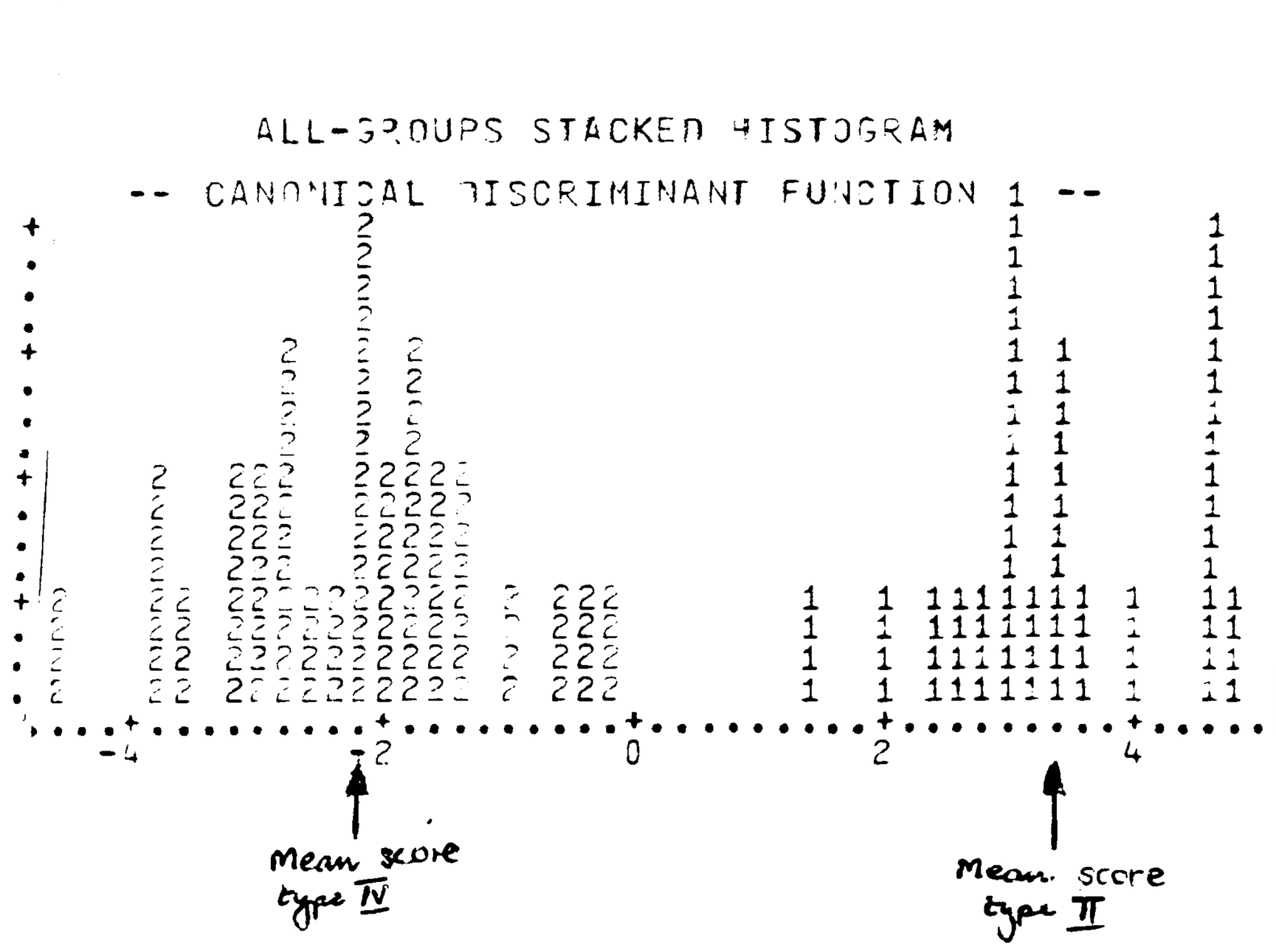
TABLE E THE VARIABLES COMPRISING THE DISCRIMINANT FUNCTION

	Variable	Standardised discriminant function coefficient
Attainment	A-level score	0.883
Sixth-form study and motivation	Fear-of-failure	0.713
	Study methods	0.783
	Intrinsic motivation	0.622
	Extrinsic motivation	-0.286
	Physics examination motivation	0.619
A-level teaching methods	NOTESYL (P)	0.261
	NOTESYL (E)	-0.663
	PUPINIT (P)	-0.240

FIGURE E CLASSIFYING TYPES II AND IV 100% reclassification

SYMBOLS USED IN PLOTS

SYMBOL	GROUP
1	II
2	IV



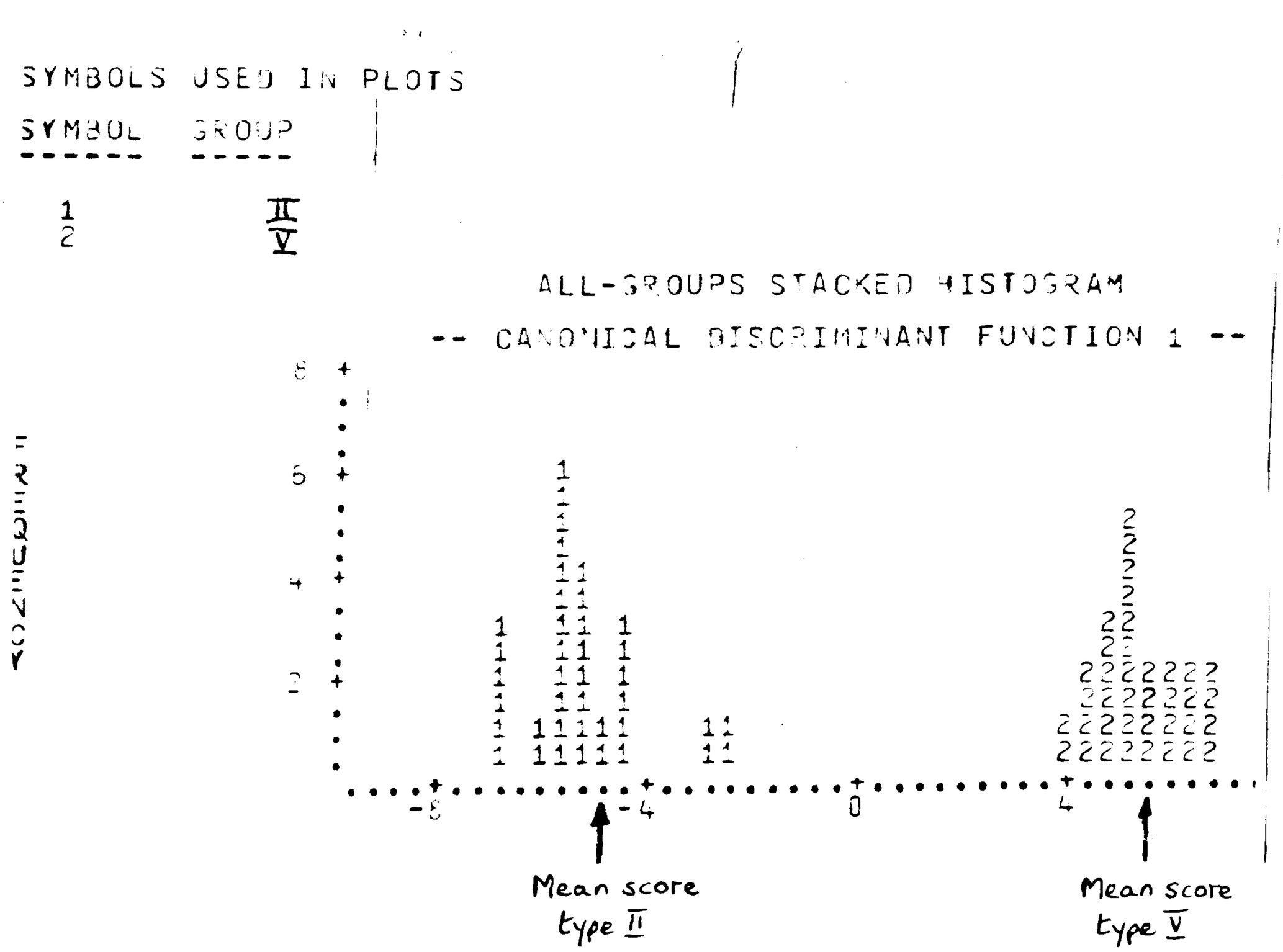
(F)

