GÖTEBORG STUDIES
IN EDUCATIONAL SCIENCES

Editors:

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Allan Svensson Relative Achievement

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Allan Svensson

Relative Achievement

School performance in relation to intelligence, sex and home environment

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February 1971 Allan Svensson

CHAPTER 1

PREVIOUS RESEARCH

Much attention has been paid during recent years to students whose school performances are very good or very bad in relation to their intelligence. The number of research reports published is so great that it is quite impossible to give any exhaustive account of previous investigations in this field. The purpose of the following survey of the literature is, instead, to inform the reader how the present author views the problem and how certain research results have influenced him in his work. Readers wanting a more comprehensive report of earlier research are referred to Lavin (1965), Kornrich (1965) and Raph *et al.* (1966).

The starting point for the research is the incomplete relationship between intelligence and achievement in school. This relation varies very greatly, due to the composition of the groups of pupils, the different measuring instruments used, and varying intervals of time between the measurements. For unselected samples of pupils, the correlations between intelligence tests and school marks are usually between .50 and .60, while the correlations between intelligence tests and standardized achievement tests rise to between .70 and .80 (Thorndike & Hagen, 1969, p. 324).

Thus there is a substantial relationship between intelligence and achievement, but it is far from perfect, and scarcely half of the variance in scholastic achievement can be explained by differences in intelligence. Starting from this fact, many studies have been concerned with explaining the characteristics of pupils who achieve more or less in their school work than might be expected of them in view of their intelligence.

In design, most of the studies are very similar, in so far as they often begin with some kind of comparison between the two categories of pupils. There exist, however, great variations in the theoretical starting points of the research workers, in the methods they apply, in the instruments they use and in the groups of pupils included in the investigations. These variations may probably explain many of the inconsistent and disparate results arrived at in this field.

The purpose of this chapter is to discuss a few of the prevailing differences of opinion, and to discuss various factors decisive for the results, and to endeavour in this way to arrive at a suitable research strategy.

Theoretical starting points

A scrutiny of the research made earlier soon reveals a terminological dispute, which seems to originate in deep theorecital disagreement. Some workers consider that the incomplete relation between intelligence and achievement is due to individual characteristics or to certain circumstances in the environment of the individuals, while others emphasize features of or shortcomings in the instruments used. The first group talks of *over- and underachieving pupils,* and the second of *over- and underestimating instruments.* A pupil with poor scholastic achievement but high intelligence test results may, according to the first way of looking at things, be regarded as underachieving, and according to the second as overestimated or overpredicted. A pupil with good achievement in relation to test results may, in the same way, be regarded as overachieving or underestimated.

Let us first consider the reasons that may exist for the first view and begin by quoting works favouring this view.

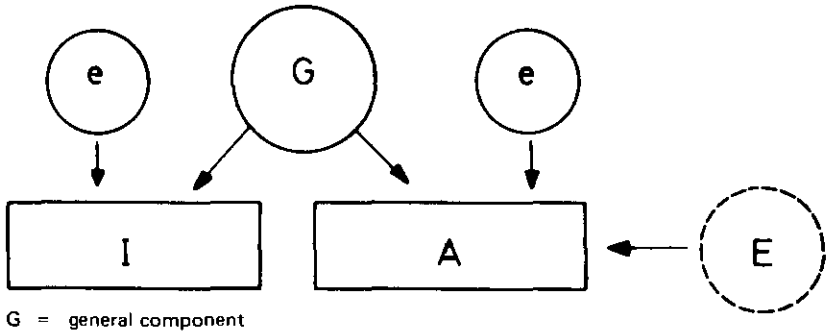
> "Underachievement among high school sophomores is not a surface phenomenon which is easily modifiable, but rather related to the basic personality matrix of the individual" (Shaw & McCuen, 1960, p. 103).
>
> "It is true that the child's underachievement is *his* symptom, but the underachievement is rarely *the* problem. It is an outward manifestation that a deeper problem exists in the child and in the family" (Halpern, 1965, p. 589).
>
> "But we reject the now often-heard speculation that 'underachievement' is a mistake of terminology or a mere manifestation of the present inadequency of our measuring techniques, a problem which will cease to trouble us when we have devised better 'instruments'" (Impellisseri *et al.*, 1965, p. 172).
>
> "It is probably justifiable to conclude that regardless how much of the discrepancy between prediction and achievement may be due to errors of measurement, to statistical artifacts and to inadequate research designs, a part of the dissonance in all likelihood resides within the social and psychological makeup of the individual and the nature of the school he attends" (Raph *et al.*, 1966, p. 13).

One feature common to all these quotations, and to most of the workers who regard the discrepancy between intelligence and achievement as an "individual characteristic", is that the underachieving pupil is in the focus of interest. The purpose is mainly diagnostic, to ascertain what disturbing factors are behind the relatively poor achievement – and possibly, by various treatments, to counteract them.

Among the disturbing factors traced are opposition to the norms of the school (Dureman, 1956), low motivation for studies (Impellisseri, 1965), unsatisfactory study habits (Wilson & Morrow, 1965), anxiety in the school situation (Gill & Spilka, 1962) and conflicts in the home (Wallach *et al.*, 1965).

The theoretical considerations steering these workers are probably as follows: It is thought that an individual's intelligence should be the main decisive factor for school performances. This in its turn should imply that a general component – let us call it intellectual capacity – should be

responsible for most of the variance in the two variables. Some disturbing factors, or systematic error components, however, prevent this general component from having as strong an influence on scholastic achievement as on intelligence test results. If these disturbing factors could be eliminated, the correlation would become stronger, and the remaining discrepancies could be attributed to the uncorrelated random error components, caused by lack of reliability which always affects both the measures. Very schematically, an attempt has been made to express this view in the following model.



G = general component
e = random error components
E = disturbing factors (systematic error component)
I = variability in intelligence measure
A = variability in achievement measure

Fig. 1:1. Schematic diagram illustrating the discrepancy between intelligence and achievement from a diagnostic point of view.

If this theory is to be accepted, one must have great faith in the individual's scores on intelligence tests, and consider that it is more difficult to alter the intelligence level than to influence scholastic achievement, a view that Jensen expresses as follows:

> "The fact that scholastic achievement is considerably less heritable than intelligence also means that many other traits, habits, attitudes, and values enter into a child's performance in school besides just his intelligence, and these non-cognitive factors are largely environmentally determined, mainly through influences within the child's family. This means there is potentially much more we can do to improve school performance through environmental means than we can do to change intelligence per se" (Jensen, 1969, p. 59).

It is assumed here that most of the above-mentioned research workers agree with this statement. And also that they accept my interpretation of the theoretical starting points. On the other hand, there is no doubt that this theory would be criticized very adversely by those who stress "instrumental shortcomings". A few quotations will perhaps show why this criticism would be forthcoming.

> "To say that a student is or is not achieving up to his ability, when the measure of ability is one or several test scores, assumes that the tests provide a stable measure of potential on all subjects and that the test score is highly correlated with grade point average . . . neither suggestion is acceptable. It is to be expected that some studiously-minded students will be more successful on some of the specialized tasks of the school (achievement) than they are on the more general hapazard tasks of everyday life (intelligence)" (Demos & Spolyar, 1961, p. 477).
>
> "But neither our psychological insights nor our statistical evidence give us reason to believe that a scholastic aptitude test measures all of the significant determiners of scholastic achievement. A legitimate and significant area of inquiry is the determination of other kinds of facts about an individual that can be shown to improve predictions. As we are able to extend our understanding of the relevant factors, increase the accuracy of our forecasts, and so reduce 'overprediction', we will automatically reduce 'underachievement'" (Thorndike, 1963, p. 5).
>
> "What appears to happen is that the error in an observer's prediction is attributed to the student as a motivational, willful, or moral error on his part. — Students whose performance is less than expected could be termed 'overpredicted' students as well as 'underachieving' students" (Schwitzgebel, 1965, pp. 485–486).
>
> "Studies of over- and underachievement are found very frequently in the literature. However, the choice of terms seems unfortunate. For one reason, such labels tend to raise intelligence and aptitude tests to almost sacrosanct level. — In short, these terms actually refer to the inaccuracy involved in predicting academic performance from ability measures alone" (Lavin, 1965, p. 25).

These quotations show that here it is considered that intelligence tests and measures of scholastic achievement partly measure different things, and perfect correlation, therefore, cannot be expected between the two variables. Nor are the results of intelligence tests regarded as "sacrosanct" or unalterable as they are by the workers quoted earlier. Further, the following question is addressed to these:

> "Since statistics are usually interpreted in terms of variation in either direction from the mean, it is difficult to understand how a discrepancy in one direction marks a student as a deviant requiring treatment while an equal deviation in the opposite direction is not considered of diagnostic significance. It is especially difficult to comprehend since both test scores and teacher grades are expected to distribute themselves statistically along the range of achievement and ability. Is a chill of greater diagnostic significance than a fever?" (Kowitz, 1965, p. 471).

This question is fully justified, for if a very strong correlation is required between intelligence and achievement, it is not enough to treat underachieving pupils, but the overachieving pupils must also be treated in order to make them reduce their achievement. None of the workers mentioned, all of whom are mainly interested in the underachieving pupils, discuss such treatment, although Dureman does point out:

> "That overachievement in school – and later in life – may often be at the expense of – or as a consequence of – neurotic personality traits is nothing new, nor is it a particularly sensational fact" (Dureman, 1956, p. 27).

Getzels & Jackson (1962, pp. 26–27) claim, however, that overachieving children are occasionally sent to a counseling office in order to reduce their achievements to a level more in line with their intelligence. These authors are clearly negatively inclined to such treatment, for they do not consider that overachievement is associated with emotional disturbances, but is rather due to the measure of achievement taking into account some cognitive functions that are not expressed in the results of conventional intelligence tests. They also belong to the group of authors preferring the terms *"overestimating"* and *"underestimating"* tests to *"underachieving"* and *"overachieving"* pupils.

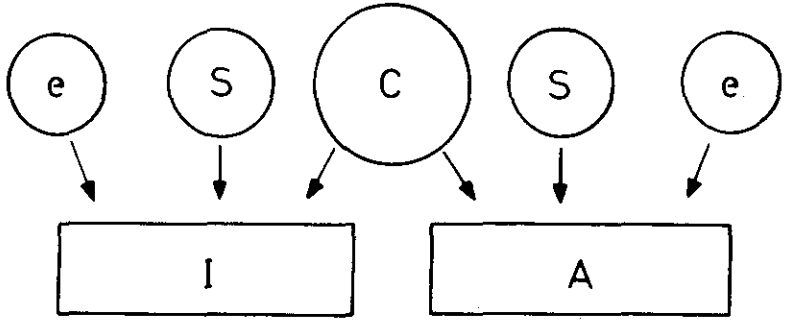
As far as can be found, therefore, Kowitz's claim that pupils with relatively good performances have not attracted much attention from the *diagnostic* aspect is correct. On the other hand, it may be said that they have attracted great *predictive* interest. As mentioned earlier, the research workers concerning themselves with underachieving pupils usually have a diagnostic-therapeutic objective. The aim of those interested in overachieving or underestimated pupils, on the other hand, is predictive, and intended to elucidate the factors that covary with the relatively good achievement. Thus, factors were sought which, together with or in addition to intelligence, give a more valid prediction of the individual's prospects of succeeding in a certain line of education. This has become of great importance during recent decades, during which more and more students in an increasing number of countries are applying for admission to educational institutions with a limited number of places (cf. Coombs, 1968, pp. 31–34). In such circumstances, those making the selection have the heavy responsibility of ascertaining that those chosen really can follow the courses, and that more capable applicants are not rejected. This is of special interest in Sweden, where marks from lower schools – according to many investigations the best predictors – have been very adversely criticized during recent years.

Many investigations with a predictive purpose are reported by Lavin (1965). In design they differ from the diagnostic studies by, among other things, the longer intervals of time between the application of the measures of intelligence and achievement. In spite of this, it is rather obvious that factors which are related to underachieving pupils are also related to overestimated pupils – they belong, of course, to the same categories of pupils. As often, or as seldom, as underachieving pupils are characterized by poor study habits, low motivation or the like, these characteristics are found to be typical of overestimated pupils.

Even though the results of diagnostic and predictive studies agree to a

certain extent, they are nevertheless interpreted and used in different ways. In predictive contexts no attempt is made to eliminate the factors causing discrepancy between level of intelligence and success in school; on the contrary, they are considered valuable as complementary predictors. To make it easier to understand this point of view, an attempt will be made to report the theoretical starting points which seem to be valid here.

The quotations on page 11 show that measures of intelligence and achievement cannot, and are not intended to, measure the same things, and further factors of importance for good achievement must be found. The workers preferring the terms *over-* and *underestimating tests* should therefore agree that the variations in the measures of intelligence and achievement are dependent only to a certain extent on the same underlying component, and that, in addition to uncorrelated random error components, uncorrelated specific components must be allowed for. A very simple model, which may be accepted by these research workers is given in Figure 1:2.



C = common component
S = specific components
e = random error components
I = variability in intelligence measure
A = variability in achievement measure

Fig. 1:2. Schematic diagram illustrating the discrepancy between intelligence and achievement from a predicitive point of view.

To stress the distinctions between the two theoretical models, terms taken partly from Tukey (1951) may be used. Since neither of the models neglects lack of reliability, it must be possible to accept the following statements in both cases:

observed quantity of intelligence = steady part + fluctuations,

observed quantity of achievement = steady part + fluctuations.

The differences between the models are due to the fact that the steady parts are regarded in different ways. In the first model, the "steady part of intelligence" is taken as the real value of the individual's potential ability to

succeed in school. Over- and underachievement are consequences of the fact that a *systematic* error component affects the "steady part of achievement". If this systematic error component could be eliminated, and also very reliable measuring instruments evolved, the correlation between intelligence and scholastic achievement would approach one.

In the second model, on the other hand, it is considered that each of the steady parts can be divided into a "common part" and "an individual part", and the predictive ability of the intelligence test is directly related to how great a part of the "observed quantity of intelligence" consists of the "common part". The closer this ratio approaches one, the less scope there will be for the test to over- and underestimate.

I am well aware that a sharp – perhaps too sharp – demarcation line is drawn between the diagnostically and the predictively inclined research workers, and that it may be difficult to assign some workers to one or the other category. Also that there is no complete agreement between the theoretical starting points, the aims of the investigations, and the terminology used, but the very schematic models may still be of value to emphasize the fundamental theoretical differences existing between certain groups of workers. These differences of opinion seem, as suggested above, to be due partly to the objectives that have steered investigations and partly to the categories of pupils on which interest was focused. If a diagnostic-therapeutic objective is to be meaningful, one must start from the theory that an underlying component in the form of general intellectual capacity should to a very great degree be of influence in the measures of both intelligence and achievement. If, on the other hand, the aim is predictive, and complementary predictors are sought, it seems equally obvious that the start must be made from a theoretical model which emphasizes specific components more strongly.

What possibilities are there of eliminating, or at least reducing, the discrepancies reported here? As far as the purely terminological differences are concerned, it might be wise not to use the terms *"over-"* and *"underachievement"* nor *"over-"* and *"underestimation"*. Instead, the term *"relative achievement"* could be used (cf. Willingham, 1964; Potts & Savino; 1968). Then it will be unnecessary to take into account possible shortcomings in either the individual or the instruments, but only to ascertain whether a pupil's relative achievement is high or low, that is to say, whether his achievement is higher or lower than might be expected in view of his intelligence. A change in terminology would probably not in itself lead to greater theoretical agreement, but it might be a first step, if it is followed up by certain common principles in the choice of methods and instruments. How these principles are to be drawn up will be discussed in the following sections.

Methods

When one considers all the greatly diverging techniques used in this field of research, one feels as if faced by a gigantic chaos. Closer scrutiny shows, however, that practically all the techniques can be grouped into two main categories which are greatly dependent on two different theoretical models. As a rule, no account is given of the underlying theory, but most often one may assume that the method is steered by one of the theoretical models reported here.

One of the main methods seems to be based on the first of the theoretical models, in which level of intelligence is considered to be a valid measure also of the individual's potential ability to succeed in school. In this method, therefore, relative achievement is defined as the difference between intelligence and achievement, both being expressed on the same scale. Since there are no measuring instruments available unaffected by random error components, the differences between the observed achievement and the observed intelligence must be used.

The other main method is based on the theoretical model in which it is assumed that specific components are of influence in both variables, and that the degree of relative achievement is directly related to the size of these components. Here a start is made from the correlation found between the two variables, expressed as a regression equation, and relative achievement is defined as the difference between observed achievement and achievement expected from level of intelligence. Thus, the predicted achievement is regarded as the normal achievement of all pupils at a certain level of intelligence, but, on account of lack of correlation, scatter occurs around the regression line, which means that certain individuals achieve more and others less than can be predicted from the results of the intelligence test.

In the following, these principal methods will be called the *method of difference* and the *method of regression* respectively. The consequences of the choice of method will now be discussed. First a brief description of six variants of the method of difference (D) will be given. These variants have great or small similarities, and must serve as more or less representative examples, but are probably only a few of all the possible variants.

D.1. Mitchell (1959) converts achievement and intelligence test scores into z-scores, and then calculates the difference between the scores on the two variables. If the achievement score is higher than the intelligence score, the relative achievement is judged to be positive, and the pupil is classed as an "overachiever". If, on the other hand, the intelligence test score is higher, the relative achievement is regarded as negative and the pupil is considered to be an "underachiever".

D.2. Duff & Siegel (1960) apply the same technique at Mitchell, but use

decile values instead of z-scores. They also make separate analyses for pupils above and below the mean on the intelligence test.

D.3. McKenzie (1964) converts raw scores into T-scores and classifies the pupils as "overachievers" if their achievement scores are at least 10 units higher than their intelligence test scores. If the opposite is the case, the pupils are classified as "underachievers". If the difference is less than 10 units, the pupils are included in the group "achievers" and their achievement is considered to be on a level with their intelligence.

D.4. Raph *et al.* (1966) classify a pupil as an "overachiever" if his level of intelligence is at or below the average for the school and if his achievement is above the 75th percentile. An "underachiever", on the other hand, has a level of intelligence clearly above average, but a scholastic achievement below the 60th percentile.

D.5. Gill & Spilka (1962) took a group of pupils around average in respect of intelligence. One half of these pupils had a high relative achievement and were above the 70th percentile, while the other half comprised "underachievers" below the 30th percentile in respect of marks.

D.6. Frankel (1960), in his study, uses pupils with a very high level of intelligence. He does not include an "overachieving" group, but instead "achievers" are compared with "underachievers". There is no difference in the intelligence level of these two categories, but the former belong to the top quartile of the class in respect of school performances while the latter belong to the lowest quartile. This design is rather common, and has been used with slight modifications by Shaw & McCuen (1960), Shaw & Dutton (1962) and others.

After this brief account of the various methods of difference, criticism will be summarized in three main points.

The first is concerned with the lack of agreement between the definitions of the concept "over" and "underachievement" in the six sub-methods which implies that the classification of pupils varies greatly according to choice of technique. This must be considered unsatisfactory from many aspects, and the confusion causes, among other things, uncertainty as to which pupils are to be regarded as "underachievers" and may therefore be expected to have possibilities of improving their scholastic achievement. When using different techniques to compare groups varying greatly in respect of both degree of discrepancy and level of intelligence, it is not surprising that rather different descriptions of over- and underachieving students are found.

The other two points deal with the fact that insufficient consideration is paid by the method of difference to *the regression effect,* which means that individuals with extreme values on one variable tend to have scores closer to average on another variable. This regression towards the mean is inversely related to the strength of the correlation and has been discussed in detail by

Thorndike (1942). He, like Lavin, has criticized the method of difference in this respect (Thorndike, 1963, pp. 13–15; Lavin, 1965, pp. 26–27). That the regression effect is discussed here is because it seems necessary to me to distinguish between two types of regression effect, and I will give an account of how they may affect different variants of the method of difference.

One type of regression effect is due to the presence of lack of reliability in both variables. This effect may be explained on the assumption that errors have zero mean and zero covariances with each other and with true scores. There is, on the other hand, covariance between the observed scores and the errors; observed values above the average contain positive errors more frequently than do observed values below the average, and this trend becomes stronger the farther from the means the observed values are. Since the errors are uncorrelated, this leads to individuals with extreme values on one variable not usually having equally extreme scores on another variable, even though the true values are the same. This regression effect, emanating from lack of reliability, will be designated *intravariate regression effect,* because it is caused by the true values *within* a variable being less extreme than the observed values.

The other type of regression effect will be called *the true regression effect,* because it arises if the true values in two variables do not coincide. To explain this effect, still another assumption must be introduced, namely that the specific components in two variables are independent of each other as well as of the common component (cf. Tukey, 1951, p. 35; Ekman, 1952, p. 197). This means that not all the individuals with high scores on one variable, who have partly obtained their results by superiority in the component specific for the variable, can be expected to have equally high scores *on* another variable.

If the total regression effect – which arises when, for instance, an attempt is made to predict achievement from intelligence – is called *the intervariate regression effect,* the true regression effect may be defined as the difference between the intervariate regression effect and the sum of the intravariate effects. Starting from this definition, the following proposition may be formulated, which must be taken into account in research concerned with relative achievement: The less of the total variance that can be assigned to a common component, the greater will be the intervariate regression effect, and the more the extreme values in one variable tend to approach the mean of the other variable, and this regression can only partly be attributed to unreliability within the variables. This reasoning is illustrated in the following example:

The correlation between scores on an intelligence test and scores on an achievement test amounts to .70. Both the variables have the average 50, the standard deviation 10, and the reliability .90. With the help of the attenuation correction formula, the correlation between the true values can be assessed at about .78 $[70/\sqrt{.90 \times .90}]$. If now, all pupils with 60 points

on the intelligence test are studied, it will be found that they have only 57 points on an average on the achievement test [50+.70 (60–50)]. If perfectly reliable measures were available, pupils scoring 60 points on the intelligence test would, instead, score on an average approximately 57.8 points on the achievement test [50+.78 (60–50)]. The intervariate regression effect in this example amounts to 30 per cent of the observed deviation from the mean in the intelligence variable, of which 8 per cent can be assigned to intravariate regression effects and 22 per cent to the true regression effect.

Of the six sub-methods reported, the intravariate regression effects probably have the most serious consequences for D.1 and D.2, in that certain individuals classified as "over-" and "underachievers" respectively would have changed groups if true and not fallible observed values had been available. The lower the reliability of the variables is, the more frequent this change of group will be, and the more fallible will be the differences found between the over- and underachievers. The other four attempt to guard against the effect of random error components by introducing a neutral zone between groups of over- and underachievers. The probable consequence of the intravariate regression effects here will be that some pupils leave the respective group and some from the neutral zone will replace them. This exchange also implies a source of error, but probably a less disturbing one than is the case in the first two methods.

The most serious objection to the method of difference, however, is that most of these variants seem to be more or less unconscious of the true regression effect, which is not surprising since they are steered by a theory which neglects, or at least does not emphasize sufficiently the specific components. The true regression effect is unavoidable, however, in that the true values in two variables do not coincide, and no advocate of the method of difference would claim that the true values of intelligence and achievement tests are identical, for if they were, it would have to be admitted that the studies are concerned with something due to errors in measurement only.

Here the true regression effect means that even though extremely reliable variables are available, "the systematic error component" in scholastic achievement will be dependent on level of intelligence. The method provides little scope for highly gifted pupils to overachieve and for poorly gifted pupils to underachieve. When over- and underachieving pupils are compared, therefore, level of intelligence is not kept constant, but a comparison is also made between pupils of high and low intelligence. This implies that differences will be found between the groups in *all* the variables in which pupils of high and pupils of low intelligence differ.

Among the variants of the method of difference described above, D.1, D.3, and D.4 seem totally unconscious of the true regression effect, and no attempt is made to guard against this. The others attempt to avoid the

negative correlation between relative achievement and level of intelligence, by, to different degrees, keeping intelligence under control. Nevertheless, the authors do not seem to be fully conversant with the true regression effect. In D.2, for example, a dichotomization of the intelligence variable is considered sufficient, and the true regression effect has, therefore, still some scope. If we look at D.6 and consider the three investigations mentioned there, there is no trace in any of them that the group with good scores on both variables is in any way overachieving or has better achievement than might be expected from level of intelligence. If comparisons are to be made here with an overachieving group, one must clearly choose the one on the lower level of intelligence, and land in the same situation as D.4, that is to say, intelligence is no longer kept constant. Only in D.5 does the true regression effect seem to be without significance, due to the fact that the pupils in the investigation groups are around the average on the intelligence variable. If this method were to be applied to other intelligence groups, the difficulties would be the same as in D.4 and D.6.

The result of the true regression effect depends, therefore, on which variant of the method of difference is used, but nowhere do its consequences seem to have been fully realized. Even when one finds the correlation in question between relative achievement and intelligence, one does not always recognize that this is a consequence of the method, but other explanations are sought. One of the advocates of the method of difference expresses himself as follows, for example:

> "Academic achievers often obtain average or better scores on tests of intelligence. This would appear to indicate that the primary operant factor in academic underachievement is not intelligence alone" (Fink, 1965, p. 73).

It is impossible to agree with this conclusion; both over- and underachievement must be independent of level of intelligence, and one must define relative achievement as *that part of the total achievement which is independent of a pupil's intelligence.*

Thus we must reject the method of difference and its underlying theory when we see the practical results to which it leads. This means that the method of regression and the theoretical model on which it is based must be used. Before this method is dealt with in detail, however, an attempt will be made to illustrate graphically certain differences between the two principal methods.

In Figure 1:3, intelligence and achievement are expressed in a common scale, and the correlation between them is calculated at .60. Further, two regression lines are shown, one with a slope of 1 and the other with a slope of .60. The first line is the one used in the method of difference, for when the

decile values instead of z-scores. They also make separate analyses for pupils above and below the mean on the intelligence test.

D.3. McKenzie (1964) converts raw scores into T-scores and classifies the pupils as "overachievers" if their achievement scores are at least 10 units higher than their intelligence test scores. If the opposite is the case, the pupils are classified as "underachievers". If the difference is less than 10 units, the pupils are included in the group "achievers" and their achievement is considered to be on a level with their intelligence.