CLUSTERS II AND V

TABLE F THE VARIABLES COMPRISING THE DISCRIMINANT FUNCTION

Variable		Standardised discriminant function coefficient
Attainment	O-Grade physics	-0.406
	Number of O-level passes	-0.386
Post-test attitudes	Modern	-0.874
	Easiness	-0.366
Sixth-form study and motivation	Study methods	-0.887
	Intrinsic motivation	-0.744
	Extrinsic motivation	1.281
	Academic motivation	-1.253
	Physics examination motivation	-0.337
Personality	Lie	-1.134
A-level teaching methods	PLANMETH(E)	-0.589
O-level attitudes	Physics identification	-0.872

FIGURE F CLASSIFYING TYPES II AND V 100% reclassification

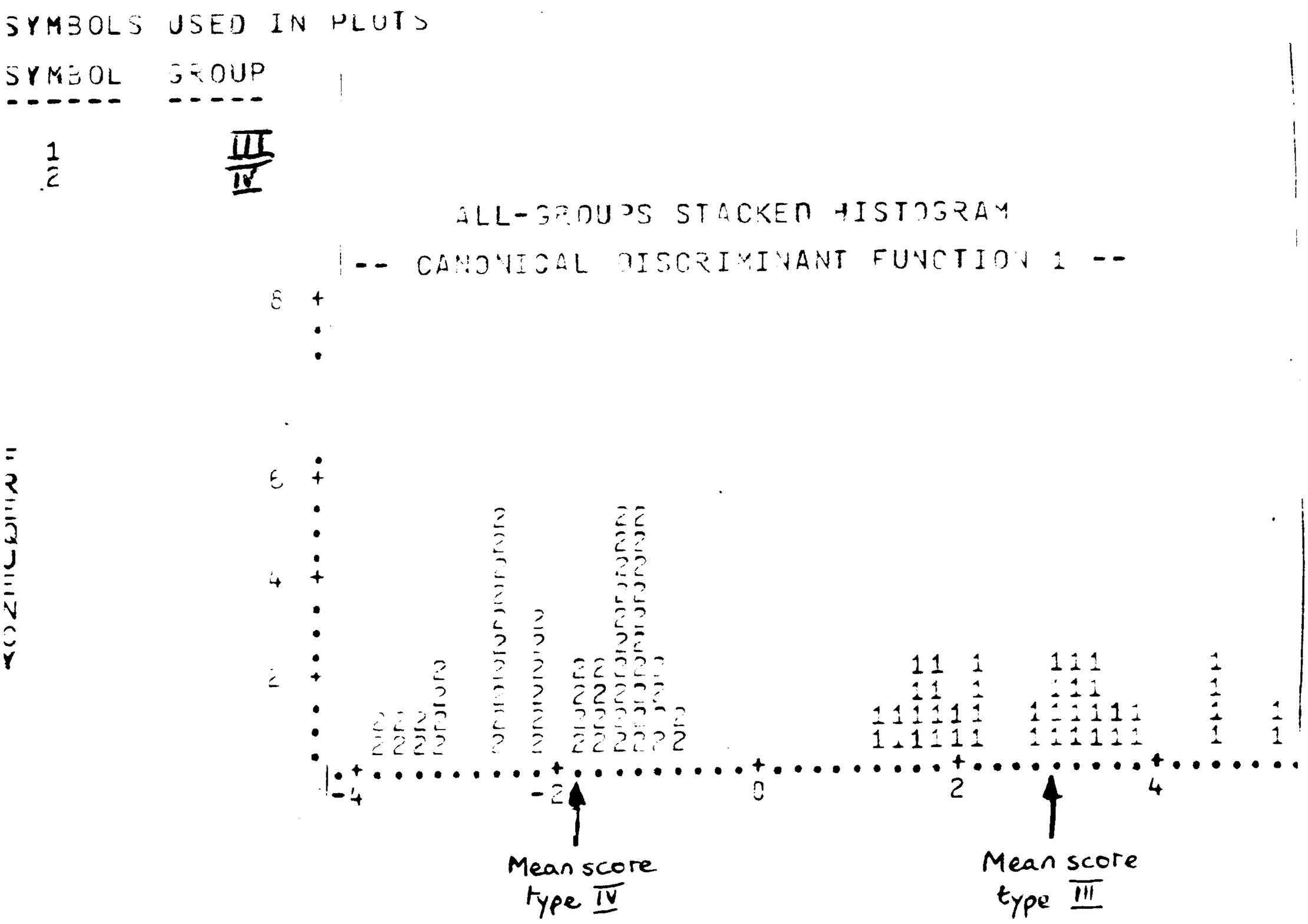


(g) CLUSTERS III AND IV

TABLE G THE VARIABLES COMPRISING THE DISCRIMINANT FUNCTION

	Variable	Standardised discriminant function coefficient
Attainment	A-level score	0.920
Post-test attitudes	Philosophical	-0.483
	Intrinsic motivation	0.764
Sixth-form study and motivation	Extrinsic motivation	0.297
	Academic motivation	-0.332
	Physics examination motivation	0.478
Personality	Lie	-0.340
A-level teaching methods	PLANMETH(P)	-0.531
	PLANMETH(E)	0.702
	NOTESYL (P)	-0.391
	NOTESYL (E)	-0.660
	PUPINIT (E)	-0.566
	Matched to pupil needs	-0.436
O-level attitudes	Physics identification	-0.583

FIGURE G CLASSIFYING TYPES III AND IV 100% reclassification



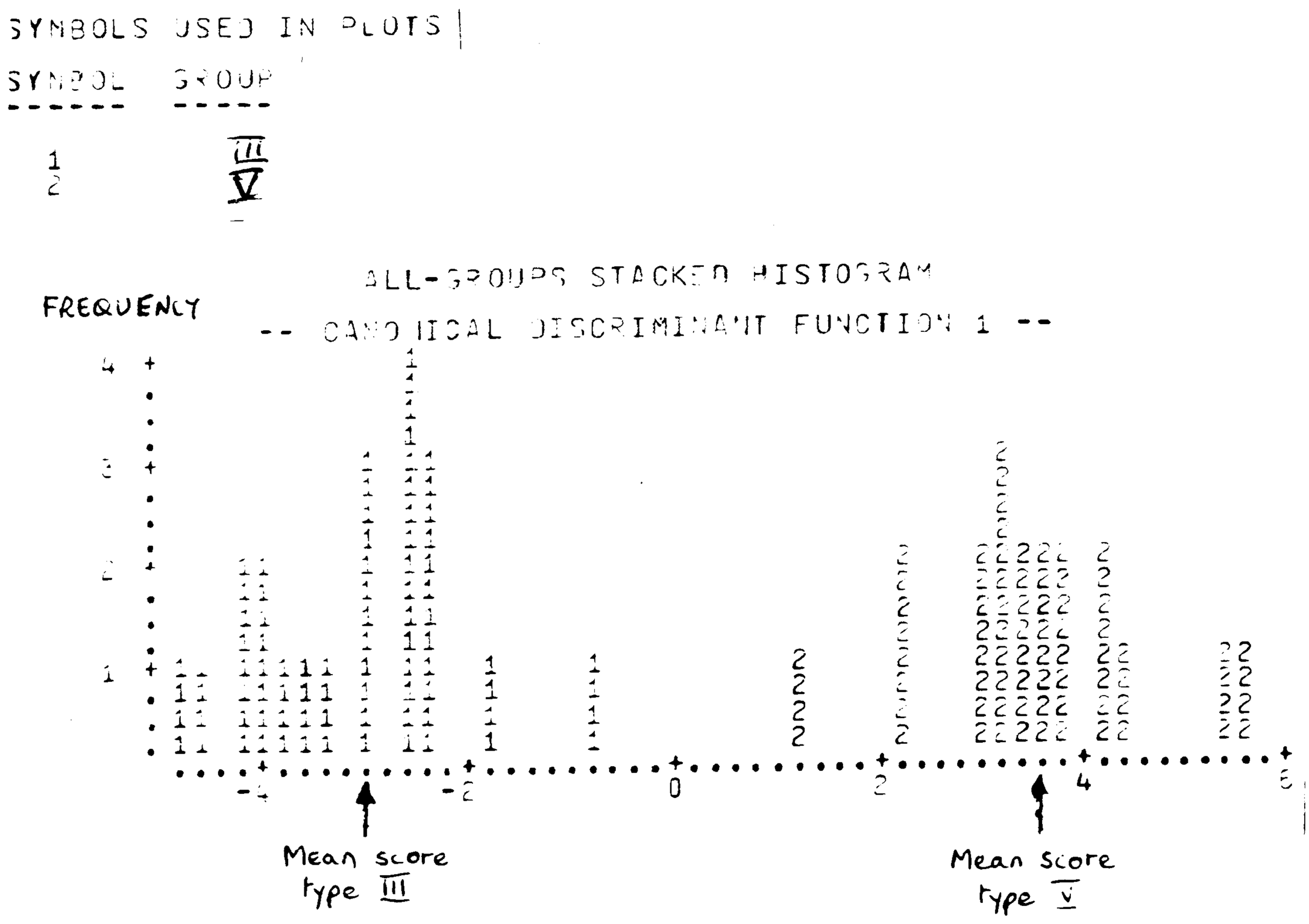
(h) CLUSTERS III AND V

TABLE H THE VARIABLES COMPRISING THE DISCRIMINANT FUNCTION

	Variable	Standardised discriminant function coefficient
Attainment	Number of O-level passes	-0.567
Post-test attitudes	Social implications	-0.258
	Philosophical	0.309
	Enjoyment	-1.173
Sixth-form study motivation	Study methods	0.441
	Intrinsic motivation	-0.711
	Extrinsic motivation	-0.595
	Physics examination motivation	-0.985
Personality	Extraversion	0.484
	Neuroticism	-0.604
	Lie	-0.689
A-level teaching methods	PLANMETH(P)	-0.432
	PLANMETH(E)	-0.512
	NOTESYL (P)	0.957
	NOTESYL (E)	-1.031
	PUPINIT (P)	-0.618
O-level attitudes	Physics identification	1.181