D.4. Raph *et al.* (1966) classify a pupil as an "overachiever" if his level of intelligence is at or below the average for the school and if his achievement is above the 75th percentile. An "underachiever", on the other hand, has a level of intelligence clearly above average, but a scholastic achievement below the 60th percentile.

D.5. Gill & Spilka (1962) took a group of pupils around average in respect of intelligence. One half of these pupils had a high relative achievement and were above the 70th percentile, while the other half comprised "underachievers" below the 30th percentile in respect of marks.

D.6. Frankel (1960), in his study, uses pupils with a very high level of intelligence. He does not include an "overachieving" group, but instead "achievers" are compared with "underachievers". There is no difference in the intelligence level of these two categories, but the former belong to the top quartile of the class in respect of school performances while the latter belong to the lowest quartile. This design is rather common, and has been used with slight modifications by Shaw & McCuen (1960), Shaw & Dutton (1962) and others.

After this brief account of the various methods of difference, criticism will be summarized in three main points.

The first is concerned with the lack of agreement between the definitions of the concept "over" and "underachievement" in the six sub-methods which implies that the classification of pupils varies greatly according to choice of technique. This must be considered unsatisfactory from many aspects, and the confusion causes, among other things, uncertainty as to which pupils are to be regarded as "underachievers" and may therefore be expected to have possibilities of improving their scholastic achievement. When using different techniques to compare groups varying greatly in respect of both degree of discrepancy and level of intelligence, it is not surprising that rather different descriptions of over- and underachieving students are found.

The other two points deal with the fact that insufficient consideration is paid by the method of difference to *the regression effect,* which means that individuals with extreme values on one variable tend to have scores closer to average on another variable. This regression towards the mean is inversely related to the strength of the correlation and has been discussed in detail by

Thorndike (1942). He, like Lavin, has criticized the method of difference in this respect (Thorndike, 1963, pp. 13–15; Lavin, 1965, pp. 26–27). That the regression effect is discussed here is because it seems necessary to me to distinguish between two types of regression effect, and I will give an account of how they may affect different variants of the method of difference.

One type of regression effect is due to the presence of lack of reliability in both variables. This effect may be explained on the assumption that errors have zero mean and zero covariances with each other and with true scores. There is, on the other hand, covariance between the observed scores and the errors; observed values above the average contain positive errors more frequently than do observed values below the average, and this trend becomes stronger the farther from the means the observed values are. Since the errors are uncorrelated, this leads to individuals with extreme values on one variable not usually having equally extreme scores on another variable, even though the true values are the same. This regression effect, emanating from lack of reliability, will be designated *intravariate regression effect,* because it is caused by the true values *within* a variable being less extreme than the observed values.

The other type of regression effect will be called *the true regression effect,* because it arises if the true values in two variables do not coincide. To explain this effect, still another assumption must be introduced, namely that the specific components in two variables are independent of each other as well as of the common component (cf. Tukey, 1951, p. 35; Ekman, 1952, p. 197). This means that not all the individuals with high scores on one variable, who have partly obtained their results by superiority in the component specific for the variable, can be expected to have equally high scores on another variable.

If the total regression effect – which arises when, for instance, an attempt is made to predict achievement from intelligence – is called *the intervariate regression effect,* the true regression effect may be defined as the difference between the intervariate regression effect and the sum of the intravariate effects. Starting from this definition, the following proposition may be formulated, which must be taken into account in research concerned with relative achievement: The less of the total variance that can be assigned to a common component, the greater will be the intervariate regression effect, and the more the extreme values in one variable tend to approach the mean of the other variable, and this regression can only partly be attributed to unreliability within the variables. This reasoning is illustrated in the following example:

The correlation between scores on an intelligence test and scores on an achievement test amounts to .70. Both the variables have the average 50, the standard deviation 10, and the reliability .90. With the help of the attenuation correction formula, the correlation between the true values can be assessed at about .78 [$70/\sqrt{.90 \times .90}$]. If now, all pupils with 60 points

on the intelligence test are studied, it will be found that they have only 57 points on an average on the achievement test [50+.70 (60–50)]. If perfectly reliable measures were available, pupils scoring 60 points on the intelligence test would, instead, score on an average approximately 57.8 points on the achievement test [50+.78 (60–50)]. The intervariate regression effect in this example amounts to 30 per cent of the observed deviation from the mean in the intelligence variable, of which 8 per cent can be assigned to intravariate regression effects and 22 per cent to the true regression effect.

Of the six sub-methods reported, the intravariate regression effects probably have the most serious consequences for D.1 and D.2, in that certain individuals classified as "over-" and "underachievers" respectively would have changed groups if true and not fallible observed values had been available. The lower the reliability of the variables is, the more frequent this change of group will be, and the more fallible will be the differences found between the over- and underachievers. The other four attempt to guard against the effect of random error components by introducing a neutral zone between groups of over- and underachievers. The probable consequence of the intravariate regression effects here will be that some pupils leave the respective group and some from the neutral zone will replace them. This exchange also implies a source of error, but probably a less disturbing one than is the case in the first two methods.

The most serious objection to the method of difference, however, is that most of these variants seem to be more or less unconscious of the true regression effect, which is not surprising since they are steered by a theory which neglects, or at least does not emphasize sufficiently the specific components. The true regression effect is unavoidable, however, in that the true values in two variables do not coincide, and no advocate of the method of difference would claim that the true values of intelligence and achievement tests are identical, for if they were, it would have to be admitted that the studies are concerned with something due to errors in measurement only.

Here the true regression effect means that even though extremely reliable variables are available, "the systematic error component" in scholastic achievement will be dependent on level of intelligence. The method provides little scope for highly gifted pupils to overachieve and for poorly gifted pupils to underachieve. When over- and underachieving pupils are compared, therefore, level of intelligence is not kept constant, but a comparison is also made between pupils of high and low intelligence. This implies that differences will be found between the groups in *all* the variables in which pupils of high and pupils of low intelligence differ.

Among the variants of the method of difference described above, D.1, D.3, and D.4 seem totally unconscious of the true regression effect, and no attempt is made to guard against this. The others attempt to avoid the

negative correlation between relative achievement and level of intelligence, by, to different degrees, keeping intelligence under control. Nevertheless, the authors do not seem to be fully conversant with the true regression effect. In D.2, for example, a dichotomization of the intelligence variable is considered sufficient, and the true regression effect has, therefore, still some scope. If we look at D.6 and consider the three investigations mentioned there, there is no trace in any of them that the group with good scores on both variables is in any way overachieving or has better achievement than might be expected from level of intelligence. If comparisons are to be made here with an overachieving group, one must clearly choose the one on the lower level of intelligence, and land in the same situation as D.4, that is to say, intelligence is no longer kept constant. Only in D.5 does the true regression effect seem to be without significance, due to the fact that the pupils in the investigation groups are around the average on the intelligence variable. If this method were to be applied to other intelligence groups, the difficulties would be the same as in D.4 and D.6.

The result of the true regression effect depends, therefore, on which variant of the method of difference is used, but nowhere do its consequences seem to have been fully realized. Even when one finds the correlation in question between relative achievement and intelligence, one does not always recognize that this is a consequence of the method, but other explanations are sought. One of the advocates of the method of difference expresses himself as follows, for example:

> "Academic achievers often obtain average or better scores on tests of intelligence. This would appear to indicate that the primary operant factor in academic underachievement is not intelligence alone" (Fink, 1965, p. 73).

It is impossible to agree with this conclusion; both over- and underachievement must be independent of level of intelligence, and one must define relative achievement as *that part of the total achievement which is independent of a pupil's intelligence.*

Thus we must reject the method of difference and its underlying theory when we see the practical results to which it leads. This means that the method of regression and the theoretical model on which it is based must be used. Before this method is dealt with in detail, however, an attempt will be made to illustrate graphically certain differences between the two principal methods.

In Figure 1:3, intelligence and achievement are expressed in a common scale, and the correlation between them is calculated at .60. Further, two regression lines are shown, one with a slope of 1 and the other with a slope of .60. The first line is the one used in the method of difference, for when the

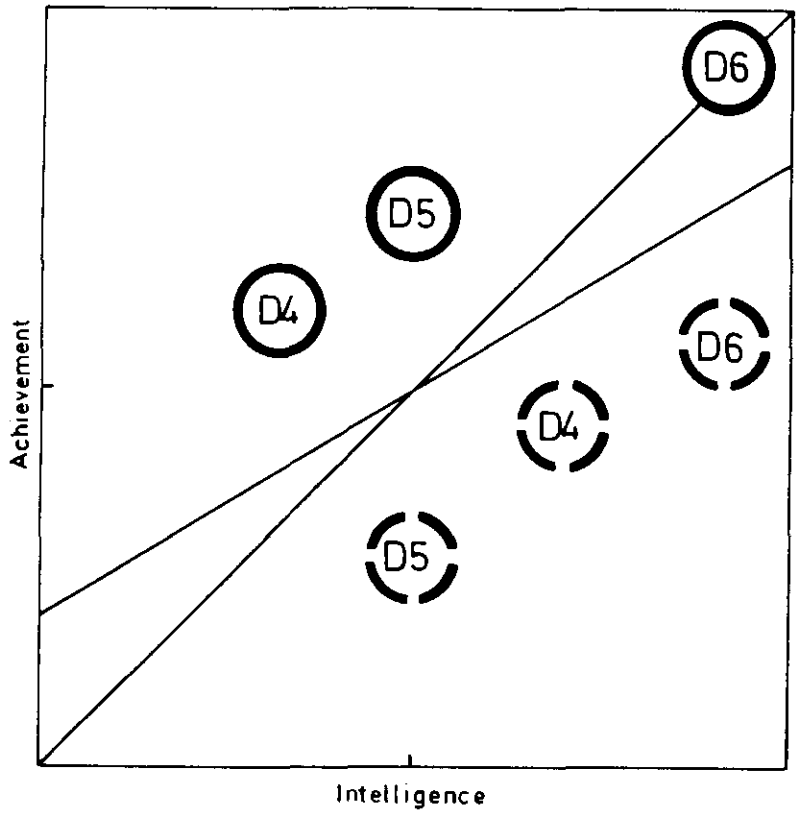


Fig. 1:3. A comparison between the method of difference and the method of regression. The unbroken circles indicate groups of achievers or overachievers, and the broken circles underachievers. The legends indicate the variant of the method of difference to which reference is made.

differences between observed scores on intelligence and achievement tests expressed on the same scale are calculated, it is the same as when the deviations from a regression line with a slope of 1 are calculated. The slope of the other line is calculated on the basis of the assessed correlation, and since the standard deviations have been made equal, the numerical values of the regression and correlation coefficient coincide. This line is used in the calculation of relative achievement according to the method of regression, i.e. attention has been paid to the intervariate regression effect.

An attempt has also been made in the figure to indicate the approximate positions of the groups of pupils compared in the last three variants of the method of difference. Starting from the figure, some of the situations that affect agreement between the methods will be listed:

1. The higher the correlation is between the variables, the better the two lines will coincide, and the greater will be the agreement between the classifications of over- and underachievers in the two methods.
2. If the lines do not coincide, agreement will nevertheless be good if only pupils around average on the intelligence variable are used, as will be seen if the groups compared in D.5 are studied.
3. Dependent of whether the pupil's intelligence points are above or below average, the relative achievement will be more or less favourable respectively if the method of regression is used instead of the method of difference. This is shown by the pupils used in D.4.
4. Pupils who, according to the method of difference, are considered normal achievers may, in certain situations, be regarded as overachievers on the basis of the method of regression. This is exemplified by the group of achievers in D.6.
5. Some pupils may be classified as over- or underachievers regardless of which method is used, which may explain why certain similarities are found when the characteristics of the groups are described, in spite of the fact that different methods were used.

After this comparison between the two principal methods, three variants of the method of regression will be discussed. These variants will be designated R.1, R.2 and R.3, and may serve as examples of some techniques used commonly in the method of regression. Common to the three variants is that they start from a factually calculated regression line in order to obtain a measure of relative achievement, but there are otherwise certain differences between them.

In R.1, the standard deviation around the regression line, usually called standard error of measurement, is used to distinguish between different categories. Sprinthall (1964), for example, classifies a pupil as "superior achiever" and "underachiever" respectively, if his achievement is one standard error of estimate or more *above* or *below* the regression line. If the value is within this zone, he is classified as a "par achiever". A similar technique is used by several other research workers, but the boundaries of the divisions vary. Thus, the boundary for underachievement is set by Winkler *et al.* (1965) at -.8, by Parsley *et al.* (1964) at -.6, and by Morrison (1969) at -.5 standard error of measurement. The R.1 technique is illustrated in Figure 1:4, where different types of achievers are indicated by different symbols.

When the method of difference was dealt with, the comments were collected under three main points. The first of these was concerned with the lack of agreement between different definitions of "over-" and "underachievement", and to some extent this criticism may be advanced of the above-mentioned investigations, too. In these investigations, however, over-

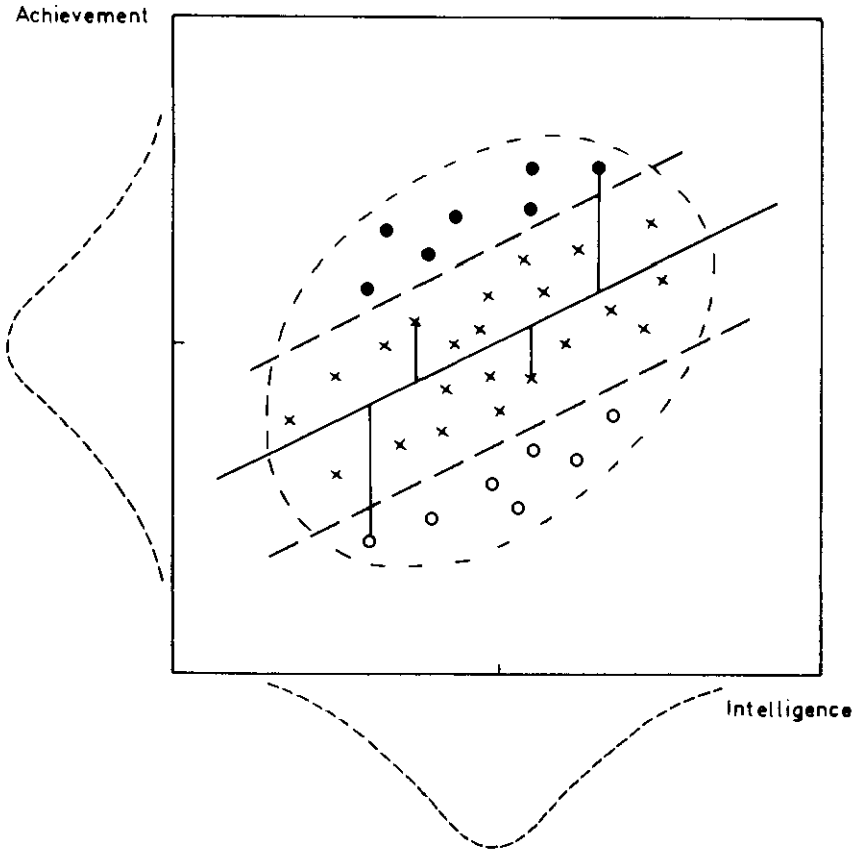


Fig. 1:4. Illustration of the R1 and the R2 variants. ● = overachievers, ○ = underachievers, x = par achievers according to R1. The vertical lines show the distances on which R2 is based.

and underachievers differ only in degree of discrepancy, not in intelligence, and greater agreement may therefore be expected in respect of the factors that covary with relative achievement.

The second point must also be discussed, for the intravariate regression effects cause trouble in all contexts in which one is compelled to work with fallible variables. As with the method of difference, they result in a certain degree of transition between the categories, and here, too, an attempt is made to neutralize this by introducing a "transitional zone" between the groups of over- and underachievers, but with the difference that this zone is not along a diagonal but around a calculated regression line. The category of pupils between the extreme groups does not act only as a "buffer zone", however, but often also has another, more important function. The purpose of many

investigations applying the R.1-technique is namely to study in what respect over- and underachievers, as well as normal achievers, differ (Ahnmé, 1963; Hummel & Sprinthall, 1965; Parsley *et al.*, 1964; Sprinthall, 1964).

If the reliability of the variables had been perfect, the true regression effect would have been the same as the total intervariate regression effect, which is the effect to which attention has been paid here. Then there would not have been any transition between the groups, but such transition increases very rapidly when the random error components in the intelligence and achievement variables increase. Some idea of the degree of transition may be obtained by calculating the reliability for the observed deviations from the regression line. In addition to the reliability of the intelligence and achievement variables, the reliability of this discrepancy score is also dependent on the correlation between the two variables, as is shown by a formula given by Thorndike (1963, p. 8). As far as is known, however, it is impossible to correct for this lack of reliability in such a way that the intravariate effects in this variant of the method of regression are counteracted or eliminated.

What is to be done, then, to overcome wholly or partly the drawbacks mentioned? The answer is that the problem must be tackled in a way different from that used in all the studies mentioned hitherto, for, in spite of differences in methods, they have one thing in common: starting from the discrepancy between intelligence and achievement they have defined two or three categories and then compared these in different variables in order to elucidate which factors covary with relative achievement. If, instead, a start is made from the variables considered to be of significance in this connection, and their correlations with the degree of relative achievement are studied, the situation will be more favourable. This technique is applied in the other two variants of the regression method, which are described briefly below.

If a *continuous* variable is the subject of interest, variant R.2 may be used. This implies that the individual deviations from the regression line (marked in Fig. 1:4) are correlated with the scores on the relevant variables. The strength of the correlation then reveals how much of the variation in relative achievement can be attributed to differences in this variable. This technique has been used by Magnusson (1964), Stone & Foster (1964) and others. The advantage of this technique is that it is unnecessary to draw artificial and, on the whole, arbitrary boundaries between different degrees of relative achievement, but it is possible to state immediately whether a variable is important by ascertaining whether the correlation is statistically significant. Further, the intravariate regression effects – even though serious – cannot cause such dramatic effects as when they give rise to shifts between definitionally distinct categories.

If the variable in question is not continuous but *discrete,* variant R.3

should be used, where, instead of calculating correlations, the method of analysis of covariance is used, as, for example, in Svensson (1964) and Feldhusen *et al.* (1967). By this procedure, one can study whether differences in achievement between pupils with different positions on the discrete variable are greater than the differences that can be attributed to differences in intelligence. To be more exact, this means that one studies whether there are any significant differences between the regression lines for different groups, where division into groups has been made according to, e.g., pupils' sex, type of school or social background. This variant of the regression method is illustrated in Figure 1:5, where the pupils are divided according to a dichotomized background variable.

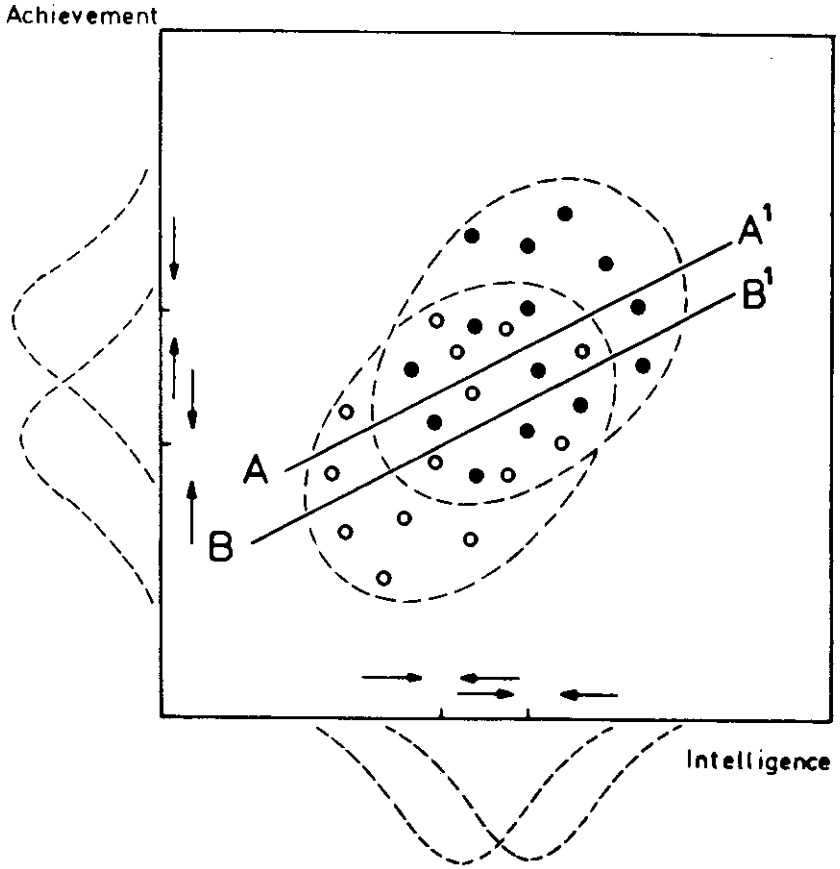


Fig. 1:5. Illustration of variant R3. The individuals are divided according to a certain background variable into groups A and B. The regression lines of these groups and marked A – A^1 and B – B^1 respectively. ● = the positions of the individuals in group A, ○ = the positions of the individuals in group B.

In addition to the advantages that R.3 shares with R.2, a possibility arises of mastering the intravariate regression effects. This possibility is based on the fact that division into groups in R.3 is made according to sex, age, etc., and not according to the observed and fallible scores of intelligence and scholastic achievement. Thus, the groups compared are regarded as samples drawn from different populations and in such circumstances the intravariate regression effects should be manifested in the observed individual scores regressing towards the mean of their own population and not towards the common mean of the populations. Provided that the means of the errors are zero in all groups (cf. Härnqvist, 1968, p. 56), the means of the samples within the limits of the sampling errors will coincide with those of the respective populations. The intravariate effects – marked by arrows in Figure 1:5 – cannot, therefore, alter the observed group means in a systematic way. On the other hand, the individual fluctuations, caused in the intelligence variable by the intravariate regression effect, have a systematic influence on the predicted means of achievement. This source of error can be corrected for, however, according to a method suggested by Härnqvist and described in Appendix 5.

This survey of methods will be closed with a recommendation to use the method of regression not only for predictive but also for diagnostic purposes, which seems rather unusual, at least judging from the fifty studies included in Kornrich's work, *Underachievement,* from 1965. To elucidate which factors covary with relative achievement, however, comparisons should not be made between arbitrarily defined categories of pupils, but, depending on the type of variable under consideration, either the correlations between the deviations from the regression line and the variable in question should be calculated or the relations should be expressed by the help of the method of analysis of covariance.

Measures of intelligence and scholastic achievement

Also when we are concerned with the choice of measures of intelligence and scholastic achievement, there are great variations between different studies, and it is more the exeption than the rule if two research workers are found using exactly the same instruments. The wealth of variation may at least be due partly to the fact that no uniform norms, to guide individual researchers in their choice of predictors and criteria have been formulated in this field. It would probably be difficult to draw up norms, but nevertheless an attempt will be made to outline a few.

Thorndike has drawn attention to the greatest difficulty when it is a question of choosing measures of intelligence and achievement:

> "We are, then, in something of a dilemma. We need a measure of potential that bears some substantial relationship to our index of achievement. However, the measure of potential should not include within itself any of the specific components of the achievement measure" (Thorndike, 1963, p. 52).

If I understand Thorndike rightly, the following demands must be satisfied:

1. Intelligence must be measured by a test whose result is, by and large, unaffected by the specific skills learned at school.
2. Achievement must be assessed by a measure for which pupils' school performances are really decisive for the result.
3. There should be high correlation between the measures of intelligence and achievement.

It is easy to see that two of these demands can be met simultaneously, but difficulties arise when all three must be met. Certain deviations must obviously be made from one or more of the demands, and a strategy may be recommended whereby demands 1 and 2 are first given priority, then demands 1 and 3, and finally demands 2 and 3. Three models, in which different combinations of demands are given priority, will be developed and discussed.

Model A implies that priority is given to demands 1 and 2. This means, for example, that a test should be chosen which, according to Cattell's (1963) terminology, is mainly a measure of *fluid intelligence* which, unlike *crystallized intelligence,* is relatively unaffected by education and knowledge gained at school. Such a test would, in Cronbach's (1961, p. 235) spectrum, which stretches from Maximum to Minimum Educational Loading, be rather close to the latter extreme. As a measure of scholastic achievement teachers' marks should be taken, for they are based on continuous observation of the pupils' knowledge and skill during a long period of time. In addition to written examinations the marks include certain other *objective* features in the form of oral accounts and capacity for independent work, which are essential for success at school and which are difficult to measure in any other way (Marklund *et al.,* 1968, p. 58). Marks are influenced by a number of *subjective* elements, too, which reflect interaction between teacher and pupil, and which cannot be regarded only as a source of error when marks are awarded (Lavin, 1965, p. 21).

When priority is given to the first demands, the third should not be completely ignored, however. It is to be recommended, therefore, that when starting from the first model, it should be possible to explain at least 25 per cent of the variance in achievement on the basis of differences in test scores. If the unexplained variance is greater than 75 per cent, the demands on the purity of the intelligence test must either be modified, or *absolute* not relative achievement should be studied, i.e. differences in achievement should

be considered without any attempt being made to keep the pupils' intelligence constant.

Model B gives priority to demands 1 and 3, which means that the comments made in model A regarding the intelligence test are valid here, too. Demand 3 will be defined in detail, in the form of a demand that at least 50 per cent of the total variance in achievement should be explained by differences in intelligence test scores. To meet this demand, it will probably, as a rule, be necessary to reject marks as a criterion. The instruments that may be used instead will probably be standardized achievement tests. These lack, it is true, some of the advantages characteristic of teachers' marks, but give, instead, more reliable scores.

Demands 2 and 3 are given priority in *model C,* and marks can therefore again be used as a measure of achievement. What measure of intelligence shall then be chosen to give priority to demand 3 at the expense of demand 1? I should like to make the bold, and no doubt in many people's opinion suspect proposal that the standardized test of achievement should be allowed to alter from measure of scholastic achievement to measure of intelligence. This point of view may be justified when it is borne in mind that achievement tests are usually very heavily loaded with intelligence, while marks are more influenced by such factors as ambition, adjustment and school motivation (Marklund, 1962, p. 116). Further, it should be considered an advantage if, in one way or another, the relative achievement obtained by model A could be divided into two components. One would be obtained when achievement test scores are predicted from scores of intelligence tests, and the other when marks are predicted from scores on achievement tests.

Hitherto, the discussion has been concerned with different types of measures of intelligence and achievement and varying combinations of these. Thus, what may be called the form or *external characteristics* of the instruments has been in the centre of interest, but now the aspect of content or the *internal characteristics* of the instruments will be considered. Let us begin by asking a question: Have individuals with the same general ability, behind which are concealed distinct differences in the ability profile, the same prospects of success in school?

There are two studies which provide some possibilities of throwing light on this problem (Frankel, 1960; Carmical, 1964). In these, pupils with the same IQ, but with great differences in marks, are compared. Both the authors use the designations Achievers (A) and Underachievers (U), and test the pupils on the Differential Aptitude Test and the Kuder Vocational Preference Record. It is interesting in this context to study how the two categories of pupils succeeded on the various subtests in DAT, and a summary in table form is therefore given below. It will be seen from this that the achiever groups are superior in the verbal and numerical subtests, which measure the aptitudes

that are of the greatest significance for success in school. Of course, DAT does not measure any pure intelligence factors, but it may still be considered that the results reported give some justification for answering my question negatively.

DAT Test	Frankel (1960)	Carmical (1964)
Verbal	A > U	A > U
Numerical	A > U	A > U
Abstract	NS	NS
Space	NS	A < U
Mechanical	–	A < U
> = significantly higher	NS = no significance	
< = significantly lower	– = no result reported	

Instead of keeping the IQ or other global measures of intelligence constant, it may be considered more relevant to match pupils according to their scores on such intelligence tests as measure the *ability factors most* essential for scholastic achievement. Similar ideas can be found in the following passage:

> "Should it be demonstrated that specific school subjects depend more heavily on certain cognitive abilities than on others, then the IQ may prove to be no longer valid as a predictor of academic performance in these subjects. Consequently, students now considered underachievers because of their inadequate performance in such subjects might instead be working well within the limits of their capacity. This might be especially true of those high IQ students who do poorly in mathematics, an area hardly *tapped by present measures* of intelligence, or in foreign language, where very little is known about the cognitive abilities required for success. A more refined and differentiated approach to the measurement of intelligence would provide more valid predictive information" (Raph *et al.*, 1966, p. 196).

The above quotation contains a recommendation that not only should the global intelligence test be replaced by a test of essential ability factors, but a further step should be taken in the direction of differentiated measurements. I interpret the authors to mean that one should endeavour to find *different* predictors, depending on the school subject with which the study is concerned.

Empirical studies have also been made with single tests or groups of tests in order to predict achievement in specific subjects. Some of these gave encouraging results, but it is not yet known if such a method of tackling the problem is superior to one using global tests of intelligence. Lavin, for example, gives the following summary after having scrutinized results from a number of studies of both kinds:

> "Thus, even though a particular differential prediction study may obtain fairly high correlations, we do not know whether these correlations are significantly higher than those which could be obtained using global predictors or uniform test batteries. Considerably more research needs to be done before these matters can be clarified" (Lavin, 1965, p. 54).

We must agree with this appeal for more research, and it must also be agreed that efforts should be made to find the types of differentiated predictors Raph *et al.* would like. By far the best strategy would be to compare individuals with varying success in a certain school subject when the results of a certain intelligence test are kept constant, these results having statistically high and psychologically interpretable correlations with achievements in the subject in question. The strategy outlined should have great advantages, because it should make it possible to obtain a nuanced picture of the factors which covary with relative achievement within different domains of subjects. Several workers claim, namely, that the decisive factors may be strongly associated with the situation, and vary considerably from one school subject to another (Uhlinger & Stephens, 1960, p. 265; Gowan, 1965, p. 118).

This section will close with the following summarizing views on the choice of measures of intelligence and achievement. Use intelligence tests, school marks and standarized achievement tests, which will make it possible to apply all the models outlined. If this should be impossible, give a detailed report of the external characteristics of the instruments, e.g. whether marks or standardized achievement tests were used as criterion, which is of decisive importance for the outcome of the results (cf. Matlin & Mendelsohn, 1965; Miner, 1968; Morrison, 1969). Regardless of which model is used, try to find predictors and criteria which can, to a high degree, be considered to be indicators of the same underlying psychological function. This should lead one to increase the correlation within each model and thus reduce the scope of the specific components, which gives practical advantages in both diagnostic and predictive studies, and should reasonably lead to greater understanding between the two lines of thought. This understanding might probably be obtained at the expense of diagnostic researchers' admitting that the specific components exist, but that they – in at least two of the models – are far less important than is usually considered when one's aims are predictive.

Composition of the investigation groups

The varying research results in this field can most probably be attributed partly to lack of homogeneity in the composition of the groups. It is quite easy to understand that different research workers make use of different

samples and thereby arrive at different results, and, of course, no criticism can be levelled at this type of heterogeneity. The importance of a careful definition of type of school, grade, character of class and other school variables of interest to the study in question must be borne in mind, however.

On the other hand criticism may be levelled at investigations in which lack of homogeneity is present in the investigation group used. This lack of homogeneity may refer to the above-mentioned school variables, i.e. mixing pupils from different types of school which demand different performances for the same marks, whereby pupils from the less demanding system are placed in an undeservedly favourable situation. This mode of procedure leads to what Thorndike (1963, p. 16) calls *criterion heterogeneity* and causes serious errors in the results. This type of heterogeneity seems to be quite rare, while on the other hand, it is sometimes found that demands on homogeneity are unsatisfied regarding sex and social background. These variables must be taken into consideration however, for it has often been found that girls are superior to boys in relative achievement (Duff & Siegel, 1960; Lum, 1960; Shaw & Dutton, 1962; Parsley *et al.*, 1964), and that pupils from higher socio-economic groups are superior to pupils from lower ones (Strodtbeck, 1958; Frankel, 1960; Chopra, 1967; Miner, 1968).

Failure to keep sex and social background constant will not necessarily lead to such serious errors as when there is no control over school variables, but gives, perhaps, a rather diffuse picture of the factors which, in addition to these variables, are decisive for relative achievement, There is a risk that *all* the features more typical of girls than of boys and *anything* that characterizes higher social strata more than lower strata will be associated with relative achievement (cf. Thorndike, *op.cit.*, p. 18).

Thus, homogeneity in the investigation group in respect of different school variables, sex, *and social background* must be regarded as a necessary condition. But to obtain reasonably wide knowledge of relative achievement it is not enough. In addition to *the demand for homogeneity within the group,* I will raise *the demand for numerous demographically separated groups.* This demand may be met by using the same instruments to make separate analyses, which permit comparison between boys and girls divided according to socio-economic background and different school variables. This will give information about:

1. To what extent sex, social background, and type of school affect achievement, i.e. what relations there are between these demographic variables and relative achievement.
2. What personality variables are of importance when demographic variables are kept constant, and whether the same variables are of importance in all categories.

The first piece of information is of importance for studies with diagnostic-therapeutic aims. By making a very detailed classification of the pupils' socio-economic background and ascertaining how this finely differentiated variable covaries with relative achievement in different subjects among boys and girls within different types of schools, knowledge can be obtained of which background characteristics are typical of pupils with special difficulties in certain subjects. After that it will be possible at a very early stage – even in grade 1 for example – to provide special help to those groups containing many presumptive underachievers.

In investigations with predictive aims, too, the first piece of information should be of some interest, but to use this information as a complement to intelligence test scores in selection situations would be regarded as very undemocratic, as is suggested in the following passage:

> "There is little doubt that if some account were taken of a child's home background when trying to forecast his future scholastic success, this would add to the predictive efficiency of intelligence and other standardised tests. The improvement would not be a spectacular one but would almost certainly be significant. It might enable the selectors for senoir secondary education, for example, to eliminate a small number of children who have the necessary ability but the wrong environment for success in the senior secondary school, and allow to go forward an equal number of children with rather less ability but with a more suitable home environment. The explicit adoption of such a policy would, however, give rise to serious problems. The accusation would most certainly be made that it was undemocratic and class-biased, and the advocates of the selection system would forfeit one of their strongest arguments, namely the complete objectivity of the procedure" (Fraser, 1959, p. 73).

The second piece of information is of interest to elucidate whether there are any personality factors that covary with relative achievement when sex and social background are kept under control, for by this procedure differences in values, attitudes and interest, which lie behind group membership and give it a diagnostic or predictive value are eliminated to some extent. If, however, it should be found that such personality factors exist, access to the results obtained in various demographic groups makes it possible to ascertain whether the same factors are decisive within different groups, and the degree of agreement in respect of the direction and strength of the correlations. Lavin, for example, speculates over the fact that different factors may be decisive where boys or girls are concerned, and that a factor that is of positive importance for boys may have a negative effect on girls and vice versa (1965, p. 44). The size of the correlation may, however, very well be the most valuable piece of information. Assume that clearly positive correlations are observed between a certain personality variable and relative achievement in a low social group, while the same factor is uncorrelated in a high social group. Assume further that the higher social group has a higher mean on this variable. Such a result

must be very important, since it throws light on one of the underlying factors that cause a child from a favoured home environment to be superior in relative achievement.

To sum up, the demands on homogeneity and number of groups respectively must be borne in mind. These demands assume access to large and representative samples, otherwise there is a risk that one or both demands will be disregarded. In this field of research, however, studies are made on relatively small samples. For example, in a compilation of 50 articles called *Underachievement,* made by Kornrich (1965), only ten reported studies on samples of more than 100 individuals. When the subjects are divided into over- and underachievers, it is only in one or two studies that the groups exceed this number, which should be regarded as an absolute minimum in this context. Apart from the fact that it is difficult with such small investigation groups to satisfy the demands which I consider necessary, there arise the problems that one must always expect when working with small samples (cf. Thorndike, 1963, pp. 36–39).

Explanatory variables

In spite of all the differences existing between researcher in this field, there is one thing they have in common: they all strive to find variables associated with relative achievement. These variables will be called *explanatory variables.* This term does not mean that the relative achievement is causally dependent on these variables, but only that, in some cases, it is possible to explain some of the variation in relative achievement from differences in the explanatory variables. It is beyond the scope of the present work to report the great number of explanatory variables used earlier; only some questions of principle can be discussed. Those who want a detailed account of previous research in this context are referred to Lavin (1965) and Raph *et al.* (1966). The former work approaches the problem from a predictive angle, and the latter from a diagnostic, but, as hinted earlier, this line of demarcation is sometimes rather diffuse, and partly the same investigation results are therefore cited in the two works.

It is also difficult to distinguish between different types of explanatory variables. To make the account clearer, therefore, a division will be made between variables which attempt to measure personality and social-psychology factors respectively. Nine aspects of personality, under which Lavin groups more than 100 research results (Lavin, *op. cit.,* pp. 66–95), are given below.

1. Study habits and attitudes toward study

2. Interest
3. Achievement motivation
4. Independence
5. Impulsivity
6. Anxiety
7. Introversion
8. Self-image
9. Adjustment

Within each category there are at least two investigations in which significant correlations are present between the personality variable in question and relative achievement. As a rule, however, the correlations are weak, inconsistent and difficult to interpret, and Lavin ends his survey of each category in the same way, namely by stating that more research is needed before it can be said definitively to what extent a certain personality variable is important for relative achievement.

That the correlation between a certain personality variable and relative achievement varies between different investigations is probably due largely to the above-mentioned differences in methods, the differences in measures of intelligence and achievement and the varying degree of homogeneity between and within the investigation groups. Still another source of variation can be added, namely the low or non-existent correlations sometimes observed between variable which, according to their definition, should measure the same personality factors (Hills, 1958; Weiss *et al.,* 1959; Shaw, 1961).

Shaw, for example, uses the Need Achievement Scale of the Edwards Personal Preference Schedule, the McClelland Achievement Motivation Test and the French Achievement Scale to study differences in achievement motivation between over- and underachievers. She found, however, that, strictly speaking, only weak and insignificant correlations existed between the scales themselves and between the scales and relative achievement, and she felt constrained to state that: "These three scales not only tend to be poor predictors of academic achievement for this group, but are not measuring the same variable" (Shaw, *op.cit.,* p. 284).

In order to obtain a more stable and more diversified picture of the personality factors which are really of importance for relative achievement, the following mode of procedure may be recommended:

1. Use measures of personality with as high reliability as possible, which should, at any rate, increase the correlation between different variables considered to measure the same personality factor.
2. Give a careful description of the measures of personality chosen, and report their intercorrelations.
3. Study the correlations between personality factors and relative achieve-

ment within different domains of school subjects as well as within different demographic groups.

4. Make a careful analysis of the results obtained and endeavour to explain why a certain measure of personality may show relationships only within some domains of subjects or within certain groups of pupils.

If the aim of the investigation is diagnostic-therapeutic, it will be necessary then to ascertain experimentally to what extent and at what cost a certain personality factor – e.g. poor study technique or low school motivation – can be influenced, and whether an increase in the value on this variable also causes a rise in relative achievement. The results of such an investigation are also of interest for a predictive goal, for information can be obtained about which personality factors are relativeiy easy to modify and are thus poor predictors.

Let us now study the results of a few investigations in which certain social-psychology factors are in the centre of interest. These investigations are concerned with how the relations between pupils, parents and teachers *affect relative achievement.*

The clearest results seem to have been obtained when the relations between parents and teachers have been studied, in so far as a number of reports show that positive parent attitudes towards teachers, the school, and education in general, have a favourable effect on the children's relative achievement (Fraser, 1959; Morrow & Wilson, 1965; Whiteman & Deutsch, 1968).

When, on the other hand, relations between parents and pupils are studied, the picture becomes more diffuse. Thus, Drews & Teahan (1965), in a study in high schools, found that mothers of overachievers are more authoritarian than mothers of underachievers, while Teahan (1965) found that the opposite was the case at college level. Teahan attempts to explain the contradictory results by stating that an authoritarian upbringing may facilitate success at high-school level, but is a handicap for college success. This interpretation is not supported at all by Shaw & Dutton (1962), who show that mothers of underachieving girls at high-school level are more authoritarian than mothers of overachieving girls, while there are, in this respect, no significant *differences between over- and underachieving boys. These results in their turn* are in poor agreement with the results of another study in high school (Pierce & Bowman, 1965), where it was found that overachieving girls and underachieving boys are two categories characterized by authoritarian mothers.

The results are somewhat unclear also in respect of relations between teachers and pupils. Dureman (1956), for example, showed that there were significant correlations between pupils' relative achievement and how teachers judge their conduct in school. The underachievers are conceived by their

teachers as awkward, noisy, defiant and aggressive to a much greater degree than the overachievers. This finding is supported to a certain extent by Magnusson (1964) and Sprinthall (1964), but is, on the other hand, incompatible with the results obtained by Getzels & Jackson (1962), for they found that teachers liked underachievers much better than they liked overachievers.

Thus, even when explanatory variables are used to measure different social-psychology factors, the results are often inconsistent and sometimes contradictory. In these cases, too, differences in methods, investigation variables and the like are probably partly responsible for the divergent results. In this context, still another source of variation must be mentioned, which may have a disturbing effect on research results in this area. It is concerned with relations between pupils or, to be more exact, how highly good school marks are valued in the pupils' own system of norms. A study by Coleman (1961) throws some light on this. In this study it will be found that the average level of intelligence among pupils with high marks tends to be higher in schools *where the pupils themselves appreciate* academic performance. Coleman interprets this finding as follows:

> "In every social context, certain activities are highly rewarded, while others are not. The activities that are rewarded are those for which there is strong competition – the activities in which everyone with some relevant ability will compete. In such activities, the persons who achieve most should be those with most potential ability. In contrast, in unrewarded activities, those who have most ability may not be motivated to compete; consequently, the persons who achieve most will be persons of lesser ability" (Coleman, *op.cit.,* p. 260).

Coleman's reasoning seems plausible, and it would therefore be interesting to study how various kinds of personality and social-psychology factors affect relative achievement in schools where study takes pride of place and in schools where other performances – sport, for example – are valued more highly.

Summary

This chapter deals with some of the circumstances that may have caused the lack of agreement between different research results in respect of the factors of importance for relative achievement. It also ventures to outline a few principles according to which work should be planned to obtain more stable and therefore more valuable results. The aim now is to endeavour to apply these principles as far as possible in an investigation within the framework of the *Individual Statistics Project,* described in the following chapter.

CHAPTER 2

DESIGN AND PURPOSE OF THE INDIVIDUAL STATISTICS PROJECT

The present investigation is part of a project, the Individual Statistics Project. The project started in 1961 with the collection of information on all pupils in Sweden born on the 5th, 15th and 25th of any month in 1948. This information, for about one-tenth of the age cohort, has been supplemented by data each year, and the supplementation will continue as long as the individuals are attending an educational institution. In 1966 a new sample, of all pupils born on the 5th, 15th and 25th of any month in 1953, was collected and the follow-up of this sample started in 1967. The number of pupils in the first sample was about 12,000, and in the second about 10,000. In both samples, about 90 per cent of the pupils at the first collection were in the sixth grade of the compulsory school system. Before a more detailed account is given of the design and purpose of the project, a brief description of the compulsory school system in Sweden in 1961 and 1966 will be given.

The compulsory school during the 1960's

In 1961 the compulsory school in Sweden was divided into two systems, as, during the 1950's, some school districts had begun to introduce a nine-year experimental comprehensive school (*enhetsskola*), while others still had the old system, with a seven- or eight-year elementary school (*folkskola*). In 1966 compulsory education was divided into the elementary school and the comprehensive school (*grundskola*), since in 1962 the experimental comprehensive school had been turned into a more definitive nine-year "basic school", which is to be introduced into all school districts by 1972 at the latest. As early as the middle of the 1960's most school districts had introduced the nine-year school, and the number of pupils attending such schools increased from barely 40 per cent in the 1961 sample to more than 80 per cent in the 1966 sample.

The elementary and the experimental comprehensive schools differed in several ways, particularly in respect of the pupils' possibilities of choosing an academically inclined education. The elementary school pupils could, after grade 6, apply to enter a lower secondary school, where, however, the number of places was limited, and the pupils were therefore selected on the basis of marks awarded in the elementary school. In both types of comprehensive school, no selection takes place, instead, pupils and their parents decide whether an academic stream is to be chosen. This means, among other things, that pupils in grades 7 and 8 take another foreign language in addition to English, but for most subjects these pupils have the same instruction as other pupils. It is not until grade 9 that the pupils are divided into different streams, of which one is academic, in the meaning that from this stream – as from the lower secondary school – pupils may apply to attend senior secondary schools (*gymnasium*), which may later lead to university level studies. The experimental comprehensive school differed from the comprehensive school in that there were three instead of nine streams in grade 9, and that, from and including grade 7, pupils choosing academic streams usually formed separate classes. An attempt is made in Figure 2:1 to illustrate the greatest organizational differences between the three systems. For a more detailed account the reader is referred to Norinder (1957) or Husén & Boalt (1967).

One of the reasons for the introduction of the comprehensive school with free admission to theoretical studies in grades 7, 8 and 9 was a desire to make it easier for pupils from lower socio-economic strata to obtain higher education. The older selective system implied not only a division into academic and practical studies, but also a division of pupils according to home background, in that the majority of the pupils from higher social strata moved on to lower secondary schools, while most of the pupils belonging to the lower strata remained in the elementary school (Boalt, 1947; Husén, 1950). This division into categories was extremely unsatisfactory, and implied injustice to the individual pupil and a handicap for society, in the form of, among other things, poor utilization of many gifted pupils (cf. Härnqvist, 1958a; de Wolff & Härnqvist, 1961).

The school systems also differ in their general aims, in which both types of comprehensive school place more emphasis on personal and social development, while the elementary school stressed more the purely knowledge-communicating functions. (*Undervisningsplan för rikets folkskolor*, 1955; *Timplaner och huvudmoment vid försöksverksamheten med nioårig enhetsskola*, 1955; *Läroplan för grundskolan*, 1962).

It is difficult to say to what extent the somewhat varying aims affect the daily work of the school during a pupil's first six years at school. It is possible that the more knowledge-directed aims of the elementary school, in conjunction with the demand for high marks to qualify for entrance to the lower secondary school, gave rise to a more competitive and straining study environment in the older school system. Generally speaking, however, all pupils had a more or less identical school environment up to and including grade 6, i.e. the grade in which most of the pupils were when the first data were collected for the Individual Statistics Project. Evidence of this is the fact that it was considered possible to use identical standardized achievement tests

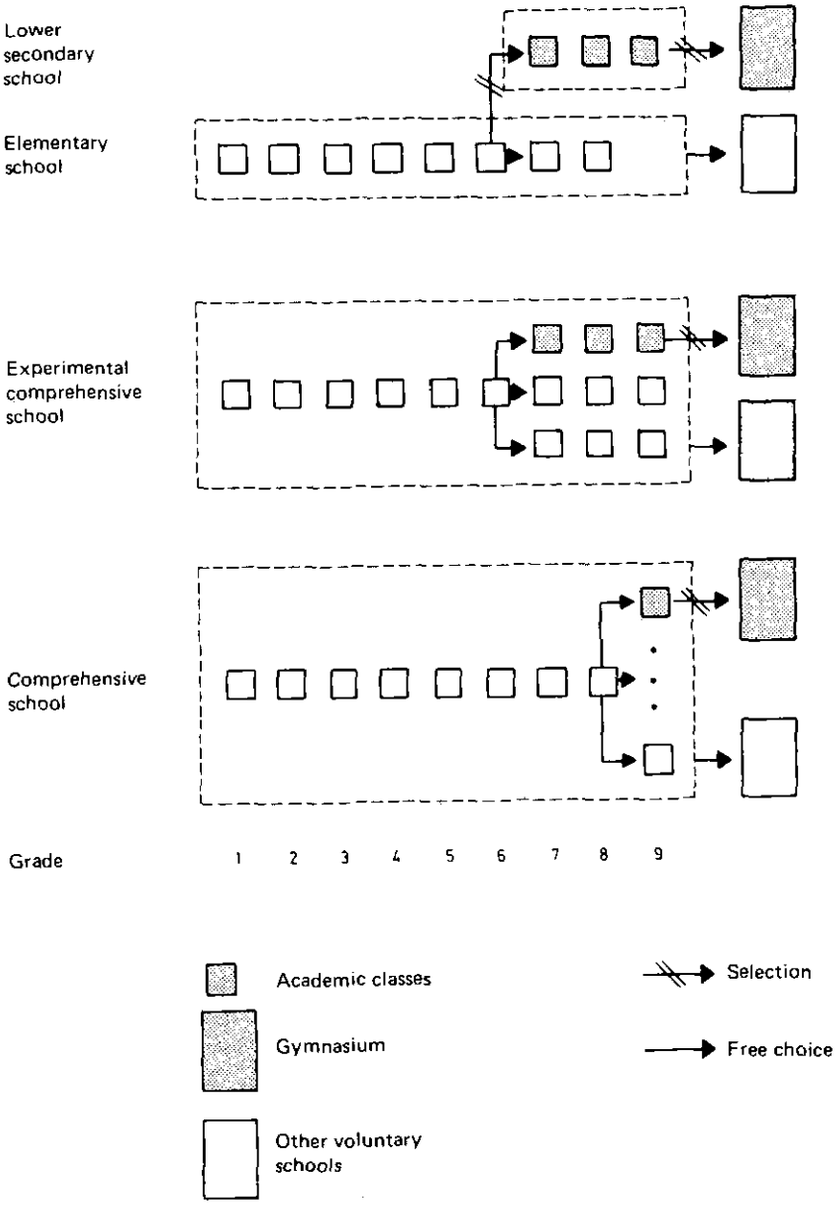


Fig. 2:1. The Swedish educational systems during the 1960's.

in grade 6 of the two school systems in 1961. In the same way, almost identical tests were used in grade 6 of the elementary school and the comprehensive school in 1966.

The design of the project

The design of the Individual Statistics Project is shown in Figure 2:2, where the various types of information are indicated by different symbols. A brief account of the data is given below. A more detailed description of the data used in this investigation will be found in later chapters.

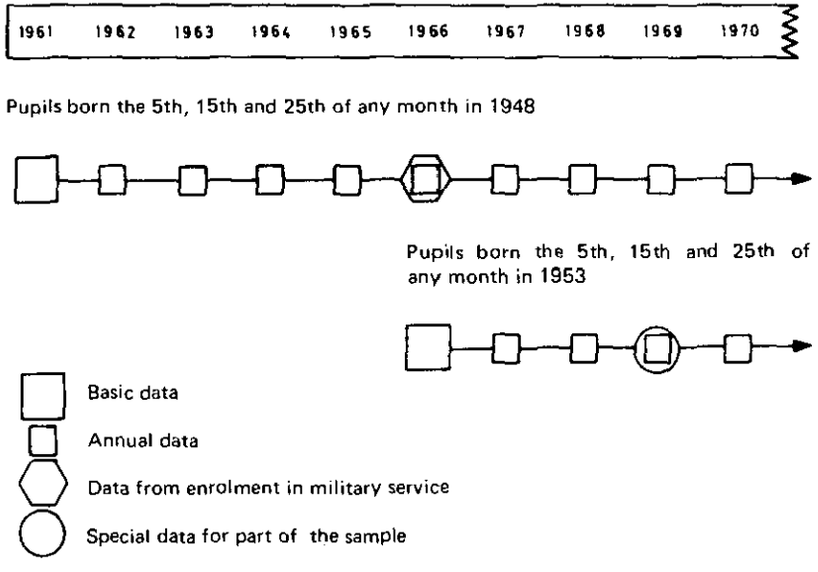


Fig. 2:2. Plan of the project.

I. BASIC DATA

a. Information from the school records, e.g. class, type of class and school marks.
b. Information on personal background, such as parents' occupations and education.
c. Scores on three intelligence tests; verbal, spatial and reasoning.
d. Scores on standardized achievement tests in Swedish, Mathematics and English from grade six.
e. Replies to questionnaires on the pupils' attitudes to school, their spare time interests, and plans for study and work.

II. ANNUAL DATA

Information from the school records of the type listed under Ia above. The information is collected as long as the pupils are at school.