FIGURE H CLASSIFYING TYPES III AND V

100% reclassification

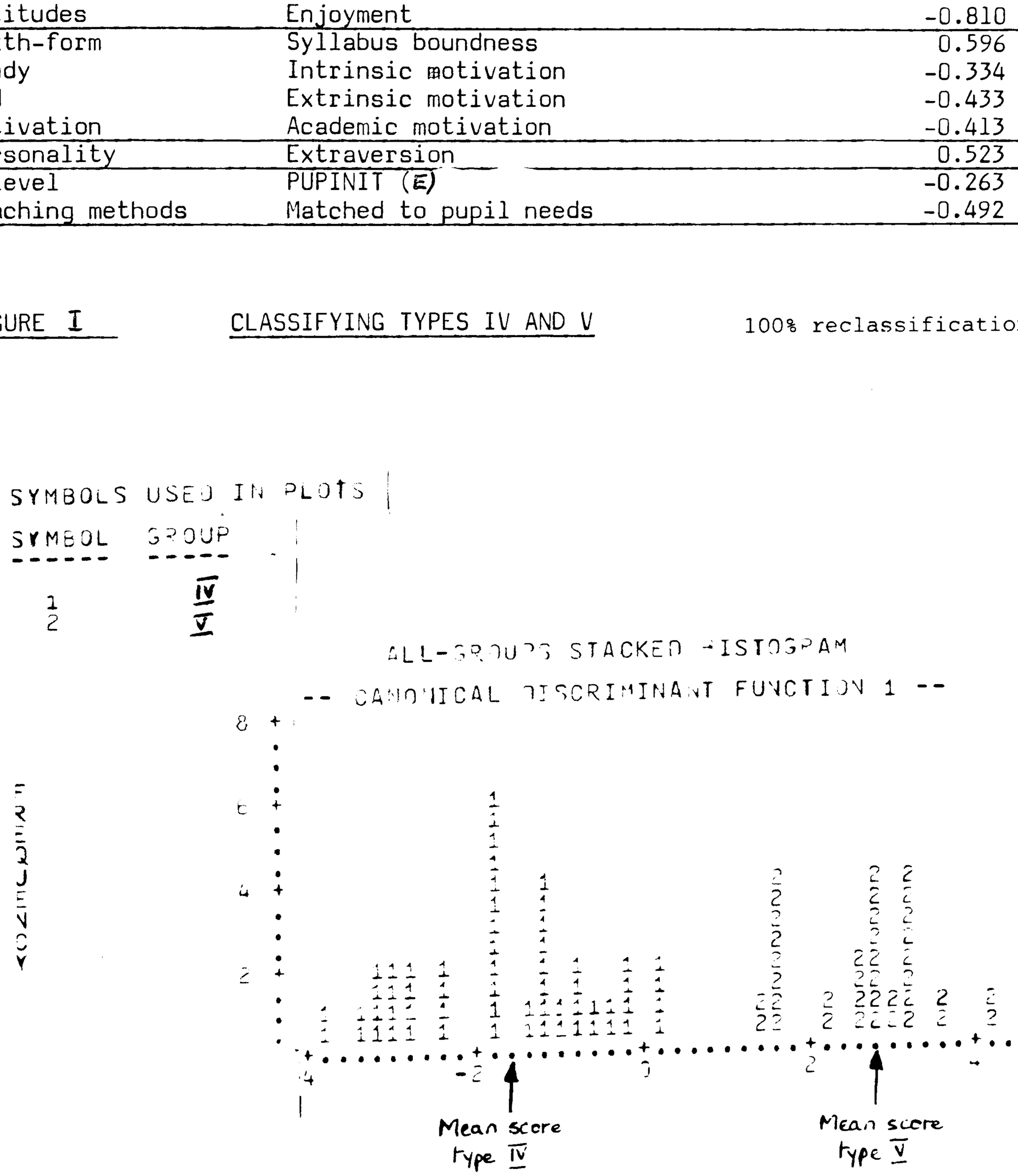


(i) CLUSTERS IV AND V

TABLE I THE VARIABLES COMPRISING THE DISCRIMINANT FUNCTION

	Variable	Standardised discriminant function coefficient
Attainment	A-level score	1.237
	A-grade physics	-0.689
	O-grade physics	-0.989
	Number of O-level passes	-0.268
Post-test attitudes	Philosophical	-0.437
	Enjoyment	-0.810
Sixth-form study and motivation	Syllabus boundness	0.596
	Intrinsic motivation	-0.334
	Extrinsic motivation	-0.433
	Academic motivation	-0.413
Personality	Extraversion	0.523
A-level teaching methods	PUPINIT (E)	-0.263
	Matched to pupil needs	-0.492

FIGURE I CLASSIFYING TYPES IV AND V 100% reclassification



APPENDIX 9.5.8.

'FREE RESPONSE' COMMENTS MADE BY A

FIFTH-FORM GIRL IN A 'NUFFIELD' O-LEVEL CLASS

I would enjoy physics if we did more practical work, and made more detailed studies on subjects related to us in everyday life. I can see little point in spending lessons exploring the amount of charge an oil drop has, and not knowing how a vacume cleaner works.

I think that we should also be taught useful subjects such as wiring plugs, etc, fixing cars and so on.

I think that atoms, electrons and rays etc. should be made more exciting in lesson, from outside reading I know that they are fascinating, and should not be killed by endless notes and unimportant calculations. I should also like to be given a chance to explore computers and how they work, and up to date subjects.

Thankyou for your
Interest.

REFERENCES

AHLGREN, A. and WALBERG, G. (1973) 'Changing Attitudes towards Science among Adolescents'. Nature, 245, 187-190.

ALEXANDER, D. (1974) 'Nuffield Secondary Science'. In Evaluation in Curriculum Development: Twelve Case Studies. Schools Council Research Studies. London: Macmillan Education.

ANDERSON, G.J. and WALBERG, H.J. (1968) 'Classroom Climate and Group Learning'. Int. J. Educ. Sci., 2, 175- 180.

ANDERSON, G.J. and WALBERG, H.J. (1976) Manual for the Learning Environment Inventory (Available from H.J. Walberg, University of Illinois at Chicago Circle, College of Education, Box 4348, Chicago, Illinois, 60680, U.S.A.).

ASE (1980) 'ASE Annual Meeting'. Educ. in Sci., 88, 18.

ASHTON, B and MEREDITH, H (1969) 'The Attitudes of Sixth-Formers to Science and Scientists'. Sch. Sci. Rev., 51, 15-19.

AUSUBEL,D.P. (1968) Educational Psychology : A Cognitive View. London: Holt, Rinehart and Winston.

BAUSOR, J. (1979) 'Image and Reality'. Phys. Educ., 14, 329.

BECHER, R.A., and co-authors (1975) The Drift of Change, London: NuffieldFoundation.

BENNETT, N. (1976) Teaching Styles and Pupil Progress. London: Open Books.

BENNETT, N. and ENTWISTLE, N.J. (1977) "Rite and Wrong: a Reply to 'A Chapter of Errors'". Educ. Res., 19, 217-222.

BEN-ZVI, R., HOFSTEIN, A. and SAMUEL, D. (1977) 'Modes of Instruction in High School Chemistry'. J. Res. Sci. Teach., 14, 433-9.

BLACK, P.J. (1977) 'Pupils' Attitudes to Science'. Stud. Sci. Educ., 4, 149-153.

BLOOM, B.S. (ed.) (1956) Taxonomy of Educational Objectives, Handbook I, The Cognitive Domain. London: Longmans.

BONDI, H. (1975) 'Physics, education and society'. Phys. Educ., 10, 469-474.