III. MILITARY ENROLMENT DATA

This information consists of, among other things, data on level of education, the scores on four intelligence tests, and the replies to certain questions concerning adjustment to home, school and work. These data are available for males only.

IV. SPECIAL DATA

In connection with another project, questionnaire data on the pupils' adjustment and attitudes to further education and occupational choice have been collected for about a third of the 1966 sample.

Information under Ia, Ib and II is collected by the National Bureau of Statistics, and under Ic – e and IV by the Institute for Educational Research, University of Göteborg, with financial support from the Ministry of Education, the Swedish Council for Social Science Research and the National Board of Education. Data under III are obtained from the Institute of Military Psychology in Stockholm.

The purpose of the project

The purpose of the Individual Statistics Project and the "data bank" the project has established may be said to be threefold:

1. To make possible follow-up studies of large and representative samples of pupils, and to ascertain how geographic, social and psychological factors affect the choice of education and occupation, and to discover what changes the switch-over to the nine-year comprehensive school has caused in these respects.
2. To provide a basis for studies concerned with the importance of various environmental factors for changes in intelligence, both within a sample of pupils tested at different ages, and between different samples of pupils tested at the same age level but at different points of time.
3. To supply data to investigations made to elucidate how different types of demographic and personality factors are associated with success in and adjustment to school.

Extensive investigations in the first field have been made by Härnqvist (1966; 1967), Carlsund (1968) and Reuterberg (1968). In these studies it is

found that the demand for and possibilities of higher education have increased considerably within the comprehensive school as compared with the old "parallel" school system. More than half of the pupils in the experimental comprehensive school born in 1948, for example, chose theoretical subjects after grade 6, while fewer than 40 per cent of the elementary school pupils moved on to lower secondary schools. Of the pupils in the new school system, about 30 per cent continued studying at the gymnasium, as against 25 per cent in the old system. Thus, the introduction of the comprehensive school has facilitated transfer to higher schools, but great differences were present in both systems between children from different social groups. Thus, for example, in senior secondary schools there were more than 80 per cent of the sons of parents with a university education as against 16 per cent in the old and 18 per cent in the new system of sons of manual workers and farmers. Even when correction is made for differences in intelligence and earlier scholastic achievement, great differences still exist between the groups.

In the comprehensive school in 1966, the demand for theoretical education has increased further, which has meant, among other things, less scope for variation between children from different social strata. This is especially noticeable in the choice of theoretical study alternatives for grade 7 among pupils with good study potentials. On the other hand, differences are still great between pupils from different social groups when it is a question of continuing in the gymnasium after grade 9, as is shown by a study made for the 1968 Education Commission (Bengtsson, MS).

Some studies of pupils' plans for future occupations may be assigned to the first group of investigations (Svensson, 1963; Berndtsson & Swerlander, 1968; Josefsson & Rudander, 1968). It is remarkable how a very restricted number of occupations attract the majority of the pupils. This tendency is stronger among girls than among boys, and is more marked in 1961 than in 1966. A certain amount of realism in choice of occupation can also be discerned, in so far as they are related to the pupils' level of intelligence in a way that is in good agreement with the demands on education in the respective occupations.

In the second field, Härnqvist (1968) has, with the help of the basic data from 1961 and military enrolment data from 1966, studied, in a theoretically and methodologically very interesting investigation, the *relative* changes in intelligence between the ages of thirteen and eighteen years. It was found that these changes in intelligence during the five-year period were related to differences in education and to some extent also to home background. The relationship is stronger for general intellectual level than for a component contrasting spatial with verbal performance.

Pupils born in 1953 and tested in 1966 took exactly the same tests as pupils born in 1948 and tested in 1961. The mean score for the samples

increased between 1961 and 1966. These *absolute* changes are now being related to various kinds of educational and cultural characteristics (Stahle, MS).

In the third field, some investigations have been concerned with certain specific categories of pupils. Adjustment to school, level of attainment and direction of interests, has been studied among pupils of extremely high intelligence (Haavasalu & Olsson, 1967), among pupils who started school at six years of age instead of seven (Ling, 1968), and among pupils attending special classes for slow learners (Dahlgren & Patzold, 1966). Svensson (1964), starting from basic data collected in 1961, has made certain preliminary studies of over- and underachievement in school, which show that girls, and children from the higher socio-economic groups, get better results at school than were to be expected from their level of intelligence. Pupils' scholastic achievements were assessed on their total scores on standardized tests of reading, writing and mathematics, and by sums of marks in the same subjects. A measure of the pupils' general ability was obtained by adding the scores on the three intelligence tests included in the Individual Statistics Project.

A list of all the reports in the Individual Statistics Project is given in Appendix 1. A scrutiny of the titles of these reports will give further information on the project. The reports are available at the Institute for Educational Research, University of Göteborg, but most of them are in Swedish.

The investigation to be reported here is concerned with the third of the above-mentioned fields. It is, in effect, a continuation of the studies on over- and underachievement by Svensson (1964) and Härnqvist & Svensson (1967). The primary purpose is to study the relationship between relative achievement and different background factors, using the basic data collected in 1961 and 1966. Further the relations between relative achievement and certain school adjustment and interest variables will be analysed by the help of the basic data collected in the comprehensive school in 1966. The purpose of the investigation is presented in detail in Chapter 7, but before that a relatively comprehensive account is given of the representativeness of the samples (Chapter 3), measures of intelligence and scholastic achievement (Chapter 4), division into background categories (Chapter 5), and the various measures of school adjustment and interest (Chapter 6).

CHAPTER 3

SIZE AND REPRESENTATIVENESS OF THE SAMPLES

Not all the pupils for whom basic data have been collected are included in this investigation. It was necessary to restrict the study to pupils of normal age for their grades, i.e., the pupils who, when data were collected, were attending sixth grade classes in the compulsory school, and who were not in any form of special class. This restriction had to be made, otherwise there would have been the risk of *criterion heterogeneity* since, for example, marks awarded in grade 5 or 7 are not directly comparable with those given in grade 6. Further, the pupils not of normal age for their classes are few in number and distributed among several categories, which makes separate studies of them difficult.

It has been impossible to ascertain just how many "normal-age" pupils there should be in the samples, but, by the help of various sources of statistics, an attempt has been made to *assess* their number in Table 3:1.

Table 3:1. Estimated size of samples.

Individuals born in	1948	1953
1. Alive on 1/1 1961 and 1966 respectively	123,688	108,716
2. . . . in compulsory school	120,591	108,083
3. . . . in grade 6	108,579	97,953
4. . . . in normal classes	105,865	95,504
5. . . . expected in the samples	10,413	9,420

The data in lines 1, 2 och 3 are from official statistics (Statistical Abstract of Sweden, 1962; 1966, and Statistiska centralbyrån, 1961a, 1961b, 1966, 1968). However, the number of normal-age pupils is reported each third year only, beginning in 1961 in respect of the academic year 1960/61. In this year, 108,579 or 87.8 per cent of all the thirteen-year-olds were in grade 6 in the compulsory school system. By 1966/67 the percentage of normal-age pupils had risen to 90.1 per cent, and this figure has been used to assess the number of normal-age pupils in the academic year 1965/66.

In 1961, 4.3 per cent and in 1966 4.9 per cent of all thirteen-year-olds were in some kind of special class. How many of these were of normal age cannot be found in official statistics, but from the Individual Statistics Project data, the number of normal-age special-class pupils has been calculated at 2.5 per cent. The information in line 4 was arrived at by multiplying the corresponding figures in line 3 by 0.975.

The expected size of the samples (line 5) was arrived at by multiplying the respective figures in line 4 by the number of sampling days and dividing by

the number of days in the year during the respective year of birth. Thus, the 1961 sample should consist of 10,413 individuals (105,865 x 36/366), and the 1966 sample of 9,420 individuals (95,504 x 36/365).

The number of individuals in the two samples to be included in this investigation is smaller, however, than the number arrived at in Table 3:1. The cause of this is that only pupils with complete basic data can be used, and in some cases these are lacking partly or wholly. Table 3:2 reports how the samples were reduced by various types of drop-outs.

Table 3:2. Drop-outs and cases remaining for analysis.

	1961		1966	
	Number	%	Number	%
Expected total	10,413	100	9,420	100
Drop-outs I:				
Pupil data not available	932	9.0	590	6.3
Drop-outs II:				
Background data not available	454	4.4	794	8.4
Drop-outs III:				
Not on record	122	1.2	392	4.2
Cases remaining for analysis	8,905	85.5	7,644	81.1

Drop-outs I comprise pupils without scores on intelligence tests and/or achievement tests. In most cases, absence from school on the days of the testing accounts for these drop-outs. There is no reason to suspect that these pupils differed in any important way from the pupils included in the investigation. Among other things, a comparison of such variables as parents' education and father's occupation shows good agreement between these drop-outs and the investigation groups.

Droup-outs II include such pupils as have given incomplete information about parents' education and father's occupation. Unlike the previous group of drop-outs, it cannot be assumed that this is random. Most of these pupils gave information on the education of one parent, which suggests that children living with mother or father alone are over-represented among these drop-outs. Further evidence of this is the fact that 39 per cent of the fathers and 10 per cent of the mothers were given as dead in the 1961 drop-outs, as against only 1 per cent for each parent in the part of the sample used. (These data on parents are not included in the 1966 sample.)

Drop-outs III include the pupils who did not supply any information to the project. The cause of this was that, for one reason or another, these pupils had not been reported by their schools, and were therefore not registered by the Central Bureau of Statistics. These drop-outs may be more or fewer, depending on errors in the assessment of the size of the samples. As in drop-outs I, it is assumed that there are no systematic differences between these drop-outs and the investigation groups.

Table 3:3 shows how the pupils included in the investigation are distributed according to school system and sex. Further, it gives the distributions for drop-outs I and II and for all the pupils in grade 6 (normal classes) in the academic years 1960/61 and 1965/66 (Central Bureau of Statistics, 1961a, 1966). The three distributions are not, unfortunately, wholly comparable, due to the fact that line two gives no information on drop-out category III, and line three includes over- and under-age pupils, too. Agreement between lines 1 and 3 in particular is so great, however, that the investigation groups can hardly be impaired by serious skewness as regards sex or the school system to which the pupils belong.

Table 3:3. Distributions of different categories according to school system.

	Pupils born in 1948				
	Elem. school		Exp. comp. school		
	Boys	Girls	Boys	Girls	Total
1. Cases remaining for analysis (N=8,905)	33.1	32.3	16.8	17.7	100
2. Drop-outs I and II (N=1,386)	33.8	31.5	16.0	18.7	100
3. All in grade 6 1960/61 (N=115,256)	32.4	31.2	18.2	18.1	100

	Pupils born in 1953				
	Elem. school		Comp. school		
	Boys	Girls	Boys	Girls	Total
1. Cases remaining for analysis (N=7,644)	9.6	10.1	40.5	39.9	100
2. Drop-outs I and II (N=1,384)	6.4	6.1	41.9	45.6	100
3. All in grade 6 1965/66 (N=102,748)	9.6	9.3	41.1	40.0	100

An attempt has been made in this chapter to elucidate as far as possible the representativeness of the samples, and to give information on various types of drop-outs. Owing to the exclusion of pupils for whom information on both parents' education is not available, children from incomplete families are under-represented among the pupils included in the investigation. In other respects, the number and variation of the drop-outs can hardly be so great that they can seriously affect the result of the study. It is therefore assumed that the investigation groups – with the above reservation – comprise representative samples of all normal-age pupils in Sweden, who, in the spring term of 1961 and 1966 respectively, were attending grade 6 in either of the two systems of compulsory education.

CHAPTER 4

INTELLIGENCE AND ACHIEVEMENT VARIABLES

This chapter first describes the tests of intelligence, the standardized achievement tests and the marks that will be used in the investigation. After that, an account will be given of the relations between these variables with the help of, among other things, what Bartlett (1948) calls external factor analyses. Starting from the information obtained in this way, the combinations of control and criterion variables that will be used are finally determined.

Description of the variables

INTELLIGENCE TESTS

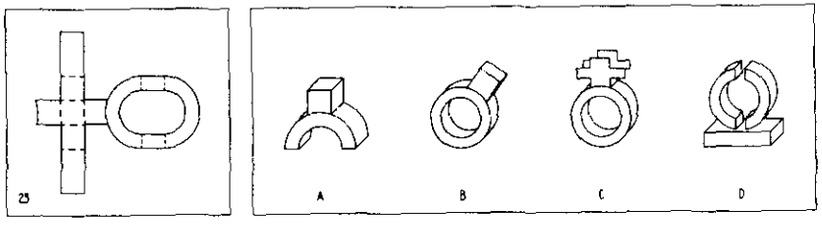
The three intelligence tests used in conjunction with the collection of basic data for the project were constructed at the Institute for Educational Research, and a detailed description of the work of construction has been given by Svensson (1964). In addition to the collection of data in 1961 and 1966, the tests have been used only in the project Metropolit, which in some ways collaborates with our project (Janson, 1964). The tests chosen represent the verbal, spatial and reasoning factors of intelligence according to a Thurstonian classification of abilities, and are called Opposites, Metal folding and Number series.

Opposites: To find the opposite of a given word among four choices. 40 items, 10 minutes.

Example: ANONYM: godkänd, välkänd, berömd, färgglad

Metal folding: To find the three-dimensional object among four choices that can be made from a flat piece of metal with bending lines marked on the drawing. 40 items, 15 minutes.

Example:



Number series: To complete a number series, of which six numbers are given, with two more numbers. 40 items, 18 minutes.

Example: 5, 7, 11, 17, 25, 35 – –

The tests were set during the periods 8–27 May 1961 and 9–28 May 1966. All answers were written in a test booklet, which also contained the specially constructed questionnaires. The tests were administered by the class teachers according to detailed written instructions.

The means and the standard deviations in the three tests are reported for the two samples in Table 4:1. It will be observed that the means are fairly near the midpoint of the possible score range, but a change can be discerned between 1961 and 1966. Thus, the mean in the verbal test increased by about 1 1/2 units, and the means in the other two tests by about 1 unit each. These changes distinctly affect the distributions, as is shown in Figure 4:1, where the scores of the two samples on the verbal test are presented in the form of frequency polygons. As the figure shows, the two distributions are approximately normal, which is true also of the other test scores.

Table 4:1. Means and standard deviations of the intelligence tests.

Test	No. items	1961 (N=8905)		1966 (N=7644)	
		Mean	S.D.	Mean	S.D.
Opposites	40	22.88	6.56	24.43	6.29
Metal folding	40	21.41	7.05	22.47	7.19
Number series	40	19.94	7.62	20.93	7.74

The reliabilities of the tests are approximately .90 (Table 4:2), calculated according to the Kuder-Richardson formula 20. The calculations are based on all the pupils born on 15 May in the respective samples.

Table 4:2. Reliability of the intelligence tests.

Test	1961 (N = 349)	1966 (N = 304)
Opposites	.87	.87
Metal folding	.88	.89
Number series	.92	.93

STANDARDIZED ACHIEVEMENT TESTS

Since the mid-1940's, standardized achievement tests have been used in Sweden, to give teachers information on the standard of the class in relation to other classes in the country. The aim is that the results of standardized

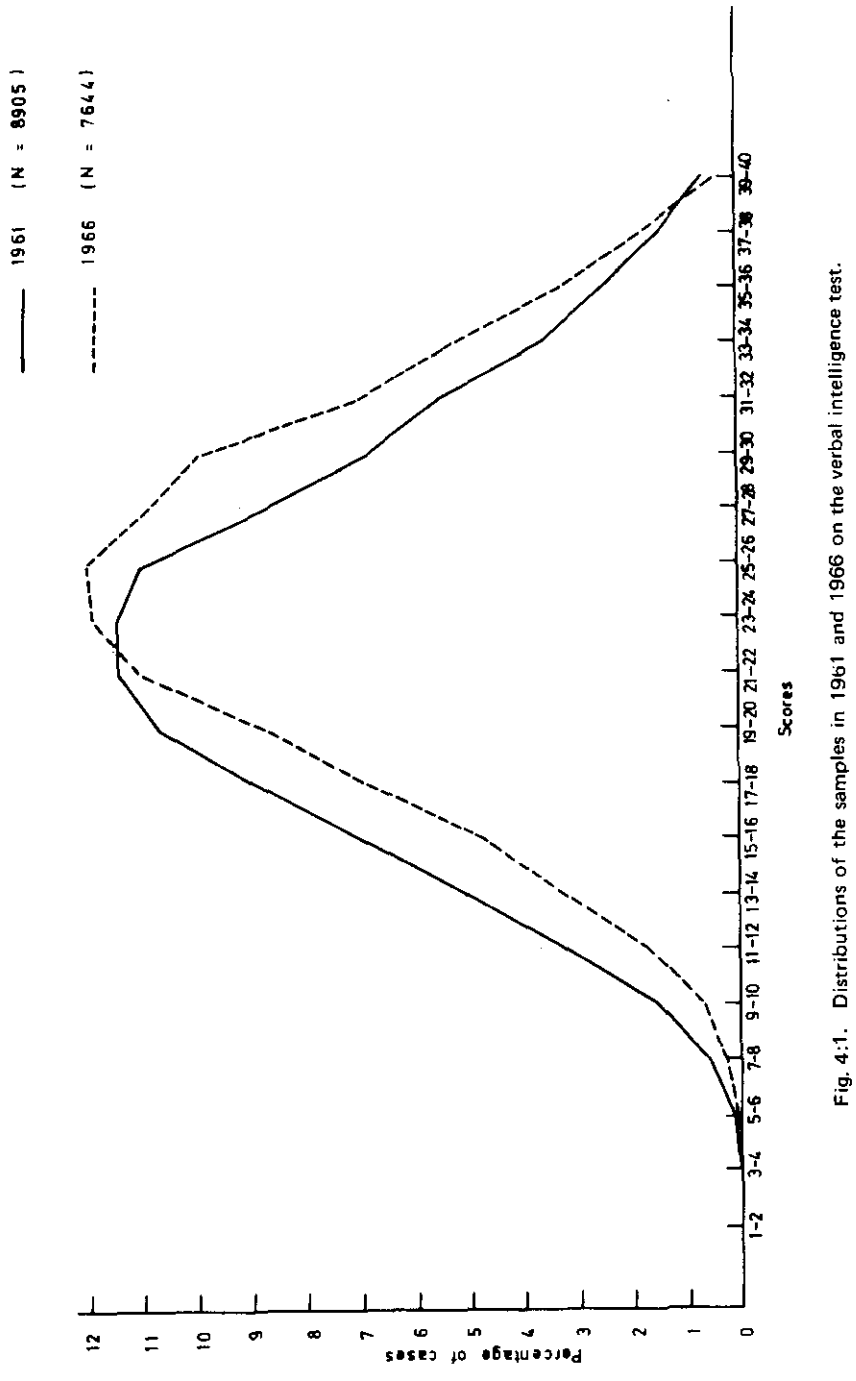


Fig. 4:1. Distributions of the samples in 1961 and 1966 on the verbal intelligence test.

achievement tests shall give teachers guidance in awarding marks, and that, in this way, marks will become equivalent and comparable all over the country. The aim is also that the distribution of marks for a whole population of pupils on a certain grade level shall follow the normal distribution. The aim is not, on the other hand, that agreement between individual results of standardized tests and marks shall be perfect, but to obtain an adjustment of the marks in the class in respect of mean and standard deviation. A detailed account of the purpose of the standardized achievement tests is given in Husén *et al.* (1956).

In 1961, achievement tests were set in grade 6 in the subjects reading, writing, mathematics and English. Identicial tests were set in the elementary school and the experimental comprehensive school and were administered during the months of March, April and May. The use of such tests is voluntary, but practically all teachers made use of the first three tests mentioned, and sent the results to the Institute for Educational Research. On the other hand, results of achievement tests of English are lacking for about 10 per cent of the pupils, due to the fact that English was not studied in all the classes on this occasion. In this investigation, therefore, only results of the achievement tests of reading, writing and mathematics will be used.

The subtests included in the 1961 tests are reported in Tables 4:3 and 4:4. For a detailed description see Ljung (1965, pp. 263–266). The results on each subtest are given on a seven-point standard scale which is multiplied by a certain coefficient, which implies that the final scores in each subject comprise a sum of weighted standard scores.

The differences between the achievement tests in 1961, and those used in the elementary school in 1966 are rather small in view of the skills measured, but owing to continuous revision the specific contents of the items vary. To this must be added that the total scores in 1966 did not consist of weighted standard scores but of the sums of raw scores.

Of the achievement tests used in the comprehensive school in 1966, the tests of mathematics were exactly the same as those set in the elementary school. In reading and writing, however, the subtests contained considerably fewer items, which, with a few exceptions, were taken from the tests in the elementary school. Still another difference is that the scores on the nine subtests in reading and writing were added together to make a final score under the heading *Swedish*. This is because separate marks are not awarded for reading and writing in the comprehensive school, but these subjects are, instead, components of the subject Swedish.

Owing to the varying contents of items and different scoring systems in 1961 and 1966, it is difficult to judge categorically possible shifts in the influence of the subtests on the total scores for the different subjects. It seems, however, as if spelling and mathematical reasoning had somewhat less,

Table 4:3. Survey of achievement tests in reading and writing.

Subtest	1961			1966 Elem. school			1966 Comp. school		
	Carried out	W	T	Carried out	N	T	Carried out	N	T
READING	1.3.–15.3			1.3.–16.3			7.3.–2.4		
1. Reading comprehension		3	30		23	30		12	20
2. Word knowledge		2	12		24	14		11	6
3. Reading rate		2	4		24	3		13	2,5
4. Information seeking		2	15		24	10		13	5
WRITING	1.4.–15.4			28.3–21.4			7.3.–2.4		
1. Arrangement of sentences		2	30		16	30		10	17
2. Sense of language		3	10		22	10		13	7
3. Choice of phrases		2	15		19	10		10	5
4. Punctuation		2	10		32	15		11	6
5. Spelling		4	30		20	16		10	7

W = Weight; N = No. items; T = Test time in min.

Table 4:4. Survey of achievement tests in mathematics.

1961				1966			
Subtest	Carried out	W	T	Subtest	Carried out	N	T
	1.5.–15.5				9.5.–28.5		
1. Mental arithmetic		1	15	1. Mental arithmetic		20	9
2. Mechanical arithmetic		1	35	2. Mechanical arithmetic and denominations		21	40
3. Denominations		2	20	3. Mathematical reasoning		18	60
4. Mathematical reasoning I		3	40	4. Geometry		11	40
5. Mathematical reasoning II		3	40				

W = Weight; N = No. items; T = Test time in min.

Table 4:5. Means and standard deviations of the achievement tests.

Subject	1961 (N = 8905)			1966 E.S.[1] (N = 1500)			1966 C.S.[2] (N = 6144)		
	Possible range	Mean	S.D.	Possible range	Mean	S.D.	Possible range	Mean	S.D.
Reading[3]	9–63	37.08	7.33	0– 95	54.98	15.32	0–103	56.47	15.74
Writing[3]	13–91	51.79	10.03	0–109	64.08	15.14			
Mathematics	10–70	40.75	9.49	0– 70	34.60	12.88	0– 70	36.15	13.29

1. E.S. = Elementary school; 2. C.S. = Comprehensive school.
3. Separate values for reading and writing are not reported for the comprehensive school.

and mental arithmetic and geometry rather more importance in the 1966 tests. The differences are not so great, however, as to jeopardize meaningful comparisons between the results from the two years.

Table 4:5 gives the means and the standard deviations for the different achievement tests. The 1961 values are in good agreement with the expected values, which give the means 36.00, 51.50 and 40.25 respectively, and the standard deviations 7.50, 10.00 and 9.25. Corresponding values cannot, unfortunately, be calculated for the 1966 tests.

The reliabilities reported for the 1961 standardized achievement tests are from Ljung (1958, p. 64), and consist of coefficients of stability and equivalence, since they are based on results on two parallel versions, administered at an interval of three weeks. Thus, the coefficients were not calculated on the results obtained in 1961, but are valid for tests consisting of identical subtests. This type of coefficient of reliability was not available for the 1966 tests; instead, coefficients calculated according to the Kuder-Richardson formula 20 were used. As Ljung (1965, p. 42) points out, it is probably better in this context to use coefficients of stability rather than coefficients of homogeneity, for each achievement test contains subtests measuring different aspects of the subject. In the choice between not reporting any coefficients of reliability and reporting coefficients of homogeneity, the latter alternative is preferred here. The calculated coefficients also seem to be of a plausible size, even though they are somewhat higher than the 1961 values.

Table 4:6. Reliability of the achievement tests.

Subject	Tests used in 1961	Tests used in 1966	
		E.S.	C.S.
Reading	.84	.93	.93
Writing	.91	.91	
Mathematics	.87	.93	.93

MARKS

In the present study, marks for the subjects in which results of standardized achievement tests were available will be used. This will give two measures of scholastic achievement for the same subject; one more objective and the other influenced by the subjective judgment of the teachers, but also by oral scholastic achievement.

In the elementary school and the experimental comprehensive school, marks are awarded on a seven-point letter scale, and in the comprehensive school on a five-point number scale, in which A and 5 respectively represent the highest mark. To facilitate the statistical calculations, the letter marks have been transformed into number marks. This transformation is shown in Table 4:7, where the expected or recommended distribution of marks for the whole population in the grade is also given.

Table 4:7. Survey of marks used in different school systems.

Elementary school Exp. comp. school	A	a	AB	Ba	B	BC	C
Transformed values	6	5	4	3	2	1	0
Expected distribution	*1*	*6*	*24*	*38*	*24*	*6*	*1*
Comprehensive school		5	4	3	2	1	
Expected distribution		*7*	*24*	*38*	*24*	*7*	

In all school systems, and for all subjects, the mean marks exceed the expected average of 3.00 (Table 4:8). This is not interpreted to mean that the samples were positively selected in respect of marks, but rather as a sign of the teachers' generosity. This generosity effect has been demonstrated earlier by Marklund (1960, p. 172), and can also be observed in a comparison of standardized achievement test scores and marks in the 1961 sample. There has not been any opportunity of determining the reliability of marks, but it is probably around .80 (cf. Marton, 1967, p. 65).

Table 4:8. Means and standard deviations of the school marks.