BOOTH, N. (1975) 'The Impact of Science Teaching Projects on Secondary Education'. Educ. in Sci., 63, 27-30.

BRENNAN, T. (1972) 'Numerical Taxonomy: Theory and some Applications in Educational Research'. Unpublished Ph.D. Thesis, University of Lancaster.

BRIMER, A. and co-authors (1978) Sources of Difference in School Achievement. Slough: N.F.E.R.

BROWN, C.J. and ELLIOTT, W.E. (1973) 'Perceptions of Physics and Physics Teachers by College Students'. J. Res. Sci. Teach., 10, 51-4.

BROWN, S.A. (1974) 'Scottish Science Teachers' Perceptions of Effective Science Teaching'. Br. J. educ. Psychol., 44, 57-64.

BROWN, S.A. (1976) Attitude Goals in Secondary School Sciences, Stirling Educational Monographs 1. University of Stirling.

BUROS, O.K. (ed.) (1972) The Seventh Mental Measurements Year Book. New York: Gryphon Press.

CAPRA, F. (1975) The Tao of Physics. London: Fontana.

CARTER, C.F. (1972) Presidential Address. In Innovation in Higher Education. London: S.R.M.E.

CATTELL, R.B., EBER, H.W. and TATSUOKA, M.M. (1970) The Sixteen Personality Factor Questionnaire Handbook. Institute for Personality and Ability Testing. Champaign, Illinois 61820, U.S.A.

CHOPPIN, B.H.L., and co-authors (1973) The Prediction of Academic Success. Slough: N.F.E.R.

CHOPPIN, B.H.L. (1974) 'The introduction of new science curricula in England and Wales'. Comp. Educ. Rev., 18, 196-206.

COLLINGS, J.A. (1978) 'A psychological study of female science specialists in the sixth form'. Unpublished Ph.D. thesis, University of Bradford.

COMBER, L.C. and KEEVES, J.P. (1973) Science Education in Nineteen Countries. New York : Wiley.

COWELL, M.D. (1970) 'An investigation of the reliabilities and a comparison of two instruments for measuring motivation and study habits'. Unpublished M.A. Dissertation, Universtiy of Lancaster.

CRONBACH, L.J. and FURBY, L. (1970) "How should we measure 'change' - or should we?". Psychol. Bull., 74, 68-80.

CRAWLEY, F.E. and SHRUM, J.W. (1977) 'Effects of learning structure condition on change in preference for science courses'. J. Res. Sci. Teach., 14, 257- 262.

DAINTON REPORT (1968) Enquiry into the flow of candidates in Science and Technology into Higher Education. London : H.M.S.O..

D.E.S. (1975) Curricular Differences between Boys and Girls. Education Survey No.21. Department of Education and Science. London : H.M.S.O..

D.E.S. (1976) 'Has something gone wrong? How is it to be put right?' Times Educational Supplement, 15th October.

D.E.S. (1981, 1980 and earlier years) Statistics of Education, Volume 2. School Leavers, C.S.E. and G.C.E. London : H.M.S.O..

DUCKWORTH, D. (1972) 'The Choice of Science Subjects by Grammar School Pupils'. Unpublished Ph.D. Thesis, University of Lancaster.

DUCKWORTH, D. and ENTWISTLE, N.J. (1974a) 'Attitudes to School Subjects : A Repertory Grid Technique'. Br. J. educ. Psychol., 44, 76-82.

DUCKWORTH, D. and ENTWISTLE, N.J. (1974b) 'The Swing from Science - a Perspective from Hindsight'. Educ. Res., 17, 48-53.

EGGLESTON, J.F. and DREYFUS, A. (1977) Teaching Tactics of Student Teachers of Science. University of Nottingham, School of Education.

EGGLESTON, J.F., GALTON, M.J. and JONES, M.E. (1976) Processes and Products of Science Teaching. London Macmillan Education.

EISENHARDT, W.G. (1977) 'A search for the predominant causal sequence in the inter-relationship of interest in academic subjects and academic achievement'. Dissertation Abstracts International, 37, 4225A.

ELTON, L.R.B. (1977) 'Methodological Themata in Educational Research'. Br. Educ. Res. Ass. Bull., 3, 2, 36- 39.

ENTWISTLE, N.J. (1973) 'Personality and academic attainment'. In BUTCHER, H.J. and PONT, H.B. Educational Research in Britain 3. London : University of London Press,

ENTWISTLE, N.J. (1974) 'Aptitude Tests for Higher Education?' Br. J. educ. Psychol., 44, 91-6.

ENTWISTLE, N.J. (1977) 'Strategies of Learning and Studying : Recent Research Findings'. Br. J. educ. Psychol., 25, 225-238.

ENTWISTLE, N.J. (1978a) S.S.R.C. Motivation and Study Habits Scales. Personal communication.

ENTWISTLE, N.J. (1978b) 'Knowledge structures and styles of learning : a summary of Pask's recent research'. Br.J. educ. Psychol., 48, 255-265.

ENTWISTLE, N.J. and BRENNAN, T. (1971) 'The academic performance of students, II - Types of successful students'. Br. J. educ. Psychol., 41, 268-276.

ENTWISTLE, N.J. and COWELL, M.D. (1971) 'The relationships between personality, study attitudes and academic performance in a technical college'. Br. J. educ. Psychol., 41, 85-90.

ENTWISTLE, N.J. and ENTWISTLE, D.M. (1970) 'The relationships between personality, study methods and academic performance'. Br. J. educ. Psychol., 40, 132-143.

ENTWISTLE, N.J., HANLEY, M. and HOUNSELL, D. (1979) 'Identifying distinctive approaches to studying'. Higher Education, 8, 365-380.

ENTWISTLE, N.J.,NISBET, J.B., ENTWISTLE, D. and COWELL, M.D. (1971b) 'The academic performance of students I. - Prediction from scales of motivation and study methods'. Br. J. educ. Psychol., 41, 258-267.

ENTWISTLE, N.J. PERCY, K.A. and NISBET, J.B. (1971a) Educational Objectives and Academic Performance in Higher Education. University of Lancaster.

ENTWISTLE, N.J., THOMPSON, J.B. and WILSON, J.D. (1974) 'Motivation and study habits'. Higher Education, 3, 379-395.

ENTWISTLE, N.J. and WILSON, J.D. (1970) 'Personality, study methods and academic performance'. Univ. Quart., 24, 147-156.

ENTWISTLE, N.J. and WILSON, J.D. (1977) Degrees of Excellence : The Academic Achievement Game. London : Hodder and Stoughton.

EVERITT, B. (1974) Cluster Analysis. London : S.S.R.C. and Heinemann.