Subject	1961 (N=8905)		1966 E.S. (N=1500)		1966 C.S. (N=6144)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Reading	3.34	0.85	3.37	0.83	3.24	0.95
Writing	3.22	0.92	3.29	0.92		
Mathematics	3.18	1.06	3.30	1.04	3.23	1.02

Intercorrelations of the variables

Relative achievement will be assessed according to the models reported on page 26. The combinations of the variables, as well as the desired degree of explained variance, are shown in the schedule below. Since the pupils took the standardized achievement tests rather earlier than or at about the same time as the intelligence tests, and marks are based on observations made throughout the whole year, the terms *control* and *criterion variables,* not *predictive* and *criterion variables* are used in the schedule. In the same way,

estimation, not *prediction,* will be used in future (cf. Magnusson & Dunér, 1967, p. 6).

Model	Intelligence test	Achievement test	School marks	Explained variance
A	Control variable		Criterion variable	Minimum 25 %
B	Control variable	Criterion variable		Minimum 50 %
C		Control variable	Criterion variable	Minimum 50 %

Table 4:9 gives the intercorrelations of the composite scores of the three variables. There are very small differences between the coefficients for the two year groups, and they are of a size expected (cf. N.-E. Svensson, 1962, pp. 84–85). If the coefficients are squared, the approximate products .45, .60 and .75 are obtained, which gives a measure of how much of the total variance in the criteria can be explained when we use Models A, B and C respectively. If these composite scrores are used, the demands on *external characteristics,* stipulated earlier, would be statisfied. Demands are also made, however, on the *internal characteristics* of the measures, and the intercorrelations of the individual variables must therefore be studied.

Table 4:9. Intercorrelations of the composite scores.

	1961 (N=8905)	1966 E.S. (N=1500)	1966 C.S. (N=6144)
Int.tests-Marks	.67	.66	.69
Int.tests-Ach.tests	.78	.74	.78
Ach.tests-Marks	.87	.87	.88

A scrutiny of Tables 4:10, 4:11 and 4:12 shows that the following general statements can be made. Of the intelligence tests, Opposites reveals the highest correlations with both achievement tests in and marks for reading and writing, while Number series has the highest correlations with achievement tests in and marks for mathematics. The intelligence test Metal folding shows rather low correlations with all measures of achievement, while very high correlations are present between achievement tests and marks in corresponding subjects. The systematic variations in the strength of the correlations seem to provide some guidance regarding the groupings of the control and criterion variables required to make studies of relative achievement within various

domains of subjects possible. To obtain still more information about this important question, some factor analyses will be made.

Table 4:10. Intercorrelations of the intelligence and achievement measures in 1961 (N=8905).

		Int.tests			Ach.tests			Marks		
		1	2	3	4	5	6	7	8	9
	1. Opposites		.38	.50	.76	.73	.57	.64	.61	.52
Int.tests	2. Metal folding			.45	.38	.33	.46	.28	.26	.38
	3. Number series				.54	.53	.68	.47	.48	.62
	4. Reading					.82	.69	.78	.68	.62
Ach.tests	5. Writing						.64	.74	.80	.59
	6. Mathematics							.59	.59	.83
	7. Reading								.77	.63
Marks	8. Writing									.65
	9. Mathematics									

Table 4:11. Intercorrelations of the intelligence and achievement measures in 1966. Elementary school (N=1500).

		Int.tests			Ach.tests			Marks		
		1	2	3	4	5	6	7	8	9
	1. Opposites		.38	.49	.73	.66	.54	.61	.58	.52
Int.tests	2. Metal folding			.48	.33	.32	.46	.29	.27	.40
	3. Number series				.49	.53	.64	.45	.46	.60
	4. Reading					.80	.60	.78	.69	.60
Ach.tests	5. Writing						.62	.73	.80	.63
	6. Mathematics							.55	.57	.83
	7. Reading								.77	.63
Marks	8. Writing									.66
	9. Mathematics									

Table 4:12. Intercorrelations of the intelligence and achievement measures in 1966. Comprehensive school (N=6144).

		Int.tests			Ach.tests		Marks	
		1	2	3	4	5	6	7
	1. Opposites		.38	.50	.75	.57	.62	.54
Int.tests	2. Metal folding			.42	.35	.44	.28	.41
	3. Number series				.56	.69	.51	.65
Ach.tests	4. Swedish					.66	.81	.64
	5. Mathematics						.62	.86
Marks	6. Swedish							.66
	7. Mathematics							

Bartlett distinguishes between two categories of factor analyses, *internal* and *external* (1948, p. 73). In one case, factors are sought that can explain the correlations *within* different sets of variables, in the other factors that explain the correlations *between* different sets of variables. The two analyses probably give different factor structures, for, in the latter case, one is dependent on external criteria. Since we are interested primarily in the mutual relations of different sets of variables, it is natural to make external factor analyses. These are performed by calculating the *canonical correlations* between the combined control and criterion variables.

The method of canonical correlation, presented by Hotelling in the 1930's, is described in detail by Cooley & Lohnes (1962) and Mårdberg (1969). In educational-psychological contexts it has been applied by Härnqvist (1968), Jerkedal (1967) and others. Canonical correlations may be regarded as a type, or rather a further development, of multiple correlations, since they are used when both predictor and criterion contain several variables. Further, not one, but several coefficients of correlation are obtained. Their number depends on the number of dimensions present, but the strength of the correlations declines very rapidly, and I have not seen any application of the method that has given more than three significant coefficients.

The first canonical correlation coefficient is obtained by assigning weights to the individual variables in such a way that the correlation between the combined variables reaches a maximum. This may also be expressed by saying that a common factor or component responsible for most of the covariation between the two sets of variables has been found. The greater part of the remaining covariation can be explained by a second common component – orthogonal to the first – which is determined by giving the variables new weights, which satisfy the condition that the correlation between the combined variables reaches a maximum for this component. The process is continued until the number of canonical correlations reaches the same level as the number of variables in the smallest of the two sets of variables.

Tabel 4:13 gives the canonical correlations between intelligence tests and marks, and the weight coefficients for the different components. All correlations are significant at the 1 per cent level, except the third component in Elementary school 1966. The canonical correlations for the first component are a few units above the corresponding correlations between the unweighted variables (Table 4:9), and can explain rather more than 50 per cent of the variance in marks. The second component shows correlations around .30, and explains about 10 per cent of the remaining variance. Together these two components cover between 55 and 60 per cent of the variance, equivalent to a multiple correlation just above .75. In the cases in which a third component could be obtained, it contributed very little to increase the correlations, and as an example it may be mentioned that, in the

Table 4:13. Canonical correlations and weight coefficients. Intelligence tests and school marks.

		Weight coefficients for different components									
		1961			1966 E.S.			1966 C.S.			
		1	2	3	1	2	3	1	2		
Int. tests	Opposites	.95	−.63	−.04	.92	−.62	−.07	.68	−.60		
	Metal folding	.05	.25	−.51	.10	.29	−.51	.10	.29		
	Number series	.74	.53	.35	.70	.48	.40	.73	.41		
Marks	Reading	.57	−.50	−.66	.56	−.48	−.66	.59	−.72		
	Writing	.38	−.32	.75	.30	−.35	.75				
	Mathematics	.73	.81	−.08	.77	.80	−.06	.81	.68		
	Canonical correlation	.73	.33	.05	.71	.30	.05	.74	.31		

Table 4:14. Canonical correlations and weight coefficients. Intelligence and achievement tests.

		Weight coefficients for different components									
		1961			1966 E.S.			1966 C.S.			
		1	2	3	1	2	3	1	2		
Int.tests	Opposites	1.08	−.58	.01	1.01	−.59	−.03	.80	−.58		
	Metal folding	.12	.20	−.47	.11	.26	−.49	.11	.22		
	Number series	.63	.55	.30	.61	.51	.38	.60	.49		
Ach.tests	Reading	.64	−.50	−.70	.73	−.68	−.57	.81	−.68		
	Writing	.52	−.26	.72	.33	.01	.80				
	Mathematics	.56	.82	.01	.60	.73	−.21	.59	.73		
	Canonical correlation	.83	.43	.08	.79	.39	.07	.82	.39		

Table 4:15. Canonical correlations and weight coefficients. Achievement tests and school marks.

		Weight coefficients for different components									
		1961			1966 E.S.			1966 C.S.			
		1	2	3	1	2	3	1	2		
Ach.tests	Reading	.29	−.25	−.87	.38	−.30	−.78	.51	−.74		
	Writing	.62	−.57	.70	.57	−.46	.73				
	Mathematics	.75	.80	.16	.72	.77	.01	.85	.67		
Marks	Reading	.48	−.34	−.72	.45	−.40	−.70	.48	−.75		
	Writing	.44	−.49	.70	.41	−.44	.71				
	Mathematics	.75	.80	.01	.79	.80	−.02	.88	.66		
	Canonical correlation	.87	.66	.38	.87	.63	.36	.89	.61		

1961 sample, it increases the explained variance from 58.4 to 58.5 per cent.

The first component has rather high loadings in all variables except the Metal folding test. The second component is bipolar with high positive loadings in Number series and mathematics, and negative loadings in Opposites, and reading and writing, and Swedish respectively. The third component has its highest positive loading in writing and its highest negative in reading.

Tables 4:14 and 4:15 give information about the canonical correlations between intelligence tests and achievement tests, and achievement tests and marks respectively. All the correlation coefficients reach significant values in these combinations. In the former case the first two components are responsible for slightly more than 70 per cent of the total variance in the achievement tests and in the latter case for about 87 per cent of the variance in the marks. The third coefficient, too, has some weight in Table 4:15, and the third component therefore increases the explained variance by about 2 per cent.

The factor structure in Table 4:14 is in good agreement with that in Table 4:13, while Table 4:15 shows relatively high loadings in all variables for the first component. The second component is still bipolar (Table 4:15) with positive loadings in the mathematics variables and negative in the others. As earlier, the third component shows positive loadings in writing and negative in reading.

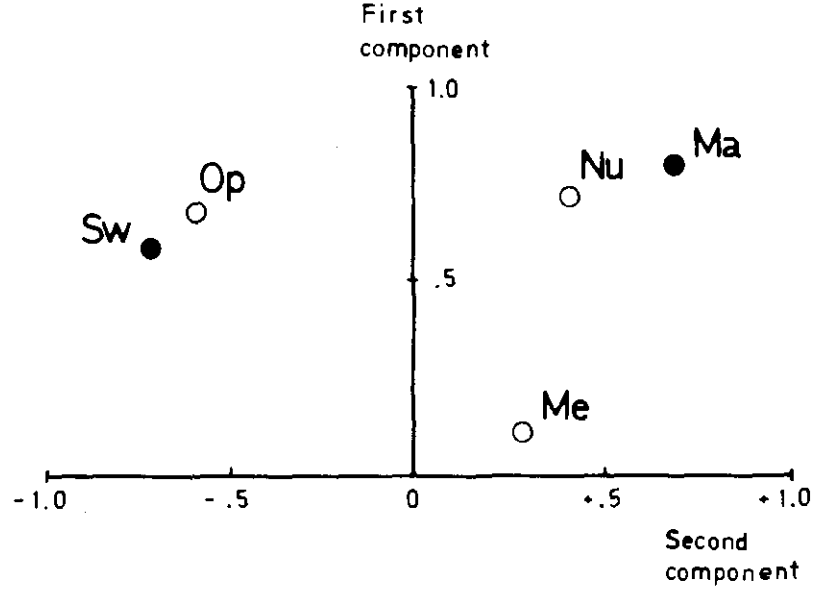


Fig. 4:2. Canonical weights. Intelligence tests and school marks.

Starting from the values in the comprehensive school, Figures 4:2, 4:3 and 4:4 illustrate the loadings of the first two components in the individual variables with different combinations of the combined variables. The control variables are marked with circles and the criterion variables with dots.

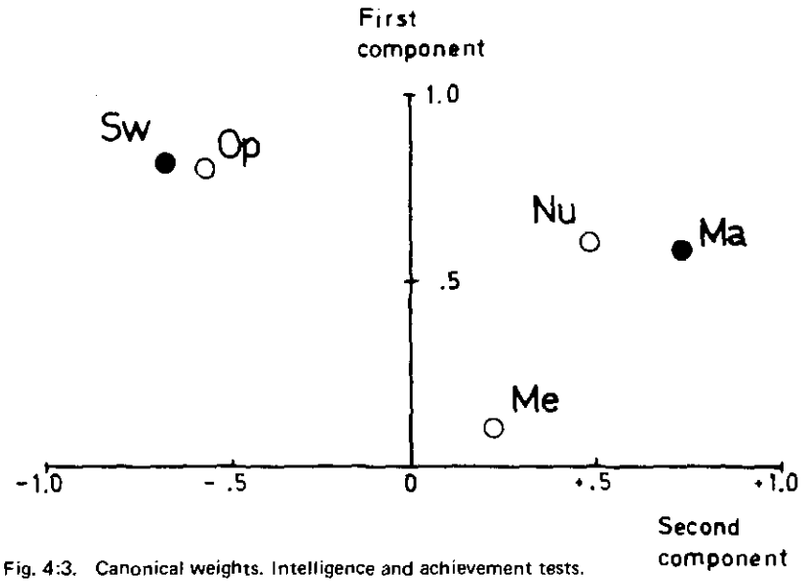


Fig. 4:3. Canonical weights. Intelligence and achievement tests.

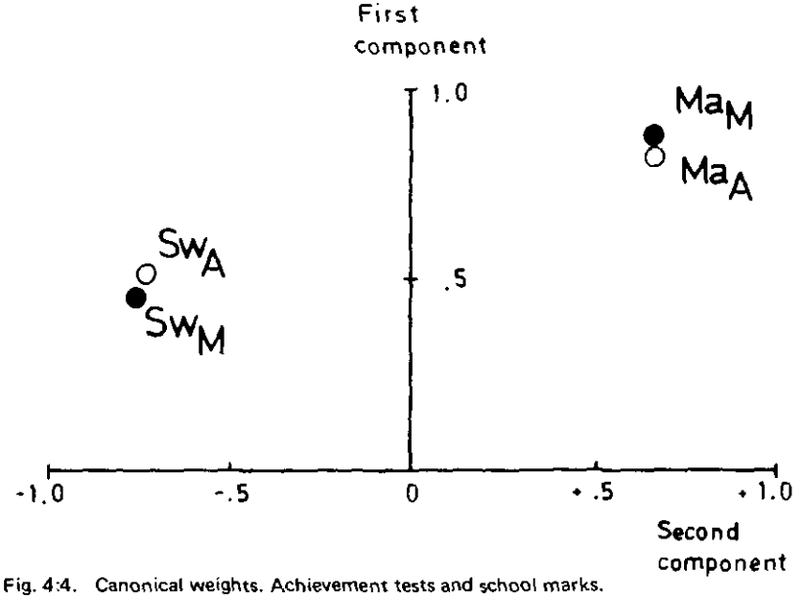


Fig. 4:4. Canonical weights. Achievement tests and school marks.

The results of the external factor analyses may be interpreted in a way which is in good agreement with Vernon's hierarchical group theory, which, in a somewhat modified form, is given in Figure 4:5 (cf. Vernon, 1950, pp. 22–24). Only the left-hand side of Vernon's model will be used here, however, and our first component will be considered, not as a general factor, but as a general academic factor, corresponding most closely to the verbal-numerical-educational factor. That the second major group factor, and thereby the g-factor, has been impossible to identify is probably due to the fact that the Metal folding test has no equivalent among the achievement variables – or, expressed in another way, that the spatial ability factor is of little importance for the central school subjects studied here. The second component has its equivalent in Vernon's minor group factor, which contrasts between the verbal and numerical factors. The third component may be regarded as a specific factor contrasting between reading and writing.

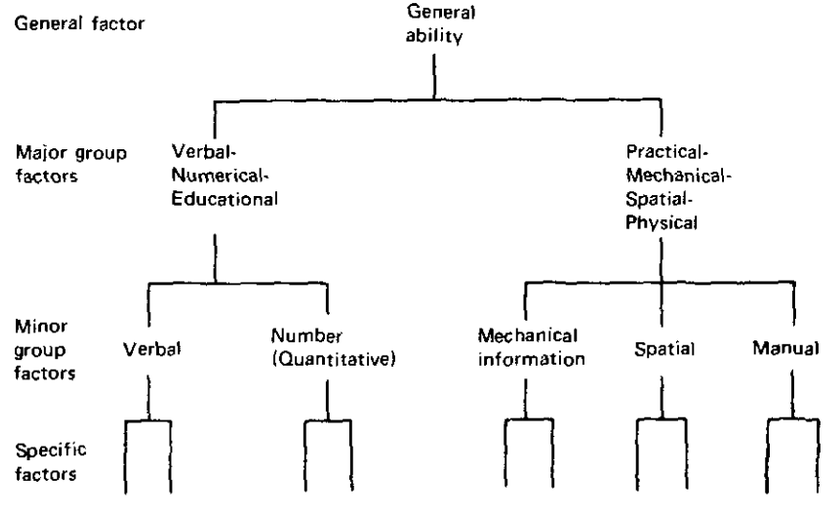


Fig. 4:5. Vernon's hierarchical structure of human abilities.

Determination of combinations of variables

How can the information provided by the external factor analyses be used? At least two possibilities are feasible. The individual results can be given the loadings obtained in the various factor analyses to give a level factor (general academic ability) and a structure factor (number *versus* verbal ability). Another possibility is to use the individuals' raw scores and work with a

verbal and a numerical factor, each represented by variables showing great agreement in respect of the loadings of both the first and the second component. I chose the latter alternative, since this seems to suit best the general principles outlined earlier. The term *numerical factor* will not be used, however, for the term *quantitative factor* seems to be preferable (cf. Sanders *et al.*, 1960), to avoid confusion with Thurstone's n-factor, which is associated with other and simpler abilities than those measured by the intelligence test, Number series, and the measures of achievements in mathematics.

Thus, relative achievement will be studied in the verbal domain and in the quantitative domain. In both cases, intelligence tests, achievement tests and marks, combined according to the models described earlier, will be used. In the quantitative domain, the intelligence test, Number series, will be used to obtain a measure of quantitative ability and marks for mathematics to measure quantitative achievement, while the achievement test in mathematics must serve as a measure of both ability and scholastic achievement. In the verbal domain, the intelligence test, Opposites, is used as measure of ability. In the school systems in which separate marks are awarded for reading and writing, these marks are combined to make a mark for Swedish, which gives greater agreement on the criterion side between the two school systems. In spite of the differences in the third component, it is not very likely that much information is lost by this procedure. In the same way, the raw scores in the achievement tests of reading and writing are combined to make an achievement test score in the subject Swedish, within which, however, the scores for writing, on account of varying standard deviations, will have more weight in 1961 than in 1966. This, together with the differences in specific content, must be borne in mind when comparing the two years. The Metal folding test in this design seems to lack justification, and it will therefore be excluded from future analyses.

Table 4:16. Intercorrelations between different combinations of control and criterion variables.

Model	Verbal domain			Quantitative domain		
	1961	1966 E.S.	1966 C.S.	1961	1966 E.S.	1966 C.S.
A	.66	.63	.62	.62	.60	.65
B	.78	.73	.75	.68	.64	.69
C	.84	.83	.81	.83	.83	.86

Table 4:16 gives the correlations between the combinations of control and criterion variables that will be used in the following. As mentioned above, marks and scores on achievement tests respectively have been combined in

the verbal sector for the elementary and the experimental comprehensive schools, so that, for example, the coefficient at the upper left-hand side gives the correlation between the results of the Opposites test and the combined marks for reading and writing, called Swedish below. Further comments on the table are given below:

Model A

Starting from the results of the Opposites test, 38 to 44 per cent of the variance in verbal achievement, when it is assessed by marks for Swedish, can be explained. The corresponding values are 36 to 42 per cent when the Number series test is used to estimate quantitative achievement as expressed in marks for mathematics. Thus, there does not seem to be any great difference in the predictive power of the tests when marks are used as criteria.

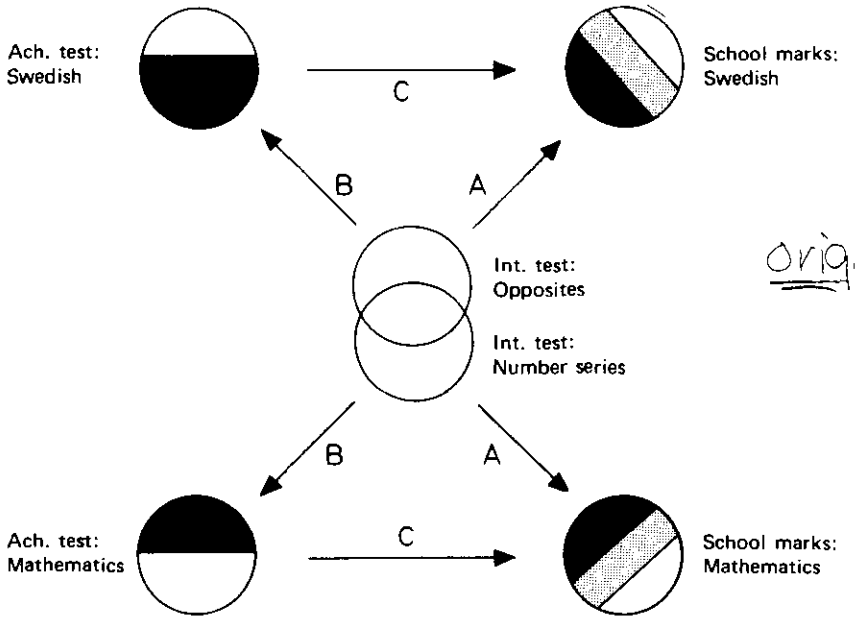
Model B

If marks are replaced by achievement tests, the certainty of the estimation increases within both domains. The proportion of explained variance increases within the verbal domain to between 53 and 61 per cent and within the quantitative to between 41 and 48 per cent. The higher values within the former domain may probably be explained by the greater similarity in content between Opposites and several of the subtests in Swedish, e.g. reading comprehension and meanings of words, than between Number series and the subtests in mathematics (cf. Ljung, 1965, pp. 46, 50). Owing to the relatively low correlations between the intelligence test and the achievement tests within the quantitative domain, we do not reach the stipulated boundary for the explained variance in Model B, which implies, among other things, that there will be more scope for relative achievement within the quantitative than within the verbal domain.

Model C

When achievement test results are used to estimate marks, the variance in these may be explained to 70 per cent on the basis of differences in achievement tests, and there are only small differences between the two domains. The high value must be viewed in the light of the fact that the same school subjects are included on the control and criterion side, and that the teachers knew the results of the achievement tests when marks were awarded.

This chapter will close by attempting to illustrate in Figure 4:6 how the explained variance increases when we go from Model A to Model C. In the figure the total variances are symbolized by circles, and the proportions of explained variance by shading.



The part of the variance in marks and achievement test respectively that can be explained by differences in intelligence

The part of the variance in marks that can be explained by differences in scores on achievement tests

Fig. 4:6. Schematic diagram illustrating the interdependence between choice of model and proportion of explained variance.

When the correlations between intelligence tests and marks are known, it is possible to assess how much of the variance in marks for Swedish and mathematics can be assigned to differences in verbal and quantitative ability (Model A). Since these two types of ability are not wholly independent, the variances in the two intelligence tests are indicated by partly overlapping circles. Part of the remaining variance in marks consists of error variance, but some part consists of true variance which cannot be explained from differences in the intelligence tests. It is assumed, therefore, that some of the remaining variance in marks can be attributed to differences in other variables, e.g. sex, social background, school adjustment and interests.

When achievement tests are substituted for marks (Model B), it implies that more of the variance in achievement in Swedish and mathematics respectively can be explained by differences in the results of intelligence tests. The unexplained variance declines, but at the same time the error variance should decline, because the reliabilities are probably higher for the achievement tests than for the marks, so that some covariance is still to be expected between the remaining differences in achievement – i.e. relative achievement – and the types of variables mentioned above.

In Model C, achievement tests and marks are used as control and criterion variables. In comparison with Model B, not only explained variance, but probably also error variance in criterion variables increases. The remaining true differences will consequently be very small and we must be prepared for rather weak correlations between relative achievement estimated here and different types of explanatory variables.

CHAPTER 5

BACKGROUND VARIABLES

One of the purposes of the present investigation is to elucidate how relative achievement is associated with sex and social background. This chapter reports which background variables were chosen for study, why they were chosen and how the samples are distributed on these variables. A description is also given of the background variables in so far as the relations between these variables and the intelligence variables are reported.

Choice of background variables

It was shown in Chapter 1 how important it is to homogenize the investigation groups in respect of sex and social background when studying relative achievement. Such homogenization is desirable, partly to make clear the relations between these variables and relative achievement, and partly to be able to isolate them in the study of other factors.

Sex is an acceptable variable in this context, for it causes no hesitation in categorization. Social background, on the other hand, is a troublesome variable, since it means division according to the parents' socio-economic status, which can be done in many ways. Most frequently some kind of categorization is made according to the father's occupation, where, among other things, the education the occupation requires and the income it gives are decisive for the more or less subjective division into categories. This is, for example, the case in Sweden where a tripartite social group classification is used (Carlsson, 1959, p. 371).

In educational-sociological contexts it has been found that parents' education is a more significant variable than the more complex measure of their socio-economic status. In Swedish investigations it has been found, for example, that covariation exists *within* the socio-economic groups between the children's educational aspirations and parents' level of education (Härnqvist, 1958, p. 58; Härnqvist & Grahm, 1963, p. 97). In the same way, a number of studies in Britain has shown that the father's and especially the mother's level of education is of greater importance than the general socio-economic standard of the home, as far as pupils' success in school is concerned (Floud, 1961, p. 102; Swift, 1967, p. 17; Nisbet & Entwistle, 1969, pp. 72–77). Finally, Frankel (1964, pp. 776–780), in an American study, states that the mother's education is far higher among achievers than among underachievers.

On the basis of earlier research results, I therefore consider it more correct to classify pupils according to both parents' education, than according to the more diffuse conception of socio-economic status which is based only on the father's occupation. In order to avoid too low cell frequencies, the following primary divisions of pupils' social background were chosen.