EYSENCK, H.J. (1972a) Psychology is about People. London : Allen Lane.

EYSENCK, H.J. (1972b) 'Personality and attainment : an application of psychological principles to educational objectives'. Higher Education, 1, 39-52.

EYSENCK, H.J. and EYSENCK, S.B.G. (1964) Manual of the Eysenck Personality Inventory. London : University of London Press.

EYSENCK, H.J. and EYSENCK, S.B.G. (1969) Personality Structure and Measurement. London : Routledge and Keegan Paul.

EYSENCK, H.J. and EYSENCK, S.B.G. (1976) Psychoticism as a Dimension of Personality. London : Hodder and Stoughton.

EYSENCK, S.B.G., NIAS, D.K.B. and EYSENCK, H.J. (1971) 'The interpretation of children's lie scale scores'. Br. J. educ. Psychol., 41, 23-31.

FORREST, G.M. (1971) Standards in subjects at the Ordinary Level of the G.C.E., June 1970. Manchester: Joint Matriculation Board.

FORREST, G.M., SMITH, G.A. and BROWN, M.H. (1970) General Studies (advanced) and Academic Aptitude. Manchester: Joint Matriculation Board.

FRASER, B.J. and WALBERG, H.J. (1981) 'Psychosocial Learning Environment in Science Classrooms : A Review of Research'. Stud. in Sci. Educ., 8, 67-92.

FRISKOPP, K.G. (1972) 'P.S.S.C. and its adoption for use in Scandinavia'. In LEWIS, J.L. (ed.) Teaching School Physics. London : Penguin Education.

GAGNÉ, R.M. (1970) The Conditions of Learning. London: Holt, Rinehart and Winston.

GALTON, M.J. (1977) The Effective Science Teaching Questionnaire. Personal communication.

GALTON, M. (1979) 'Systematic classroom observation : British Research'. Educ. Res., 21, 109-115.

GALTON, M.J., EGGLESTON, J.F. and JONES, M.E. (1975) A Modified Pupil Opinion Poll. Slough : N.F.E.R.

GARDNER, P.L. (1974) 'Research on teacher effects: critique of a traditional paradigm'. Br. J. educ. Psychol., 44, 123-130.

GARDNER, P.L. (ed.) (1975a) The Structure of Science Education. Victoria, Australia : Longman.

GARDNER, P.L. (1975b) 'Attitudes to Science : A Review'. Stud. in Sci. Educ., 2, 1-41.

GARDNER, P.L. (1976) 'Attitudes towards physics : personal and environmental influences'. J. Res. Sci. teach., 13, 111-125.

GASKELL, D. (1975) 'The Flow of Chemists'. Educ. in Sci., 62, 21-24.

GONZALEZ, G. and GILBERT, J. (1980) 'A-level physics by the use of an independent learning approach : the role of lab-work'. Br. Educ. Res. J., 6, 1, 63-83.

GOOD, T., BIDDLE, B. and BROPHY, J. (1975) Teachers Make a Difference. New York : Holt, Rinehart and Winston.

GOOD, T. and POWER, C.N. (1976) 'Designing successful classroom environments for different types of students'. J. Curric. Stud., 8, 45-60.

GORDON, A. and WILLIAMS, G. (1977) 'Question : who wants to stay at school?' Times Educational Supplement. 1st July.

HARTLEY, J., HOLT, J. and HOGARTH, F.W. (1971) 'Academic Motivation and Programmed Learning'. Br.J. educ. Psychol., 41, 171-183.

HARVEY, T.J. (1980) 'The relative importance of physics at school and university for male and female students'. Sch. Sci. Rev., 61, 774-8.

HAVELOCK. R.G. (1971) Planning for Innovation. Michigan : University of Michigan Press, U.S.A.

HEAD, J. (1979) 'Personality and the Pursuit of Science'. Stud. in Sci. Educ., 6, 23-44.

HEATH, N.E. (1972) 'New Zealand adaption of P.S.S.C.'

In LEWIS, J.L. (ed.) Teaching School Physics. London : Penguin Education.

HECKER, P.C. and WOOD, R. (1979) Report of a Cross-Moderation Study in Physics at Advanced Level : 1977. University of London : University Entrance and Schools Examination Council.

HEINEMANN (1961) The Science Study Series. London : Heinemann.

HEWITT, E.A. (1967) The Reliability of G.C.E. O-level examinations in English Language. Manchester: Joint Matriculation Board.

HILTON, T.L. and BERGLUND, G.W. (1974) 'Sex differences in mathematics achievement - a longitudinal study'. J. educ. Res., 67, 5, 231-237.

H.M.A. (1968) The Sixth Form of the Future. London : The Headmasters Association.

HOCKEY, S.W. and McKIM, F.R. (1968) 'Sixth formers tell why they chose A-level subjects'. Times Educational Supplement, 22nd March.

HOLLAND, J.L. (1966) The Psychology of Vocational Choice. London : Ginn Blaisdell.

HOLLEY, B.J. (1974) A-level Syllabus Studies : History and Physics. London : Macmillan.

HOUSTON, J. (1975) 'The effects of verbal style in physics teaching'. Phys. Educ., 10, 38-41.

HOYLE, E. (1973) 'Strategies of Curriculum Change'. In WATKINS, R. (ed.) In-Service Training : Structure and Content. London : Ward-Lock Educational.

HUDSON, B. (ed.) (1973) Assessment Techniques-on-introduction. London : Methuen Educational.

HUDSON, L. (1966) Contrary Imaginations. London : Methuen.

HUDSON, L. (1968) Frames of Mind. London : Methuen.

HUTCHINGS, D., BRADLEY, J. and MEREDITH, C. (1975) Free to Choose. University of Oxford : Department of Educational Studies.

J.M.B. (1966) O-level Latin, French and Biology. Manchester : Joint Matriculation Board.

JOSEPHS, A.P. and SMITHERS, A.G. (1975) 'Personality characteristics of syllabus-bound and syllabus-free sixth-formers'. Br. J. educ. Psychol., 45, 29-38.

KELLY, A. (1975) 'A Discouraging Process : How Women are Eased out of Science'. In Girls and Science Education - Cause for Concern? Conference Report. London : Chelsea College.

KELLY, A. (ed.) (1981) The Missing Half - Girls and Science Education. Manchester : Manchester University Press.

KEMPA, R.F. and DUBÉ, G.E. (1974) 'Science Interest and Attitude Traits in Students Subsequent to the Study of Chemistry at the Ordinary Level by the General Certificate of Education'. J. Res. Sci. Teach., 11, 361-370.