Education group 1. Father and/or mother with matriculation examination (*studentexamen*) or equivalent education.
Education group 2. Father and/or mother with only lower secondary school certificate (*realexamen*) or equivalent education.
Education group 3. Father and mother with only elementary school.

This classification means, however, that the first two groups will be relatively small in relation to the third, which will comprise about three-quarters of all the pupils. It is, therefore, desirable and possible to make a further homogenization of this group. An attempt has been made to do this by dichotomizing both according to the father's occupation and to the educational resources of the place of residence.

Information on the father's occupation is used to distinguish between children of manual workers and children of office-workers, businessmen, etc. Such a mode of procedure is justified, for it has been found earlier that children of the latter groups have somewhat higher marks than the others (Svensson, 1964, pp. 43–50). No attention has been paid to the mother's occupation in this classification, mainly because, for a great majority, no work outside the home was reported.

Group 3 is also divided into sub-groups according to whether the pupils in this group live in a municipality with a senior secondary school (*gymnasium*) or not. It is assumed that in this group in particular it is important for a pupil's educational aspirations – and also, perhaps, for his achievement in grade 6 – if it is possible for him to attend a senior secondary school near his home. Since senior secondary schools are found in most districts with more than 10,000 inhabitants, while they are very rare in districts with fewer inhabitants, this results, at the same time, in a division into urban and rural municipalities. This, it its turn, means that the teachers' somewhat more generous marking sometimes found in rural areas can be kept under control (Härnqvist, 1959, p. 60; Svensson, 1964, p. 56).

The schedule below shows how parents' education, father's occupation and educational resources of place of residence are used to attain homogenization of the pupils' home background.

Classification according to home background is performed separately for boys and girls, which gives still further homogenization of the investigation population. This division also makes it possible to study how sex and parents' education covary with relative achievement for all pupils. For the majority of the pupils (group 3) it is also possible to analyse the covariation between

Background level	Parents' education	Father's occupation	Municipality
1	High	All	All
2	Medium		
3:1	Low	White collar, small business, etc.	Gymnasium available
3:2			Gymnasium not available
3:3		Manual worker	Gymnasium available
3:4			Gymnasium not available

relative achievement and the other two background variables. In all analyses the pupils will be classified according to year of birth and the school system to which they belong, which makes it possible to compare pupils in grade 6 in 1961 and 1966, and pupils in the elementary school and the comprehensive school.

Distributions according to the background variables

Tables 5:1 and 5:2 show how the pupils in the samples are distributed according to school system, sex and home background. As mentioned earlier, the proportion of pupils in the comprehensive school increased greatly during the five-year period owing to the successive introduction of this school system. The tables reveal, however, that the switch-over to the new school system has been somewhat slower in rural areas, since groups 3:2 and 3:4 both in 1961

Table 5:1. Distribution according to school system, sex and background level in 1961.

Background level	Elementary school				Exp. comprehensive school			
	Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%
1	254	8.6	246	8.5	187	12.5	184	11.7
2	316	10.7	312	10.8	200	13.3	223	14.1
3:1	291	9.9	278	9.7	230	15.3	232	14.7
3:2	711	24.1	677	23.5	192	12.8	157	9.9
3:3	562	19.1	548	19.0	421	28.1	456	28.9
3:4	816	27.7	817	28.4	269	17.9	326	20.7
Total	2950	100	2878	100	1499	100	1578	100

Table 5:2. Distribution according to school system, sex and background level in 1966.

Background level	Elementary school				Comprehensive school			
	Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%
1	47	6.4	64	8.3	432	13.9	421	13.8
2	93	12.7	106	13.8	520	16.8	521	17.1
3:1	48	6.6	56	7.3	352	11.4	344	11.3
3:2	211	28.9	212	27.6	403	13.0	438	14.4
3:3	94	12.9	82	10.7	685	22.1	669	22.0
3:4	238	32.6	249	32.4	705	22.8	654	21.5
Total	731	100	769	100	3097	100	3047	100

and 1966 were over-represented in the old school system. It will also be observed, in a comparison between the two tables, that another increase occurred during the five-year period, namely a rise in parents' level in education, which can be discerned in the somewhat greater proportion of pupils in groups 1 and 2. This trend reflects the increasing possibilities for higher education available to parents born, on an average, approximately five years later.

Although these classifications do not pay any attention to the father's occupation or the educational resources of place of residence in the relatively low frequency groups 1 and 2, it may be of some interest to study how matters stand in these respects. The percentages of pupils in each group whose fathers are classified as manual workers, and the percentages of pupils with possibilities of gymnasium studies in their place of residence are therefore given in the schedule below.

Sample	Background level	School-system	Father's occupation: manual worker	Gymnasium available
1961	Group 1	Elementary	2	70
		Exp. compr.	1	83
	Group 2	Elementary	22	56
		Exp. compr.	25	79
1966	Group 1	Elementary	3	41
		Compr.	2	75
	Group 2	Elementary	23	31
		Compr.	25	68

Only few of the pupils in group 1 have fathers who are manual workers, but no fewer than 25 per cent of the pupils in group 2 have fathers with such

occupations. That pupils have been placed in these groups is due primarily to the fact that the mother has a higher education than the father, since very few manual workers have a theoretical education higher than the compulsory elementary school, and the much smaller proportion of manual workers in group 1 is due, in its turn, partly to the fact that the number of mothers with the matriculation examination is rather small, and partly that women usually marry men on more or less the same level of education as they themselves.

Except for the pupils who were in the elementary school in 1966, most of the members of groups 1 and 2 are living in places with a senior secondary school. This is associated with the fact that the demand for theoretically educated people increases with urbanization, and most of the parents in groups 1 and 2, therefore, live in large urban areas.

Intelligence and changes in intelligence among pupils with different backgrounds

Before studying variations in relative achievement among pupils with different background characteristics, it may be necessary to report the initial levels of the groups. In other words, an account will be given of the differences in intelligence between boys and girls, and between pupils with different home backgrounds. A study will also be made of how far the rise in level of intelligence, mentioned earlier, occurring during the five-year period, has favoured boys and girls from different social strata. Appendix 2 reports the means and standard deviations for all groups in the Opposites and Number series tests, and in the following sections this appendix will be summarized and discussed.

DIFFERENCES IN VERBAL ABILITY

To give a reasonably clear picture of the differences in verbal intelligence both within and between the samples, the pupils were divided, in Table 5:3, first according to year group, second according to year group and school system, and finally according to year group, school system and sex. After that successive calculations were made of the differences between the means for these categories and the total mean that would be obtained if all the test scores of the pupils were combined to make a common distribution. The differences were then expressed in percentages of the standard deviation of the common distribution. In the same way, the means for pupils with different home background were related to the mean and the standard deviation of the distribution valid for all pupils belonging to the same

Table 5:3. Verbal ability in relation to year group, school system, sex and background level.

Deviations of the column means from the total mean in per cent of the S.D.	Year group	1961 −11				1966 +13			
	School system	Elementary −15		Exp.comp. −4		Elementary −2		Comp. +17	
	Sex	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
		−14	−15	− 4	− 5	− 4	− 1	+15	+18
Deviations of the group means from the column means in per cent of the S.D. within the columns.	Background level								
	1	+ 58	+ 83	+ 60	+ 61	+ 75	+ 50	+ 57	+ 49
	2	+ 35	+ 28	+ 20	+ 23	+ 31	+ 21	+ 22	+ 23
	3	−11	−13	−14	−14	−11	− 9	−17	−15
	3:1	+ 12	+ 15	+ 14	+ 6	+ 17	− 5	+ 8	+ 1
	3:2	− 8	− 5	−17	− 6	−17	− 3	−12	− 5
	3:3	−10	−17	−11	−15	−14	−10	−20	−25
	3:4	−24	−26	−39	−30	−10	−15	−29	−22

category in respect of year group, school system and sex. It is true that there are small variations between the standard deviations of the eight categories, but, generally speaking, correct information is obtained about the position of a certain group in the common distribution, if the percentages for the group and category are added together.

The mean for the 1961 sample is .72 points lower, and the mean for the 1966 sample .83 points higher than the total mean of 23.60. In percentage of the standard deviation in the common distribution, which is 6.48, this implies that the former value is 11 per cent units below, and the latter value 13 units above the total mean. The differences in means between the two year groups amounts, therefore, to about one-quarter of the standard deviation. The causes of this quite great increase of verbal ability are probably the rise in parents' education, increased exposure to mass media and other factors related to the general development of society during the five-year period.

The elementary school children in both samples have lower means than those in the other school systems, and the mean for the elementary school in 1966 is only slightly higher than the mean for the experimental comprehensive school in 1961. The difference appearing in the means for the different school systems is probably due mainly to differences in the composition of the samples, for far more pupils in the elementary school are from rural areas and from families belonging to lower social strata (cf. Tables 5:1 and 5:2).

The differences in means between boys and girls are rather small in all cases, which is not surprising, since there are not usually any great sex differences in this type of test of verbal ability (Anastasi, 1958, p. 474; Härnqvist, 1960, p. 36). Some differences can be observed, however, between the two year groups, in that the mean was somewhat lower for girls in 1961 than for boys, while in 1966 it was somewhat higher. The same tendency has also been observed in other investigations concerned with changes in intelligence during the 1960's (Härnqvist, 1969 a and b).

As expected, there are substantial relationships between the pupils' verbal ability and their parents' level of education. The mean for group 1 in all categories is at least one-half and for group 2 about one-quarter of the standard deviation above the mean of the respective category. The negative deviation for group 3 – the weighted average for groups 3:1 to 3:4 – is smaller, of course, since this group, by its size, affects greatly the mean of the category. There are, however, rather great differences within this group, and, as a rule, the mean declines from group 3:1 to group 3:4. This implies that children of white-collar workers have higher values than children of manual workers, and that pupils living in districts with senior secondary schools have slightly better results than other pupils. In no case, however, does the mean for group 3:1 reach the corresponding value for group 2.

A study of Table 5:3 reveals that the gap between groups 1 and 3 became

smaller for girls during the five-year period, but no such tendency is present for boys. To elucidate this circumstance, the means for boys and girls in both year groups are given below, divided according to parent's level of education only, and expressed in raw scores.

Background level	Year	Boys	Girls	Boys-Girls
1.	1966	28.1	27.7	+ 0.4
	1961	26.8	27.8	−1.0
	1966–1961	+1.3	−0.1	
2.	1966	25.9	26.0	−0.1
	1961	24.8	24.6	+ 0.2
	1966–1961	+1.1	+1.4	
3.	1966	23.3	23.6	−0.3
	1961	22.2	22.0	+ 0.2
	1966–1961	+1.1	+ 1.6	

The increments for the three groups of boys are about the same, and the distances between them are therefore unchanged on the whole. Among girls, however, group 1 shows a slight decline, while group 3 shows the greatest increase in the table, which explains the reduced difference between the extreme groups of girls. Differences in increment give the boys in 1966, unlike 1961, higher means than the girls in group 1, but lower means in groups 2 and 3. Since these groups contain most of the pupils, the change in sex differences in favour of girls in Table 5:3 is explained. For a more detailed discussion of the factors that may have contributed to varying increments of the groups, the reader is referred to a study by Stahle (MS), the main purpose of which is to study changes in intelligence between 1961 and 1966.

DIFFERENCES IN QUANTITATIVE ABILITY

The percentages in Table 5:4 were calculated according to the same principles as in Table 5:3, and show the differences between and within the samples in respect of results for the Number series test. The differences between the 1961 and 1966 thirteen-year-olds are smaller than in verbal ability. Sex differences, on the other hand, are greater. In all cases, the boys have higher values, but here, too, the girls are somewhat better in 1966 than in 1961.

Between educational groups, as well as within group 3, there are great differences in quantitative ability, although not so great as in verbal ability. Likewise, it will be observed that the differences declined among girls but not among boys during the five-year period. This emerges even more clearly in the

Table 5:4. Quantitative ability in relation to year group, school system, sex and background level.

Deviations of the column means from the total mean in in per cent of the S.D.	Year group	1961 − 6				1966 + 7			
	School system	Elementary − 8		Exp.comp. − 3		Elementary − 7		Comp. +10	
	Sex	Boys − 3	Girls −12	Boys + 6	Girls −11	Boys − 5	Girls − 9	Boys +14	Girls + 6
Deviations of the group means from the column means in per cent of the S.D. within the columns.	Background level								
	1	+43	+ 47	+49	+41	+63	+22	+42	+36
	2	+22	+ 27	+14	+19	+27	+24	+19	+15
	3	− 8	− 9	−11	−10	− 9	− 7	−13	−11
	3:1	+ 2	+ 5	+ 9	+ 1	+10	− 4	0	+ 1
	3:2	+ 1	+ 7	−11	+12	− 8	+ 3	− 8	+ 6
	3:3	− 5	−19	−12	−18	−12	− 7	−18	−20
	3:4	−20	−20	−26	−17	−14	−16	−18	−19

schedule below, where the means for boys and girls in both year groups are expressed in raw scores.

Background level	Year	Boys	Girls	Boys-Girls
1.	1966	24.8	23.3	+1.5
	1961	24.0	22.9	+1.1
	1966–1961	+0.8	+0.4	
2.	1966	22.9	22.0	+0.9
	1961	21.9	21.3	+0.6
	1966–1961	+1.0	+0.7	
3.	1966	20.2	19.9	+0.3
	1961	19.7	18.8	+0.9
	1966–1961	+0.5	+1.1	

Group 1 increased more than group 3 among the boys, which causes a greater difference between the groups. The opposite is found for the girls, and the differences between the groups of girls have therefore become smaller. Sex differences in favour of boys have increased in groups 1 and 2, but become smaller in the high frequency group 3, which means that sex differences have declined totally between 1961 and 1966.

To sum up it may be said that the differences between boys and girls are very small in verbal, and small in quantitative ability. Very great differences in verbal and great differences in quantitative ability are found, however, among pupils with varying home backgrounds. These differences tend to become less for girls, but not for boys during the five-year period in question.

CHAPTER 6

SCHOOL ADJUSTMENT AND INTEREST VARIABLES

Unlike the tests of intelligence, the questionnaires used in conjunction with the collection of basic data for the project were greatly revised between 1961 and 1966. This was due to the fact that, among other things, the time available for the construction of the instruments used in 1961 was too short, with the consequence that the result was not wholly satisfactory. Thus, the questionnaire dealing with attitude to school had very low reliability, and the interest questionnaire was so complicated that not all the pupils could answer it (Svensson, 1964, p. 21: Rovio-Johansson, 1966, p. 2). This makes it difficult to study attitude and interest factors in the 1961 sample, and to compare results in 1961 and 1966. It was therefore decided not to use the 1961 material in that part of the investigation dealing with the relations among school adjustment, interests, and relative achievement. Further, it was necessary to exclude the elementary school material from 1966, since the cell frequencies seem far too low when subjects are distributed according to sex and home background.

In respect of the relation between relative achievement and school adjustment and spare time interests respectively, the study is restricted to the pupils who were attending the comprehensive school in 1966, a restriction which means, of course, that some information is lost, but there is still a relatively large and representative group, which, in 1966, was in the school system that will dominate Sweden during the 1970's. A brief report of the questionnaires used, and how the different categories of pupils answered them will be given now.

Description of the school adjustment and interest questionnaire

In the collection of basic data in 1966, four questionnaires were used. They had the following headings: *School, Spare time activities, Plans* and *After school.* The first two comprise several scales, which deal with different aspects of pupils' attitudes to school and their interests outside school. The other two consist of single questions referring to choice of studies and occupation, and how much time is spent reading books, watching the television, listening to music, etc. Only the questionnaires *School* and *Spare time activities* will be used, for these instruments seem best fitted to identify some of the personality factors that may be of interest in this context.

The questionnaire *School* consists of three scales, each containing ten questions. The questions were to be answered "yes" or "no", and one point was awarded for a positive reply, and none for a negative reply. The wording of the questions and the scoring method are given in Appendix 3. A description of the principles of construction may be found in Rovio-Johansson (1966).

The first scale contains questions bearing on pupils' attitudes towards higher education, and their views on the opinions of parents on this matter. This scale gives a measure of *the family's attitude towards higher education.*

In the second scale are questions referring to pupils' anxiety in school situations, and how far they can satisfy the demands made by the school. The purpose of this scale is to measure *the pupils' feeling of security at school.*

The third scale gives information on *interest in school work,* and consists of questions referring to the pupils' views on the quality of the instruction, the extent of homework, etc.

In the questionnaire *Spare time activities* the pupil gives his attitude towards ten different activities from each of the following five areas: verbal, technical, outdoor, clerical and domestic. At each activity, the pupil has to indicate whether he finds the activity *very interesting, interesting, dull* or *very dull.* At the scoring, the alternatives were awarded the points 5, 4, 2 and 1.

The activities in the five scales are given in Appendix 3. The reasons for the choices of activities, etc., are given in Rovio-Johansson (*op.cit.*).

The eight scales make it possible to measure such personality factors as have been in the centre of interest in a great number of investigations in this area, but about which, nevertheless, rather little seems to be known (Lavin, 1965, pp. 66–74; Raph, 1966, pp. 59–70). On the other hand, it is impossible to study the relationship between relative achievement and different social-psychology factors, e.g. social relations in the classroom, which is very difficult in investigations of the size of the present one.

The means and standard deviations of the eight variables among various categories of pupils are shown in Appendix 4. Before comments are made on this, the reliabilities (Table 6:1) and the intercorrelations (Tables 6:2 and 6:3) will be reported. The reliabilities were calculated with the help of the Kuder-Richardson formula 20 (variables 1–3) and the split-half method (variables 4–8). The calculations are based on a subsample consisting of all

Table 6:1. Reliability of the measures of school adjustment and interest.

Reaction to school	Boys (N=164)	Girls (N=142)	Area of interest	Boys (N=164)	Girls (N=142)
1. Further studies	.75	.79	4. Verbal	.81	.70
2. Security	.65	.69	5. Technical	.76	.82
3. School work	.71	.69	6. Outdoor	.82	.83
			7. Clerical	.74	.82
			8. Domestic	.79	.77

the pupils born 15 May. The coefficients are not particularly high, due mainly to the small number of items in each scale. This implies that caution must be observed when conclusions are to be made regarding the relations between these variables and relative achievement.

The intercorrelations between the variables are rather low. It is, perhaps, less surprising that the correlations are low between school adjustment and interest variables, than that the correlations are low also within these sets of variables. This is due partly to the fact that the aim was to obtain relatively specific and homogeneous variables, and during construction, items that correlated highly with more than one scale were rejected (Rovio-Johansson, 1966). To this must be added that the relatively low reliabilities contribute to reduce the intercorrelations.

Table 6:2. Intercorrelations of the measures of school adjustment and interest. Boys. (N=3045).

		2	3	4	5	6	7	8
Reaction to school	1. Further studies	.20	.22	.28	.00	.00	−.04	.08
	2. Security		.38	.14	.02	.10	−.03	−.04
	3. School work			.36	.15	.17	.14	.08
Area of interest	4. Verbal				.18	.16	.32	.28
	5. Technical					.16	.13	.14
	6. Outdoor						.11	.00
	7. Clerical							.39
	8. Domestic							

Table 6:3. Intercorrelations of the measures of school adjustment and interest. Girls. (N=2968).

		2	3	4	5	6	7	8
Reaction to school	1. Further studies	.22	.17	.23	.14	.08	−.17	−.05
	2. Security		.35	.12	.06	.06	−.10	−.06
	3. School work			.30	.14	.21	.13	.09
Area of interest	4. Verbal				.20	.22	.16	.21
	5. Technical					.26	.07	.15
	6. Outdoor						.05	.03
	7. Clerical							.40
	8. Domestic							

School adjustment and spare time interests among boys and girls with different home backgrounds

Appendix 4 reports the means and standard deviations of the different adjustment and interest variables for boys and girls with different home backgrounds. It will be observed that the tables do not give the results for all the 6144 pupils, but since drop-outs amount to only about 2 per cent, they should not materially affect the results.

The information given in the appendix is condensed in Table 6:4, where the differences between the means for boys and girls in the eight variables are expressed in percentages of the standard deviations common to both sexes. The differences between boys and girls with different home backgrounds have, in the same way, been related to the standard deviations for each sex.

The differences are comparatively small between boys and girls in the three adjustment scales. The boys, however, seem to feel greater security at school, but have a slightly less positive attitude towards school work itself.

The great sex differences are confined to the interest variables. The boys are higher in respect of outdoor and technical interests, while the girls are higher in verbal, clerical and domestic interests. The greatest sex differences are found in technical and domestic interests. Only 4 per cent of the girls are above the average for boys in technical interests, and only 9 per cent of the boys are above the girls' average in domestic interests.

The greatest differences between groups 1 and 3 are in the first scale, in that children of highly-educated parents have far more positive attitudes towards further education. In the second scale, too, pupils from group 1 have higher values than others, while interest in homework, etc. (scale 3), seems to be independent of parents' education.

The relations between parents' level of education and pupils' spare time interest are usually weak. Girls in group 1 however, seem to be little interested in clerical and domestic activities, and verbal interest is relatively low among boys in group 3.

Within group 3, too, the greatest differences are found in scale 1, where subgroup 3:1 has the most favourable attitude towards higher education. This implies that the views expressed in subgroup 3:1 differ less from those in groups 1 and 2 than is the case among the other pupils in group 3. This tendency is valid not only for scale 1, but is found in most of the adjustment and interest variables. Both boys and girls in rural areas were also found to be rather more interested in school work, and boys there are more interested in technical and outdoor activities.

To sum up, it may be said that sex differences are relatively small in attitudes towards school, but very great in respect of activities outside the school. Home background, on the other hand, seems to have very little effect

Table 6:4. School adjustment and interests in relation to sex and background level.

Background level	School adjustment 1		2		3	
	Boys	Girls	Boys	Girls	Boys	Girls
	+ 4	− 4	+14	−14	− 8	+ 8
1	+52	+47	+19	+25	− 5	− 9
2	+27	+32	+ 3	+ 8	+ 3	− 5
3	−16	−17	− 5	− 7	0	+ 4
3:1	+ 7	− 5	+12	+ 8	+ 2	−12
3:2	−27	−10	0	− 5	+ 4	+16
3:3	−16	−15	−11	−11	−13	− 5
3:4	−24	−29	−10	−11	+ 9	+12

Background level	Spare time interests Ve		Te		Ou		Cl		Do	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
	−40	+41	+72	−73	+28	−29	−27	+27	−60	+61
1	+11	+ 6	− 3	+16	−17	− 9	−14	−45	+11	−17
2	+16	+ 6	− 5	+ 6	− 6	− 5	+ 1	−18	+ 4	− 7
3	− 6	− 2	+ 2	− 4	+ 6	+ 3	+ 3	+14	− 3	+ 6
3:1	+ 8	− 1	−11	− 7	− 5	− 5	+ 3	+ 7	+ 4	− 9
3:2	−14	0	+11	0	+15	+12	−12	+ 1	−17	+ 6
3:3	− 5	− 2	− 4	− 5	− 1	0	+11	+21	+ 1	+10
3:4	− 7	− 2	+11	− 5	+13	+ 4	+ 4	+20	− 2	+12

on spare time interests, but is of great importance for attitude towards higher education. The results are not particularly sensational, but are in good agreement with earlier research results. A report of these and a more detailed analysis of the measures used here may be found in Rovio-Johansson (MS).

CHAPTER 7

PROBLEMS AND DESIGN

After the long but necessary description of the variables, an account will now be given of the problems and the design of the investigation. The aim must be regarded as diagnostic, but methods will be used that have been used more frequently in predictive studies.

Problems

The most important problem of the investigation may be formulated as follows: *How is relative achievement associated with sex and home background?* This problem is specified in the points below:

1. What differences are there in relative achievement between pupils with different home backgrounds?
2. Is home background of equal importance for boys and girls?
3. How great is the importance of sex in relation to home background?
4. Do these variables differ in importance when relative achievement is estimated according to different models?
5. Are sex and home background of different importance for relative achievement in the verbal and quantitative domains?
6. How does relative achievement covary with home background and sex at different times and in different school systems?

The possibilities of answering these questions seem good. There are large and representative samples available, adequate measures of intelligence and achievement, and a relevant method which makes allowance for deficiencies in the precision of the instruments.

An attempt will also be made to answer the question: *What relations are there between different types of relative achievement and certain school adjustment and interest variables, when sex and home background are kept under control?*

The possibilities of answering this question are limited, however. Only the data referring to the comprehensive school in 1966 can be used, the school adjustment and interest measures leave much to be desired, and it will be necessary to use a method whose stringency is open to question. The results must therefore be regarded as tentative and preliminary.

The methods used in the first problem

DIFFERENCES BETWEEN PUPILS WITH DIFFERENT HOME BACKGROUNDS

To study how relative achievement is associated to home background, the pupils will be divided into groups 1, 2 and 3, group 3 being further divided into four subgroups: 3:1, 3:2, 3:3 and 3:4. With the help of the method of analysis of covariance, an attempt will be made to ascertain whether there are any differences between the groups on a certain achievement variable, when the results of the groups on a certain intelligence variable are kept constant. The method of analysis of covariance is described in detail in Kendall (1946), Walker & Lev (1953) and Lindquist (1956), and may be characterized briefly as follows:

The method implies an analysis of the variance around a regression line based on average within-groups correlation. The between-groups variance estimate is based on the variation of group means around this regression line, and the within-groups variance estimate on the variation of individual scores around the regression lines of the particular groups. Dividing the between-groups variance estimate by the within-groups variance estimate gives an F ratio, and if this is significant it means that not all groups can be described by the same regression line. This implies, in its turn, that there are significant differences between the groups on the criterion variable, in spite of the fact that attention was paid to differences in the control variable. In the cases where the F test gives significant results, this must be followed by t tests to find out if there are significant differences between all means. These t tests are made between so-called adjusted means, as described in greater detail on page 91.

In this investigation, however, it is not intended to t test all differences, but only those between the following groups:

a. 1 and 2, 1 and 3, 2 and 3,
b. 3:12 and 3:34,
c. 3:13 and 3:24,

where the sign 3 implies that a weighted average has been calculated for groups 3:1, 3:2, 3:3 and 3:4, the symbol 3:12 is a weighted average for the groups 3:1 and 3:2, etc.

This gives information on whether there are significant differences in relative achievement between pupils whose parents:

a. have different levels of education,
b. have only elementary school, but where the father is a white-collar worker or a manual worker,

c. have only elementary school, but where the pupil lives in a place which has or has not a senior secondary school.

In all tests the 1 per cent level will be taken to indicate statistical significance. In the t tests a two-tailed test is used, since in some cases the expected direction of the difference is uncertain.

If the method of analysis of covariance is to be used in a meaningful way, the slope of the regression lines must be the same for all groups. In all cases, tests will be made to ascertain whether this demand on regression homogeneity is satisfied. In respect of certain other assumptions valid for the method of analysis of covariance, linearity of regression, normality of distribution and homogeneity of variance, it is only assumed that they will be satisfied. The reasons for this are that it is much more difficult to study whether these demands are met, and it does not seem to be equally serious if they are not completely satisfied, and the data available do not suggest any great deviations from the stipulated demands (cf. Lindquist, 1956, p. 330; Edwards, 1960, p. 132).

As in most research in the sphere of the behavioural sciences, work must be done with fallible variables. This may give rise to serious errors in the use of the method of covariance, as has been pointed out by Härnqvist (1958 b, 1968), Lord (1960), Sjöberg (1969) and Berglund (1970). Errors of measurement in the criterion variable, however, do not cause very much trouble in this context, for:

> "The criterion variable may be fallibly or infallibly measured – no adjustment is required in either case, any more than it would be if there were no control variable, in which case a simple t test would be made, regardless" (Lord, *op.cit.*, p. 309).

The serious errors of measurement, on the other hand, are found in the control variable. They lead to an underestimation of the slope of the within-groups regression line, and cause systematic errors in both the expected means and in the F ratio. To overcome these deficiencies, Härnqvist (1968) has suggested a method of correction, implying the use of the true instead of the observed and fallible values in the control variable in the calculation of the expected means in the criterion variable. This correction is attained by dividing the within-groups regression by the within-groups reliability of the control variable. One effect of this will be that the slope of the regression line becomes steeper, and greater consideration must be paid in the prediction to the group differences in the control variable. This is the same as eliminating the underestimation of the influence of the control variable, which is a consequence of the unreliability in the variable. For a more detailed account see Appendix 5.

This correction method, which usually leads to reduced F ratios, will be

applied consistently. When these corrected F ratios are significant, the group differences to be studied will be t tested. This will provide information on whether there are any significant differences between the groups in the criterion variable, when consideration has been paid to the true differences in the control variable.

Allowing the F test to be followed by t tests gives rise to a problem that has caused much discussion. There is great lack of agreement regarding the determination of level of significance in the multiple comparisons with which we are concerned here. The reason for this is as follows: If a significance level of 0.01 is chosen and two means are compared, the risk is 1 to 100 that a true null-hypothesis will be rejected. In multiple comparisons the differences between several groups included in the same analysis are tested, and in each comparison the risk is 1 to 100 that a false positive will be found. The more differences tested, the greater will be the probability that a Type I error is made in one or another comparison. Disagreement is concerned with whether the risk should be taken of rejecting a true null-hypothesis once per 100 times in each comparison, or once per 100 times in each analysis. In the latter case, a lower significance level must be used in the individual comparisons, whereby the degree of reduction is determined by the number of groups included in the analysis. This mode of procedure has an enthusiastic advocate in Ryan (1959, 1962), while Wilson (1962) energetically maintains the opposite. Since Wilson's arguments seem more convincing, his recommendations will be followed here, which implies that the probability of Type I errors will be 1 to 100 in each of the comparisons. By determining in advance which comparisons are to be made, and not embarking on a blind search for significances, much of the criticism levelled by Ryan against this mode of procedure will be avoided.

INTERACTION BETWEEN SEX AND HOME BACKGROUND

If there is any interaction between sex and home background, i.e. if the difference between pupils with different home backgrounds varies in size for boys and girls, both F tests and t tests wil give information on this matter. All analyses of covariance will be made separately for boys and girls. If, in a certain analysis, a significant F ratio is obtained for only one sex, it is probably a sign that interaction exists. If, on the other hand, significant F ratios are obtained for both sexes, it must be ascertained whether the same group differences are significant for boys and girls. It may be, for example, that differences in parents' educational level are significant in the one case, and regional differences in the other. Here, too, one may speak of an interaction effect, since it is different background factors that are decisive.

SEX VERSUS HOME BACKGROUND

Which of the two variables, sex and home background, has the highest correlation with relative achievement may be ascertained in the following way: In all analyses, the differences between the adjusted total means of boys and girls will be tested for significance. Three outcomes may be expected:

a. No sex differences exist.
b. The sex differences are very great and the group with the lowest adjusted average in the one sex has higher values than the group with the highest value in the other sex.
c. The sex difference is significant, but certain groups among the "weaker sex" have higher adjusted averages than some groups in the other.

The first two outcomes are easy to interpret, but it will be more difficult to compare the importance of sex and home background respectively in the third case. To facilitate such comparisons, the differences between the adjusted means of the sexes will be placed in relation to the standard deviation of a regression line common to both sexes, and the adjusted mean of a particular group in relation to the standard deviation of the regression line valid for the sex to which the group belongs. In this way, we will get quite a good idea of the importance of sex in relation to the other background factors.

IMPORTANCE OF THE CHOICE OF MODEL

Three types of analysis of covariance will be performed in respect of what have been called here the external characteristics of the achievement and intelligence variables. First marks are used as criterion variable and intelligence test as control variable (Model A), then the criterion variable is changed and marks are replaced by achievement tests (Model B), and finally marks are again used as criterion variable but with achievement tests as control variable (Model C). As far as the differences in relative achievement between various background levels are concerned, the following results are feasible:

I. None of the models give any differences.
II. All models give differences.
III. Differences are present in A and B, but not in C. The differences in A can be largely attributed to the differences in B. Some groups have low marks in relation to their intelligence, which seems to be due to their difficulties in transforming their intelligence into good results on achievement tests. In relation to their achievement test results, however, they are awarded the marks that were expected.

IV. Differences are present in A and C, but not in B. As in point III, the differences in A may be attributed largely to differences in C.
V. There are differences in A, but not in B and C. The reason may be that there are only weak tendencies in the same direction in the later models as in Model A. The total effect of these tendencies may be the cause of the difference in A.
VI. No differences are present in A, but in both B and C. These differences have different signs, however, and are therefore not manifest in A.

The F tests will show which results may be obtained. If the F ratios are significant, the t tests will provide information on between which groups the differences are to be found. Since relative achievement is always expressed in the same way, while deviations of the means from the regression lines are related to the standard deviations around the lines, it is possible to make rather detailed comparisons between the three models.

VERBAL VERSUS QUANTITATIVE DOMAINS

Separate analyses will be made in the verbal and quantitative domains. Relative achievement will be estimated in each domain according to Models A, 8 and C, which means that the following analyses will be performed:

Domain	Model	Criterion variable	Control variable
Verbal	A	School marks: Swedish	Int.test.: Opposites
	B	Ach.test. : "	" : "
	C	School marks: "	Ach.test.: Swedish
Quantitative	A	School marks: Mathematics	Int.test.: Number series
	B	Ach.test. : "	" : "
	C	School marks: "	Ach.test.: Mathematics

We will now see whether there are any differences between the domains in respect of the size of the relationships and ascertain whether there is any interaction between domain and model, e.g. whether the differences between the educational groups are greater in one domain with Model B and less with Model C than in the other domain. In the first place, information can be obtained by studying the F ratios in the analyses. More detailed information can be obtained by comparing the size of the group differences when the same model is used in both domains.

DIFFERENCES BETWEEN YEAR GROUPS AND SCHOOL SYSTEMS RESPECTIVELY

In the analyses, the pupils will be divided according to both year group and school system, which implies that there will be possibilities of comparison, both between pupils who were in grade 6 in 1961 and 1966 respectively, and between pupils in elementary schools and comprehensive schools.

Of course, most attention will be paid to the pupils who were in the comprehensive school in 1966, and the principal purpose of these comparisons is to study how far this school system differs from the others in respect of the relations between background variables and relative achievement. When interpreting any differences that may be found, it must be observed that there are differences in the achievement measures both between 1961 and 1966, and between the elementary school and the comprehensive school in 1966.

The methods used in the second problem

The product-moment correlations between the individual deviations from the average within-groups regression lines and the individual scores on each of the eight measures of personality will be calculated. These calculations are made separately for boys and girls, which means that 96 correlation coefficients [8 (personality measures) x 3 (models) x 2 (domains) x 2 (sexes)] will be obtained. A study of the direction and size of these correlations will give information on which school adjustment and interest variables covary with relative achievement, what differences there are between different models as well as between different domains, and whether there are any differences between boys and girls.

After this, the boys and girls are divided into groups 1, 2, 3:1, 3:2, 3:3 and 3:4, then, within each group, the above-mentioned correlations are calculated, but with the difference that the discrepancy measures are now based on the variation of individual scores around the regression lines of the particular groups. Use will be made of the lines that intersect the respective groups mean, but whose slope is identical with that of the average within-groups regression line. This procedure will help us to discover whether the correlations between different measures of relative achievement and certain types of personality variables vary between pupil groups with different home backgrounds.

As suggested earlier, the correlations found must be interpreted with caution. This caution is necessary, partly because variables with low and in some cases unknown reliability are correlated. Thus, the reliabilities of the

measures of school adjustment and interest vary between .65 and .83 (p. 77), and the reliabilities of the measures of discrepancy are probably still lower in many cases. If Thorndike's method (1963, p. 8) is used to estimate the reliabilities of the discrepancies in Model B, they are approximately .70 in the verbal domain and .80 in the quantitative domain. Thorndike's method cannot be used in the other two models, for no reliability data are available for marks. It may be assumed, however, that the reliabilities are about the same or somewhat lower in Model A and much lower in Model C, since the high correlations between standardized achievement tests and marks have a reducing effect on the reliabilities of the discrepancies. It is true that in the present study regression lines corrected for unreliability in the control variable are used consistently, but it is doubtful whether greater precision is obtained in the measurements in this case. It is likely that this correction is of relatively little importance in this design.

Nor has it been possible to check whether all the assumptions for the use of product-moment correlations are satisfied. If, for example, nonlinear relationships occur between measures of discrepancy and personality, it means that the coefficients obtained give a misleading picture of the strength of the correlations.

Finally, I agree with Magnusson & Dunér (1967), who point out that the method applied here should be used only in the first, exploratory stage of an investigation, and that, in more detailed studies, such multivariate analyses should be used, as these authors recommend.

A few circumstances have been mentioned that probably have detrimental effects on the strength of the correlations. If, nevertheless, it is found that one or more of the school adjustment or interest variables reveal clear correlations with relative achievement, these variables will be subjected to a special scrutiny and a study will be made to ascertain whether differences in these variables can wholly or partly explain the differences in relative achievement between pupils with different backgrounds.

CHAPTER 8

RELATIVE ACHIEVEMENT, SEX, AND HOME BACKGROUND

This chapter deals with the relations between relative achievement, sex, and home background. This means that, with the help of the method of analysis of covariance, a study will be made to ascertain whether there are any differences in Swedish and mathematics between boys and girls with different home backgrounds, when consideration is paid to differences in the intelligence factors that are strongly related to achievement in these subjects. The method of correction suggested by Härnqvist (1968) will be used consistently throughout. The method and its consequences in the different stages of an analysis of covariance are described in detail in Appendix 5. To avoid burdening the account with too many tables, a large part of the statistical material is reported in appendix form. Thus, in Appendix 6, the absolute achievements of boys and girls are given, i.e. the group means of the marks and the standardized achievement tests before these are adjusted for differences in intelligence. The adjusted means and some other data from the analyses of covariance are reported in Appendix 7.

Relative achievement in the verbal domain

The first part of the chapter is devoted to an analysis of the relationships between relative achievement in the verbal domain and sex and home background respectively. In order to facilitate the reading of the tables, the schedule below reports the principles on which division into background levels was based.

	Background level					
	1	2	3:1	3:2	3:3	3:4
Parents' education	High	Medium	Low			
Father's occupation	–	–	*White collar, etc.*		*Manual worker*	
Municipality	–	–	Urban	Rural	Urban	Rural
Urban = Gymnasium available		Rural = Gymnasium not available				

To make the reader conversant with the methods, the results from the elementary school, 1961, are reported in rather great detail. The results from the experimental comprehensive school, 1961, the elementary school, 1966, and the comprehensive school, 1966, will be given more briefly. At the end of each section, the most important results will be summarized. In conjunction

with the comments on the results in the comprehensive school, 1966, a comparison will also be made between this and the other school systems.

REPORT OF THE RESULTS WITHIN DIFFERENT SCHOOL SYSTEMS

Elementary school 1961

In this section, the relations between relative achievement, sex, and background level in the elementary school in 1961 will be studied. We will begin with Model A and use the verbal intelligence test as control variable and marks for Swedish as criterion variable.

In the co-ordinate system below (Fig. 8:1), the within-groups regression line for each sex has been drawn. The lines intersect the total mean of each sex and give information on the average marks that may be expected from the true intelligence test results of the groups. In the co-ordinate system are also included the observed means reported in Appendix 6.

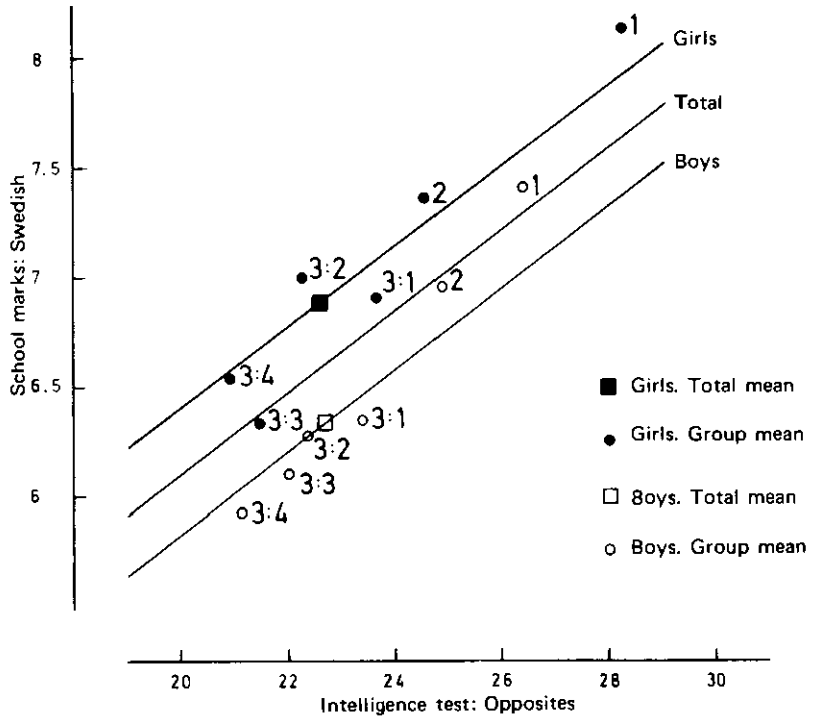


Fig. 8:1. The relation between observed and expected means in achievement, when the intelligence test Opposites is used as control variable, and marks for Swedish as criterion variable. Elementary school 1961.

If it is imagined that each observed mean is moved parallel to its within-groups regression line, until it intersects a vertical line passing through the respective total mean, the adjusted means for the groups will be obtained, i.e. the average marks the groups would have if there had been no differences in intelligence. The demand on regression homogeneity is satisfied for both boys and girls, which implies that the lines along which the means are "transported" may be regarded as parallel. This implies, in its turn, that the distances between the observed means and the respective regression line are identical with the distances between the adjusted means and the respective total mean. The adjusted group means will be found in Table VII:1 (Appendix 7). The differences between these means and the total mean of the respective sex are given in Table 8:1, where the differences are expressed in percentages of the standard deviation around the regression line for each sex. (The reporting technique is described in detail in Appendix 5.)

Table 8:1. Verbal achievement calculated according to Model A among pupils from different background levels. Elementary school 1961.

	Background level					
	1	2	3:1	3:2	3:3	3:4
Boys	+32	+18	−10	+ 1	− 8	−8
Girls	+22	+14	−15	+18	−30	−1

Table VII:1 shows that there are significant differences between the adjusted means among both boys and girls, which is the same as saying that there are significant differences between the percentages in Table 8:1. The group differences to be studied will therefore be t tested. Before doing this, the adjusted means will be calculated for the necessary combinations of groups 3:1 to 3:4. These means are not reported, but can be calculated easily from the values in Table VII:1.

Table 8:2. Comparisons between different background levels in verbal achievement: Model A. Elementary school 1961.

	Differences between educational groups			Differences within group 3	
				Occupational diff.	Regional diff.
	1–2	1–3	2–3	3:12–3:34	3:13–3:24
Boys	14	<u>38</u>	<u>24</u>	6	− 5
Girls	8	<u>26</u>	<u>18</u>	<u>21</u>	<u>−33</u>

Significant differences underscored

The results of the t tests are given in Table 8:2, which is to be interpreted as follows: There is, among the boys, a non-significant difference between groups 1 and 2 amounting to 14 per cent of the standard deviation around the within-groups regression line. Between groups 1 and 3 this difference increases to 38 per cent, which is a significant value, etc. The outcome of the t tests shows good agreement between the sexes in respect of the differences between groups 1, 2 and 3, while, on the other hand, significant differences in group 3 are found among girls only. The results obtained will be discussed further at the end of this section.

Before we leave this analysis, we must consider the relation between boys and girls. In Figure 8:1 there is, in addition to the regression line for each sex, a line for both sexes together. If the sex difference is expressed in the percentage of the standard deviation around this common line, the average for boys is 24 per cent below and that for girls 25 per cent above the line. This difference of almost half a unit of the standard deviation is very great in relation to the differences within the sexes, and significant, of course. As shown in Table VII:1, there are small differences between boys and girls in respect of both the standard deviations around the regression lines and the slopes of the lines, but rather correct information can be obtained about the position of a certain group in the total distribution around the common regression line by adding together the percentages for the group and the sex. If we return to Table 8:1 and reduce the values of the groups of boys by 24 units and increase those of the groups of girls by 25, it will be found that only group 1 among the boys is above and only group 3:3 among the girls is below the common line. This can also be seen in Figure 8:1.

In Figure 8:2 the criterion variable is changed and marks are replaced by the standardized achievement test, while the intelligence test is retained as control variable (Model B). Since the scale units of the axes are chosen so that the standard deviation will be the same in all distributions along the axes, the steeper slope of the regression line will provide information on the stronger correlation between the two variables in this analysis. As the correlation increases, the scope of the relative achievement declines, but at the same time the standard deviation around the regression line diminishes, too. Since the deviations of the groups are consistently related to this standard deviation, there seem to be possibilities to compare group deviations in the different analyses.

Table 8:3 shows the deviations of the individual means from the respective regression line. The deviations are expressed in the same way as in the previous analysis. As might be suspected after a study of Figure 8:2, no significant F ratio is obtained by the analysis of covariance between the groups of girls. For the sake of completeness, however, the differences between the groups will be reported for both boys and girls, in Table 8:4.

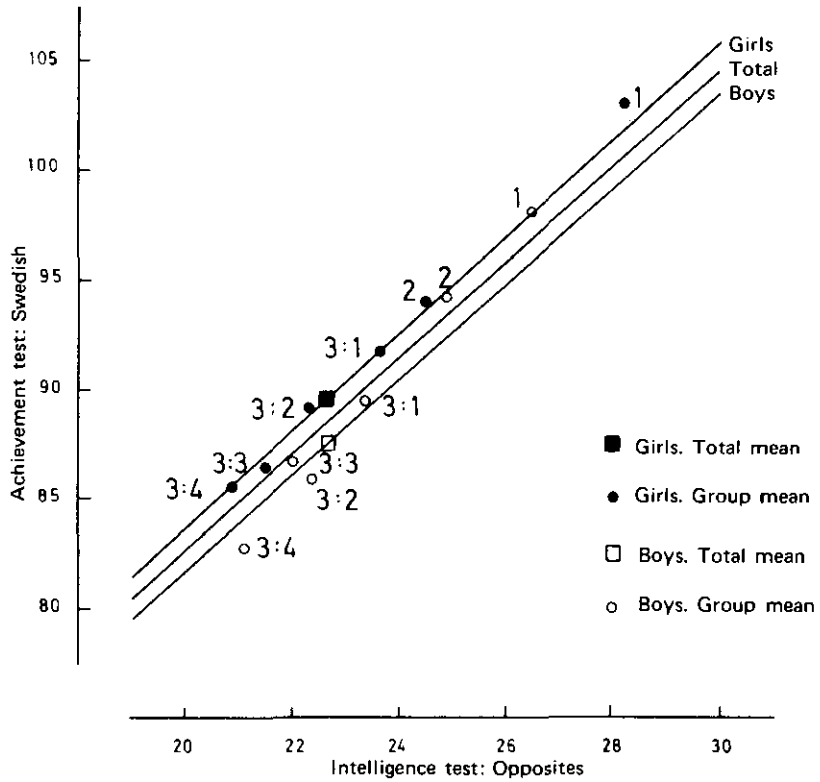


Fig. 8:2. The relation between observed and expected means in achievement, when the intelligence test Opposites is used as control variable, and standardized achievement test in Swedish as criterion variable. Elementary school 1961.

Among the boys, the t tests give a result similar to that of the previous analysis, except that in group 3 there is a significant difference in favour of the boys from urban areas.

Sex differences are smaller than when marks were used as criterion variable, but the girls' line is still above, and the boys' still below the common

Table 8:3. Verbal achievement calculated according to Model B among pupils from different background levels. Elementary school 1961.

	Background level					
	1	2	3:1	3:2	3:3	3:4
Boys	+24	+18	+ 4	−8	+ 7	−14
Girls	+15	+ 3	−2	+ 2	−8	− 2

Table 8:4. Comparisons between different background levels in verbal achievement: Model B. Elementary school 1961.

	Differences between educational groups			Differences within group 3. Occupational diff.	Regional diff.
	1–2	1–3	2–3	3:12–3:34	3:13–3:24
Boys	6	<u>29</u>	<u>23</u>	0	<u>17</u>
Girls	12	17	5	5	–6

Significant differences underscored

regression line (Fig. 8:2). In percentage of the standard deviation around the common regression line, the total mean for the girls is 12 per cent above and the total mean for the boys 12 per cent below the common line. This difference of 24 per cent is significant, but smaller than some differences between the groups of boys.

Now relative achievement will be studied according to Model C, which implies that marks will again be used as criterion variable, while the

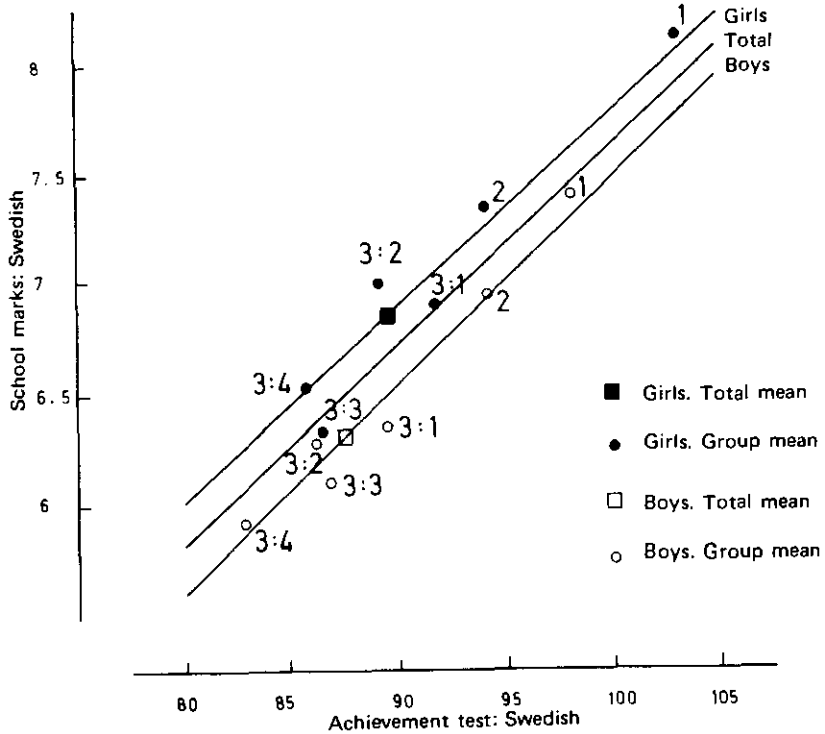


Fig. 8:3. The relation between observed and expected means in achievement, when the standardized achievement test in Swedish is used as control variable, and marks for Swedish as criterion variable. Elementary school 1961.

achievement test will be the control variable. The correlation between control and criterion variables increases further, but little of this can be discerned in the slopes of the regression lines (cf. Figs. 8:2 and 8:3), partly because the correlation increases by fewer units between Models B and C than between Models A and B, and partly because the slope increases at a diminishing rate when the correlation goes from 0 to 1.

In this analysis we are confronted with a difficulty; the demand for regression homogeneity is not satisfied for the girls. (Table VII:1.) The differences between the regressions of the particular groups are not, however, much greater than in, for example, Model A. That a significant value is obtained here is therefore probably due to the high correlation between the criterion and control variables, which gives rise to increased sensitiveness to regression fluctuations (cf. Svensson, 1964, p. 48). The lack of parallelity between the regression lines of the groups of girls means, however, that the results of this analysis must be regarded with caution.

Table 8:5 gives the deviations of the individual groups from the respective regression line, and in Table 8:6 pupils with different home backgrounds are compared. The differences between the educational groups are relatively small in comparison with the differences within group 3, where a great regional difference is especially noticeable. Sex difference increases again, and the average for girls is 23 per cent above and for boys 22 per cent below the common regression line.

Table 8:5. Verbal achievement calculated in accordance with Model C among pupils from different background levels. Elementary school 1961.

	Background level					
	1	2	3:1	3:2	3:3	3:4
Boys	+14	+ 3	–21	+10	–19	+6
Girls	+ 8	+15	–21	+23	–32	+2

Table 8:6. Comparisons between different background levels in verbal achievement: Model C. Elementary school 1961.