KEOHANE, K. (1972) 'The Nuffield programmes in the United Kingdom'. In LEWIS, J.L. (ed.) Teaching School Physics. London : Penguin Education.

KIM, J.O. and KOHOUT, F.J. (1975a) 'Multiple Regression Analysis'. In NIE, N. et al. Statistical Pacakage for the Social Sciences. New York : McGraw-Hill.

KIM, J.O. and KOHOUT, F.J. (1975b) 'Analysis of Variance and Covariance'. In NIE, N. et al. Statistical Package for the Social Sciences. New York : McGraw-Hill.

KLECKA, W.R. (1975) 'Discriminant Analysis'. In NIE, N. et al. Statistical Package for the Social Sciences. New York : McGraw-Hill.

KRATHWOHL, D.R. BLOOM, B.S. and MASIA, D.G. (1964) Taxonomy of Educational Objectives : Handbook II, The Affective Domain. London : Longmans.

KREMER, B.K. and WALBERG, H.J. (1981) 'A Synthesis of Social and Psychological Influences on Science Learning'. Sci. Educ., 65, 11-23.

LAYTON, D. (1973) Science for the People. London : George Allen and Unwin.

LEITH, G.O.M. (1973) 'The effects of extraversion and methods of programmed instruction on achievement'. Educ. res., 15, 150-3.

LEWIS, D.G. (1972) 'Subject choice in the Sixth Form - a critical review of research'. Educ. Res., 15, 21-27.

LEWIS, J.L. (ed.) (1972) Teaching School Physics. London : Penguin Education.

LORD, F. (1963) 'Elementary models for measuring change'. In HARRIS, C.W. (ed.) Problems in Measuring Change. Madison, Milwaukee : University of Wisconsin Press, U.S.A.

MANSELL, J. (1974) 'Team Teaching in Further Education'. Educ. Res., 17, 1-26.

MARTON, F. and SÄLJÖ, R. (1976) 'On qualitative differences in learning. I - Outcome and process'. Br. J. educ. Psychol., 46, 4-11.

MEYER, G.R. (1970) 'Reactions of pupils to Nuffield science teaching materials at the 'O' level of the G.C.E. J. Res. Sci. teach., 7, 283-297.

MURPHY, R.J.L. (1982) 'A further report of investigations into the reliability of marking G.C.E. Examinations'. Br.J. educ. Psychol., 52, 58-63.

NEWALL, A. (1969) 'The views of science teachers on attitudes to science and scientists'. Sch. Sci. Rev., 51, 20-22.

NIE, N.H., HULL, C.H., JENKINS, J.,G., STEINBRENNER, K. and BENT, D.H. (1975) Statistical Package for the Social Sciences. New York : McGraw Hill.

NISBET, J.D. and ENTWISTLE, N.J. (1969) The Transition to Secondary Education. London : University of London Press.

NISBET, J.D. and ENTWISTLE, N.J. (1970) Educational Research Methods. London : University of London Press.

NUTTALL, D.L. (1971) Administrators Manual for the Science Attitude Questionnaire. Slough : N.F.E.R.

NUTTALL, D.L., BACKHOUSE, J.K. and WILLMOTT, A.S. (1974) Comparability of Standards between Subjects. London : Evans/Methuen Educational.

ORMEROD, M.B. (1975) 'Subject preference and choice in co-educational and single-sex secondary schools'. Br.J. educ. Psychol., 45, 257-267.

ORMEROD, M.B. with DUCKWORTH, D. (1975) Pupils' attitudes to science. Slough : N.F.E.R.

PARLETT, H.R. (1970) 'The syllabus-bound student'. In HUDSON, L. (ed.) The Ecology of Human Intelligence. London : Penguin.

PEDLEY, R., (1963) The Comprehensive School. London : Penguin.

PELL, A.W. (1975) 'The swing from A-level physics'. Unpublished M.A. Dissertation, University of Lancaster.

PELL, A.W. (1977) 'Subject swings at A-level : attitudes to physics'. Sch. Sci. Rev., 58, 763-770.

PELL, A.W. (1979) 'Evidence in Physics Education'. Educ. in Sci., 83, 22.

PELL, A.W. (1980) 'An Evaluation of a Foundation Course in Art'. Unpublished paper. Tresham College, Kettering.

PETERS, R.S. (1958) The Concept of Motivation. London : Routledge.

PONT, H.B. (1970) 'The Arts-Science Dichotomy'. In BUTCHER, H.J. and PONT, H.B. (ed.) Educational Research in Britain 2. London : University of London Press.

POWER, C. (1977) 'A Critical Review of Classroom Interaction Studies'. Stud. in Sci. Educ., 4, 1-30.

RAMSDEN, P. and ENTWISTLE, N.J. (1981) 'Effects of Academic Departments on Students' Approaches to Studying'. Br. J. educ. Psychol., 363-383.

ROBINSON, E. (1968) The New Polytechnics. London : Penguin.

ROGERS, E.M. (1975) 'The Revision of Nuffield O-level Physics'., Educ. in Sci., 64, 14-15.

ROSENHEAD, L., (1968) Opening Address at the Easter Conference of the Association for Science Education. Educ. in Sci., June, 13-18.

ROSENSHINE, B. (1971) Teacher Behaviours and Student Achievement. London : N.F.E.R.

ROSENSHINE, B. and FURST, N. (1973) 'The use of direct observation to study teaching'.In TRAVERS, R. (ed.) Second Handbook of Research on Teaching. Chicago : Rand McNally.

ROTHMAN, A.I. (1969) 'Teacher Characteristics and Student Learning'. J. Res. Sci. Teach., 6, 340-348.

ROTHMAN, A.I., WELCH, W.W. and WALBERG, H.J. (1969) 'Physics Teacher Characteristics and Student Learning'. J. Res. in Sci. Teach., 6, 59-63.

RUTHERFORD, F.J., HOLTON, G. and WATSON, F.G. (1975) The Project Physics Course : Text. New York : Holt, Rinehart and Wisnton.

SARAGA, E. (1975) 'Girls and Boys : are there differences in ability?'. In Girls and Science Education - Cause for Concern? Conference Report. London : Chelsea College.

SARDAR, Z. (1977) 'Science Learning : a three-way split'. Times Educational Supplement, April 1st.

SCHEFLER, W.C. (1965) 'A comparison between inductive and illustrative laboratories in college biology'. J. Res. Sci. Teach., 3, 218-223.

SCHOOLS COUNCIL (1970) Sixth-Form Survey Volume 1. London : Councils and Education Press.

SCHOOLS COUNCIL (1973) The Examination Courses of First Year Sixth-Formers. London : Macmillan.

SCOTT, J.F. (1975) Comparability of grade standards in mathematics at G.C.E. A-level. London : Evans/Methuen.

SELKIRK, F. (1972) 'Subject Choice at G.C.E. Advanced Level'. Univ. Quart., 27, 74-89.

SHAYER, M. (1972) 'Conceptual demands in the Nuffield O-level physics course'. Sch. Sci. Rev., 54, 26-34.

SHAYER, M. and ADEY, P. (1981) Towards a Science of Teaching Science. London : Heinemann.

SHERWOOD TAYLOR, F. (1949) Science Past and Present. London :Heinemann.

SHIPMAN, M.D. (1972) The limitations of social research. London : Longman.

SHULMAN, L.S. and TAMIR, P. (1973) 'Research on Teaching in the Natural sciences'. In TRAVERS,R.M.W. (ed.) Second Handbook of Research on Teaching. Chicago: Rand McNally.

SIEGEL, S. (1956) Nonparametric statistics for the behavioural sciences. Tokyo : McGraw Hill Kogakusha

SIMPSON, E.J. (1966) 'The Classification of Educational Objectives - Psychomotor Domain'. Illinois Teacher, U.S.A., 10, 110-144.

SKURNIK, L.S. and JEFFS, P.M. (1970) Science Attitude Questionnaire. Slough : N.F.E.R.

SMITH, M.D. (1969)'Response to a multi-media system'. J. Res. Sci. Teach., 6, 322-332.

SMITH, M.D.,WALBERG, M.J., POORMAN, L.E. and SCHAGRIN, M. (1968) 'Affective Response to Different Media in a Multi-Media System'. Sci. Educ., 52, 16-22.

SMITHERS, A.G., SAYLES, P. and JOSEPHS, A.P. (1975) 'Syllabus-bound and syllabus-free orientations in a technological university'. Res. in Educ., 13, 67-77.

SOH, K.C. (1973) 'Dynamic structures and Science Bias'. Sci. Educ., 57, 335 -341.

STERN, G.G. (1963) 'Measuring non-cognitive variables in research on teaching'. In GAGE, N.L. (ed.) Handbook of Research on Teaching. Chicago : Rand McNally.

STEVENS, J.T. and ATWOOD, R.K. (1978) 'Interest Scores as Predictors of Science Process Performance for Junior High School Students'. Sci. Educ., 62, 303-308.

SUMNER, R. and WARBURTON, F.W. (1972) Achievement in Secondary School. slough : N.F.E.R.

TAWNEY, D.A. (1976) 'Evaluation and Science Curriculum Projects in the U.K.'. Stud. in Sci. Educ., 3, 31-54.

TAYLOR, P.H., CHRISTIE, T. and PLATTS, C.V. (1970a) Studies in the Structure of Science Teaching, 1. University of Birmingham, Teaching Research Unit.

TAYLOR, P.H.,CHRISTIE, T. and PLATTS, C.V. (1970b) 'An explanatory study of science teachers' perceptions of effective teaching'. Educ. Rev., 23, 19-32.

T.E.S. (1978) 'The exam : five different ways to do the job'. Times Educational Supplement, 21st July.

T.E.S. (1981) 'The Macfarlane Report on education for 16 to 19 year olds'. Times Educational Supplement, 30th January.

TROTTER, A.W. (1980) 'It's not like that'. Phys. Educ., 15, 65.

TYLER, R.W. (1949) Basic Principles of Curriculum and Instruction. Chicago : University of Chicago Press.

U.M.R.C.C. (1979) S.P.S.S. Version 7 Procedures,Volume 3. Manchester : University of Manchester Regional Computer Centre.

UNIVERSITY OF LONDON (1981) General Certificate of Education. Regulations and Syllabuses, June 1983/ January 1984. University of London.

VINTON, J.C. (1972) 'The relationships among lifestyle, task and structure in university classrooms'. Unpublished Ph.D. Thesis, Case Western Research University, U.S.A.

WALBERG, H.J. (1967) 'Dimensions of science interests of boys and girls studying physics'. Sci. Educ., 27, 111-6.

WALBERG, H.J. (1969a) 'Physics, Femininity and Creativity'. Develop. Psychol., 1, 47-54.

WALBERG, H.J. (1969b) 'Social environment as a mediator of classroom learning'. J. educ. Psychol., 60, 443-8.

WALBERG, H.J. and ANDERSON, G.J. (1968) 'Classroom climate and individual learning'. J. educ. Psychol., 59, 414-19.

WALLEN, N.E. and TRAVERS, R.M.W. (1963) 'Analysis and Investigation of Teaching Methods'. In GAGE, N.L. (ed.) Handbook of Research on Teaching. Chicago : Rand McNally.

WANKOWSKI, J.A. (1974) 'Teaching methods and academic success in sixth-form and university'. J. Curric. Stud., 6, 50-60.

WATSON, F.G. (1963) 'Research on Teaching Science'. In GAGE, N.L. (ed.) Handbook of Research on Teaching. Chicago: Rand McNally.

WEINER, B. (1972) Theories of Motivation : From Mechanism to Cognition. Chicago : Markham.

WELCH, W.W. (1969) 'Correlates of course satisfaction in high school physics'. J. Res. Sci. Teach., 6, 54-8.

WELCH. W.W. (1974) 'Review of the research on an evaluation program of Harvard Project Physics'.J. Res. Sci. Teach., 10, 365-378.

WELCH, W.W. and BRIDGHAM, R.G. (1968) 'Physics Achievement Gains as a Function of Teaching Duration'. Sch. Sci. and Maths, 449-454.

WENHAM, E.J., (1967) 'The Nuffield Foundation Science Teaching Project - III : Physics 11-16'. Sch. Sci. Rev., 48, 337-346.

WHEELER, D.K. (1967) Curriculum Process. London : University of London Press.

WILKINSON, W.J. (1967) 'An analysis of the choice of subjects in the sixth form'. Educ. Rev., 19, 99-109.

WILKINSON, W.J. (1975) 'Pupil Attitudes to Science in Relation to Personality, Achievement, Motivation and Role amongst Potential G.C.E. Candidates'. Unpublished Ph.D. Thesis, University of London.

WILLMOTT, A.S. and NUTTALL, D.L. (1975) The Reliability of Examinations at 16+. London : Macmillan Education.

YOUNGMAN, M.B. (1975) Programmed Methods of Multivariate Data. Nottingham : University of Nottingham School of Education.

YOUNGMAN, M.B. (1979) Analysing Social and Educational Research Data. London : McGraw Hill.

ZUKAV, G. (1979) The Dancing Wu Li Masters. London : Rider/Hutchinson.