	Differences between educational groups			Differences within group 3 Occupational diff.	Regional diff.
	1–2	1–3	2–3	3:12–3:34	3:13–3:24
Boys	11	16	5	5	<u>–28</u>
Girls	– 7	11	<u>18</u>	<u>22</u>	<u>–40</u>

Significant differences underscored

The results of the analyses in the elementary school, 1961, may be *summarized* as follows:

There are strong relations between sex and relative achievement, in that girls get higher marks than boys both when intelligence and achievement test scores are kept constant. They also get better scores on achievement tests than might be expected from their intelligence, but the sex difference is not so marked here.

The relationship between parents' level of education and relative achievement seems to be somewhat weaker, but children of parents with only elementary school (group 3) get, in relation to their intelligence, lower marks than other pupils. They also get relatively low scores on achievement tests, although significant differences are found among boys only. The results also suggest that they are awarded marks that are too low in relation to their scores on achievement tests, but in this case significant differences are found only among girls.

In group 3 there is, strictly speaking, no relation between father's occupation and relative achievement among boys. Daughters of manual workers, on the other hand, are awarded relatively low marks, regardless of whether intelligence or achievement test is used as control variable.

There is also, in group 3, some relation between place of residence and relative achievement, which is manifested in girls in rural areas being awarded rather high marks in relation to their scores on intelligence and achievement tests. The results are somewhat different for boys. Boys in urban areas get higher achievement test scores than might be expected from their intelligence, but are awarded lower marks than are justified by their scores on the achievement tests. These conflicting trends result in their getting about the marks expected from their intelligence test scores, and the regional difference between boys is insignificant when marks are adjusted for differences in intelligence.

Experimental comprehensive school 1961

In this and the following sections, the different details of the analyses are skipped. If this makes the account difficult to follow in any way, the reader is referred to the first section, for the same processing and reporting techniques will be used consistently. Further, the results of the three analyses will be given at the same time, after which comments will be made. Thus, Table 8:7 gives the deviations of the individual groups of boys and girls from the respective within-groups regression lines expressed in percentages of the standard deviations around these lines, and in Table 8:8 will be found comparisons between pupils with different home backgrounds. The differences between boys and girls expressed in percentages of the standard deviation around the common regression line is given in Table 8:9.

Table 8:7. Verbal achievement calculated according to Models A, B and C among pupils from different background levels. Experimental comprehensive school 1961.

Model		Background level					
		1	2	3:1	3:2	3:3	3:4
A	Boys	+34	+ 6	0	1	−14	−6
	Girls	+25	+ 9	−11	+30	−19	0
B	Boys	+27	+16	− 5	−13	− 8	−4
	Girls	+13	+ 6	− 4	+25	−11	−5
C	Boys	+15	−11	+ 4	+17	−11	−1
	Girls	+15	+ 4	−11	+19	−15	+8

Table 8:8. Comparisons between different background levels in verbal achievement: Models A, B and C. Experimental comprehensive school 1961.

Model		Differences between educational groups			Differences within group 3	
		1–2	1–3	2–3	Occupational diff. 3:12–3:34	Regional diff. 3:13–3:24
A	Boys	28	41	13	11	− 6
	Girls	16	31	15	17	−26
B	Boys	11	34	23	− 3	1
	Girls	7	16	9	16	−14
C	Boys	26	16	−10	17	−12
	Girls	11	18	7	6	−26

Significant differences underscored

Table 8:9. Comparisons between boys and girls in verbal achievement: Models A, B and C. Experimental comprehensive school 1961.

	Model		
	A	B	C
Boys	−22	−10	−21
Girls	+21	+10	+20
Boys-Girls	−43	−20	−41

Significant differences underscored

The results obtained in the experimental comprehensive school are very similar to those in the elementary school in 1961, and may be summarized briefly as follows:

The girls are superior to the boys in relative achievement, and this superiority is most marked when relative achievement is estimated according to Models A and C, i.e. when marks are used as criterion variable.

In general, children from group 1 have the highest and children from group 3 the lowest relative achievement. This tendency is strongest in Model A and more pronounced among boys than among girls. There are, however, great differences within group 3, and group 3:2 has, in several cases, higher values than groups 1 and 2.

The differences are rather small within group 3 between children of white-collar workers and manual workers, but, as a rule, the former have somewhat higher values. In the same way, children from rural areas have higher relative achievement, but significant differences are found only among girls.

Elementary school 1966

The relations between relative achievement and different background variables in the elementary school in 1966 are reported in the same way as in the previous section. In Table 8:10 are given the deviations of the individual groups from the respective regression lines, and in Table 8:11 pupils with different home backgrounds are compared. Finally, in Table 8:12, the differences between boys and girls are reported.

Table 8:10. Verbal achievement calculated accordning to Models A, B and C among pupils from different background levels. Elementary school 1966.

Model		Background level					
		1	2	3:1	3:2	3:3	3:4
A	Boys	+44	+25	−25	+12	−16	−17
	Girls	+31	+14	−23	+15	−46	− 6
B	Boys	+20	+18	−25	+ 7	0	−12
	Girls	+25	+13	+ 2	+ 9	−23	−12
C	Boys	+43	+16	− 7	+ 8	−23	−11
	Girls	+18	+ 7	−33	+11	−39	+ 3

Table 8:11. Comparisons between different background levels in verbal achievement: Models A, B and C. Elementary school 1966.

Model		Differences between educational groups			Differences within group 3	
					Occupational diff.	Regional diff.
		1–2	1–3	2–3	3:12–3:34	3:13–3:24
A	Boys	19	51	32	22	−16
	Girls	17	37	20	23	−41
B	Boys	2	23	21	10	− 5
	Girls	12	30	18	23	−11
C	Boys	27	49	22	19	−16
	Girls	11	21	10	9	−44

Significant differences underscored

Table 8:12. Comparisons between boys and girls in verbal achievement: Models A, B and C. Elementary school 1966.

	Model		
	A	B	C
Boys	−36	−24	−24
Girls	+ 34	+ 22	+ 23
Boys-Girls	−70	−46	−47

Significant differences underscored

From Table 8:11 it will be seen that there are some rather great differences, which do not give significant values. This is because some of the groups in this school system are small, and great differences are required between the groups before they become significantly separated. In spite of the small size of the groups, the results are usually in good agreement with those reported earlier. The following is of special interest:

The girls are still superior to the boys and this superiority has increased rather than decreased.

The differences between educational groups, too, are at least as great as earlier, and the boys in group 3 in particular seem to find it difficult to do well in school. There are no significant differences, however, when achievement tests are used as criterion variable.

Among both boys and girls, the children of white-collar workers have higher values than those of manual workers. It is only in Model A that the differences are significant, but the tendency is the same in the other models, too. Children from rural areas have relatively good results, and here again, this is most pronounced for the girls and in the models in which marks are used as criterion variable.

Comprehensive school 1966

We will now consider the comprehensive school, 1966, the school system of special interest, since it will be established in the whole of Sweden during the early years of the 1970's. The results are given below in tables, and in the next section they will be discussed and compared with the results obtained in other school systems.

Table 8:13. Verbal achievement calculated according to Models A, B and C among pupils from different background levels. Comprehensive school 1966.

Model		Background level					
		1	2	3:1	3:2	3:3	3:4
A	Boys	+18	+ 7	− 7	+ 7	−14	− 2
	Girls	+23	+ 3	−12	+14	−13	− 7
B	Boys	+ 6	+ 4	− 4	+ 1	− 3	− 2
	Girls	+10	+ 4	− 9	+ 6	− 6	− 4
C	Boys	+15	+ 4	− 7	+ 9	−15	+ 2
	Girls	+18	− 1	− 8	+12	−10	− 5

Table 8:14. Comparisons between different background levels in verbal achievement: Models A, B and C. Comprehensive school 1966.

Model		Differences between educational groups			Differences within group 3	
		1–2	1–3	2–3	Occupational diff. 3:12–3:34	Regional diff. 3:13–3:24
A	Boys	11	23	12	8	−13
	Girls	20	28	8	12	−14
B	Boys	2	8	,6	1	− 2
	Girls	6	13	7	4	− 7
C	Boys	11	19	8	8	−17
	Girls	19	22	3	11	−12

Significant differences underscored

Table 8:15. Comparisons between boys and girls in verbal achievement: Models A, B and C. Comprehensive school 1966.

	Model		
	A	B	C
Boys	−28	−18	−21
Girls	+ 28	+ 18	+ 21
Boys-Girls	−56	−36	−42

Significant differences underscored

COMPARISONS BETWEEN THE COMPREHENSIVE SCHOOL AND THE OTHER SCHOOL SYSTEMS

Differences between boys and girls

The girls in the comprehensive school in 1966 were far superior to the boys in relative achievement in the verbal domain, and their superiority can be seen clearly in all the models used to estimate relative achievement. Thus, they have higher scores on achievement tests than could be expected from their intelligence, after which they are awarded higher marks than justified by these, in themselves, very high achievement scores. These two co-operating trends cause girls to get clearly higher marks than boys when intelligence results are kept constant. The average difference between boys and girls is, in the last case, about half the standard deviation around the common regression line, which means that girls on the same level of intelligence as boys are given marks for Swedish approximately 0.4 units higher than those awarded to boys.

The results obtained are by no means restricted to pupils of the comprehensive school in 1966, but are in good agreement with those found among pupils studied five years earlier, and among pupils studied at the same time, but in another type of school.

Differences between groups 1, 2 and 3

Parents' education seems to be less decisive for relative achievement within the verbal domain than pupils' sex. In the comprehensive school, the differences between the educational groups are smaller than the differences between the sexes, and in all models the weakest group of girls has higher relative achievement than the best group of boys. The results are in the same direction in the other school systems, even though the best group of boys sometimes has, on a few occasions, higher values than the weakest group of girls.

Among both boys and girls, however, there are significant correlations between the pupils' relative achievement and parents' level of education. At the same level of intelligence, children from group 1 get higher marks than children from group 3. In the comprehensive school, this difference is about half as great as the difference between boys and girls, and seems to be due to the fact that pupils in group 1 are awarded higher marks than might be expected from their scores on achievement tests. On the other hand, the differences between the groups in achievement test scores are small and non-significant with intelligence kept constant.

The results for girls do not differ much between school systems, even though the differences are somewhat greater in 1966 in Model C. Among boys, on the other hand, relatively great changes can be observed, especially in comparison with the 1961 sample. In the comprehensive school, 1966, the differences in marks, with intelligence kept constant, are somewhat smaller among boys than among girls, while the opposite was the case five years previously. This is because the differences between the groups of boys declined very much when relative achievement was estimated according to Model B, which also caused reduced differences in Model A.

Why, then, have the differences in relative achievement, estimated according to Model B, declined between the groups of boys? Has group 3 succeeded in improving its relative achievement, or has group 1 lowered its? It is difficult to answer this question, but the latter interpretation seems more correct, for, at the same time as the differences declined between the groups of boys, the difference between boys and girls increased. Thus, the girls were more superior in relative achievement in 1966 than in 1961, which suggests that the boys in group 1 had become closer to the boys in group 3, and not vice versa, in respect of ability to transform verbal intelligence into verbal achievement.

What do the reduced differences in relative achievement among boys imply? Does it mean that the differences in *absolute* scores on standardized achievement tests – i.e. the scores which the pupils really obtain, and which are not adjusted for differences in verbal intelligence – have declined, too? The answer is "yes", for the three groups increased approximately equally in verbal intelligence (p. 73), and the differences in intelligence were consequently about the same in 1966 and 1961. (If we express the differences between groups 1 and 3 in *absolute* achievement scores, in percentages of the standard deviation in the relevant achievement test, they would be approximately 0.8 units in 1961 and 0.7 in 1966.)

Among girls, too, the difference in *absolute* achievement test scores declined between groups 1 and 3 during the five-year period. But the cause of this seems to be a different one here. The difference in relative achievement in Model B was about the same in 1966 as in 1961, but due to the fact that only group 3 increased in verbal intelligence, the differences in absolute achievement scores declined.

Thus, among boys, the differences in absolute scores on achievement tests have declined between groups 1 and 3, due to the fact that differences in relative achievement declined at the same time as differences in intelligence remained the same, while the reduced differences among girls were caused by smaller differences in intelligence and unaltered differences in relative achievement.

Differences within group 3

Among children of parents with only an elementary school education, those of manual workers have somewhat lower relative achievement than others. No significant differences can be discerned in the comprehensive school for either sex in any of the models. The tendency is the same as in the other school systems, although the differences there may sometimes reach significant values.

The regional differences within this educational group are small in respect of achievement test scores with intelligence kept constant. This result, too, is in good agreement with earlier ones, and in only one case is there a significant difference; in the elementary school in 1961, boys living in a place with a gymnasium had higher scores on achievement tests than other boys. The other, non-significant results do not support this in any way, however, and it is justifiable to conclude that a senior secondary school near the home seems to have little effect on relative achievement in grade 6.

Thus, the regional differences are unimportant when relative achievement is measured according to Model B. There are, however, clear differences when the other two models are used. The cause of this is that pupils in rural areas get higher marks than the other pupils in group 3, when differences in achievement test results are taken into consideration. These differences are approximately as large – or as small – in the comprehensive school in 1966 as in the other school systems as far as boys are concerned, while they have declined greatly among girls.

Generosity in the teachers' marking in rural areas is, as mentioned earlier, not unexpected, and is probably due to several collaborating factors. Among other things, the possibility cannot be ignored that many teachers try to get a normal distribution around the national average *within* the class, and since "objective abilities", expressed in the form of achievement and intelligence test results are somewhat lower in rural areas, it is consequently easier to obtain high marks there. That the differences were smaller in the comprehensive school in 1966 is probably due to the increased information on the principles of relative marking. If this criterion heterogeneity had not been present in the marks, the differences between the educational groups would probably have been somewhat greater in Models A and C, since groups 1 and 2 are under-represented in rural areas.

Relative achievement in the quantitative domain

An account will now be given of how relative achievement is associated with sex and home background in the quantitative domain. The same techniques of processing and reporting are used as earlier, but to avoid making the

account too long, the relations in all school systems will be given first, before the results are discussed.

REPORT OF THE RESULTS IN DIFFERENT SCHOOL SYSTEMS

The first three tables give the results from the elementary school in 1961. Table 8:16 reports the deviations of the individual groups of boys and girls from their regression lines expressed in percentages of the standard deviation around these lines. In Table 8:17 will be found the differences between the groups, and Table 8:18 gives the differences between boys and girls, expressed as percentages of the standard deviation around the common regression lines. Corresponding data for the experimental comprehensive school (1961) are given in Tables 8:19–8:21, for the elementary school (1966) in Tables 8:22–8:24, and for the comprehensive school (1966) in Tables 8:25–8:27. For a more detailed account of regressions, F ratios, etc., see Appendices 6 and 7.

Table 8:16. Quantitative achievement calculated according to Models A, B and C among pupils from different background levels. Elementary school 1961.

Model		Background level					
		1	2	3:1	3:2	3:3	3:4
A	Boys	+35	+27	− 6	+ 2	−22	− 6
	Girls	+49	+13	+ 1	+ 9	−27	− 9
B	Boys	+32	+33	+ 8	− 7	− 6	−16
	Girls	+50	+ 3	+18	− 3	−14	−11
C	Boys	+ 7	− 6	−22	+13	−28	+15
	Girls	+ 3	+14	−27	+21	−24	+ 2

Table 8:17. Comparisons between different background levels in quantitative achievement: Models A, B and C. Elementary school 1961.

Model		Differences between educational groups			Differences within group 3. Occupational diff.	Regional diff.
		1–2	1–3	2–3	3:12–3:34	3:13–3:24
A	Boys	8	42	34	13	−15
	Girls	36	56	20	23	−17
B	Boys	− 1	40	41	10	10
	Girls	47	56	9	15	4
C	Boys	13	7	− 6	6	−40
	Girls	−11	5	16	15	−36

Significant differences underscored

Table 8:18. Comparisons between boys and girls in quantitative achievement: Models A, B and C. Elementary school 1961.

	Model A	Model B	Model C
Boys	− 5	+ 8	−21
Girls	+ 5	− 8	+21
Boys-Girls	−10	+16	−42

Significant differences underscored

Table 8:19. Quantitative achievement calculated according to Models A, B and C among pupils from different background levels. Experimental comprehensive school 1961.

Model		Background level					
		1	2	3:1	3:2	3:3	3:4
A	Boys	+41	+ 9	+ 3	+10	−17	−19
	Girls	+25	+ 3	− 8	+37	−19	− 2
B	Boys	+37	+16	+ 8	− 7	− 7	−28
	Girls	+31	+ 9	+ 1	+17	−10	−19
C	Boys	+ 6	−14	− 9	+35	−18	+18
	Girls	− 6	− 9	−14	+35	−16	+24

Table 8:20. Comparisons between different background levels in quantitative achievement: Models A, B and C. Experimental comprehensive school 1961.

Model		Differences between educational groups			Differences within group 3. Occupational diff.	Regional diff.
		1–2	1–3	2–3	3:12–3:34	3:13–3:24
A	Boys	32	50	18	24	− 3
	Girls	22	30	8	22	−26
B	Boys	21	46	25	16	17
	Girls	22	38	16	21	1
C	Boys	20	4	−16	15	−40
	Girls	3	− 8	−11	5	−43

Significant differences underscored

Table 8:21. Comparisons between boys and girls in quantitative achievement: Models A, B and C. Experimental comprehensive school 1961.

	Model A	B	C
Boys	− 8	+ 4	−21
Girls	+ 8	− 4	+21
Boys-Girls	−16	+ 8	−42

Significant differences underscored

Table 8:22. Quantitative achievement calculated according to Models A, B and C among pupils from different background levels. Elementary school 1966.

Model		Background level 1	2	3:1	3:2	3:3	3:4
A	Boys	+70	+14	+ 3	+ 2	−20	−13
	Girls	+45	+16	−13	+ 3	−14	−13
B	Boys	+41	+15	+ 3	+ 6	−20	−12
	Girls	+40	+ 5	− 8	+ 2	−15	− 8
C	Boys	+57	+ 3	+ 1	− 6	− 5	− 6
	Girls	+18	+19	−10	+ 1	− 3	−10

Table 8:23. Comparisons between different background levels in quantitative achievement: Models A, B and C. Elementary school 1961.

Model		Differences between educational groups 1–2	1–3	2–3	Differences within group 3 Occupational diff. 3:12–3:34	Regional diff. 3:13–3:24
A	Boys	56	77	21	17	− 6
	Girls	29	52	23	13	− 8
B	Boys	26	47	21	19	− 8
	Girls	35	45	10	10	− 9
C	Boys	54	62	8	1	3
	Girls	− 1	23	24	7	− 1

Significant differences underscored

Table 8:24. Comparions between boys and girls in quantitative achievement: Models A, B and C. Elementary school 1966.

	Model A	B	C
Boys	−10	+ 4	−19
Girls	+ 9	− 3	+18
Boys-Girls	−19	+ 7	−37

Significant differences underscored

Table 8:25. Quantitative acievement calculated according to Models A, B and C among pupils from different background levels. Comprehensive school 1966.

Model		Background level 1	2	3:1	3:2	3:3	3:4
A	Boys	+43	+ 9	+ 2	+ 1	−18	−16
	Girls	+34	+ 9	− 4	0	−16	−11
B	Boys	+46	+12	+ 2	− 7	−14	−19
	Girls	+34	+11	− 4	− 7	−12	−12
C	Boys	+ 4	− 2	0	11	−10	2
	Girls	+ 8	0	− 2	10	− 9	− 2

Table 8:26. Comparisons between different background levels in quantitative achievement: Models A, B and C. Comprehensive school 1966.

Model		Differences between educational groups 1–2	1–3	2–3	Differences within group 3 Occupational diff. 3:12–3:34	Regional diff. 3:13–3:24
A	Boys	34	54	20	19	− 1
	Girls	25	43	18	12	− 5
B	Boys	34	58	23	14	5
	Girls	23	44	21	6	1
C	Boys	6	4	− 2	10	−12
	Girls	8	10	2	11	−10

Significant differences underscored

Table 8:27. Comparisons between boys and girls in quantitative achievement: Models A, B and C. Comprehensive school 1966.

	Model A	Model B	Model C
Boys	− 2	+ 8	−16
Girls	+ 3	− 8	+16
Boys-Girls	− 5	+16	−32

Significant differences underscored

COMPARISONS BETWEEN THE COMPREHENSIVE SCHOOL AND THE OTHER SCHOOL SYSTEMS

First the most important results obtained in the comprehensive school in 1966 will be reported, after which they will be compared with results obtained in the other school systems.

Differences between boys and girls

One thing must be borne in mind; it is difficult to make any general statements about sex differences in relative achievement within the quantitative domain, since the size and direction of the sex differences are dependent on the model used to estimate this achievement. In the comprehensive school (1966), the boys have higher scores on achievement tests than could be expected from their intelligence test results. On the other hand, girls have higher marks than could be expected from their scores on achievement tests. The latter tendency is stronger, however, and the girls have somewhat higher marks when consideration is paid to intelligence test results. In the comprehensive school the difference is not significant in Model A, which it is in the other school systems, due principally to the somewhat greater differences in Model C.

Differences between groups 1, 2 and 3

While it is difficult to make any general statement about the sex differences, it is easy to make general comments on the differences between pupils with parents at different levels of education. In the comprehensive school, group 1 is clearly superior to group 2, which in its turn is distinctly superior to group 3, when relative achievement is estimated according to Model A. These

differences are found in both boys and girls, and seem to be due to differences in ability to transform intelligence into good achievement test results, for the same differences are found in Model B. On the other hand, the differences are consistently small and non-significant in Model C. The differences between groups 1 and 3 when Model A is used are about as great in this domain as the differences between boys and girls in the verbal domain, i.e. at the same level of intelligence, group 1 is 0.4 units of marks above group 3.

With a few exceptions, the results from the comprehensive school are confirmed, if the corresponding differences in the other school systems are studied, although the comprehensive school has the clearest pattern. The greatest deviations are found in the elementary school (1966), where relatively great differences can be discerned also in Model C. This may be because here most of the pupils in groups 1 and 2 are in rural areas, and it seems not unlikely that the generous marking in the country favours just these pupils.

Since the differences in standardized achievement test results, when intelligence is kept constant, were about the same between groups 1 and 3 in 1961 and 1966, the *absolute* differences in the scores on the achievement tests decreased among girls, but increased somewhat among boys. This is a consequence of the fact that the girls in group 3 increased more in intelligence than group 1, while the opposite is true of boys (p. 75).

Differences within group 3

Within group 3, children of manual workers have a lower relative achievement than other children. This is true of both girls and boys in all models and in all school systems. The differences are small, however, compared with the differences between groups 1 and 3, and more often non-significant rather than significant.

The regional differences in the comprehensive school, 1966, are very small in group 3, and there is only a slight tendency towards lower relative achievement in places with senior secondary schools. Within both school systems in 1961, on the other hand, a very great regional difference can be observed. With equal scores on achievement tests, boys and girls in rural areas were awarded much higher marks than other pupils. Thus the regional differences in marks have declined very distinctly, which was also found in the verbal domain, although to a much smaller extent. As mentioned earlier, this is probably because of increased knowledge of the function of standardized achievement tests, manifested in the teachers' allowing the level of marks within the class to be determined by the achievement test level of

the class. On the other hand, the teacher has the possibility, and, indeed, also the duty, of adjusting marks within the class, and this has a reducing effect on the correlation between achievement tests and marks. It is said very clearly that, when marks are being awarded, consideration must be paid to other school performances than those expressed in standardized test scores (Marklund *et al.*, 1968, pp. 52–53). As shown by the results, the girls usually win and the boys lose in this further estimate of achievement.

Summary

We have found that both sex and home background are of great importance for the pupils' relative achievement, but that the importance of these factors varies, owing to the domain of subjects studied and the model according to which the relative achievement is estimated. On the other hand, the relation between relative achievement, sex, and home background seems to be rather insensitive to the changes in school systems, etc., in Sweden during the 1960's.

A summarizing survey of the results in different school systems is given in Tables 8:28–8:30. In Table 8:28 are given all the significant sex differences in relative achievement. If the significance is in favour of the boys, it is marked +, if in favour of girls, it is marked –, and when there is no significant difference, no sign is used. The significant differences in relative achievement between pupils with different home backgrounds are shown in the same way in Tables 8:29 and 8:30, the differences within the verbal domain being shown in the former and those within the quantitative domain in the latter table.

Table 8:28. A survey of the significant sex differences in relative achievement.

Model	Year	School	Verbal achievement Boys – Girls	Quantitative achievement Boys – Girls
A	1961	E.S.	–	–
		E.C.S.	–	–
	1966	E.S.	–	–
		C.S.	–	
B	1961	E.S.	–	+
		E.C.S.	–	
	1966	E.S.	–	
		C.S.	–	+
C	1961	E.S.	–	–
		E.C.S.	–	–
	1966	E.S.	–	–
		C.S.	–	–

It will be seen from the tables that agreement is good between the elementary school and the experimental comprehensive school in 1961, and between the elementary school and the comprehensive school in 1966. Agreement is also relatively good between the two year groups, and the few differences found between pupils in grade 6 in 1961 and 1966 seem to be due primarily to somewhat stricter marking since the comprehensive school was introduced into rural areas, and that boys in groups 1 and 2 improved relatively more in the verbal abilities measured by intelligence tests, than in those measured by standardized achievement tests.

Before we begin considering the causes of the relations observed between different types of relative achievement and sex and home background respectively, the next chapter will report how relative achievement is associated with certain adjustment and interest variables.

Table 8:29. A survey of the significant differences in relative achievement within the verbal domain between different background levels.

Sex	Model	Year	School	Differences between educational groups 1–2	1–3	2–3	Differences within group 3 Occupational diff. 3:12–3:34	Regional diff. 3:13–3:24
Boys	A	1961	E.S.		+	+		
			E.C.S.	+	+			
		1966	E.S.		+	+	+	
			C.S.		+			–
	B	1961	E.S.		+	+		+
			E.C.S.		+	+		
		1966	E.S.					
			C.S.					
	C	1961	E.S.					–
			E.C.S.				+	
		1966	E.S.		+			
			C.S.		+			–
Girls	A	1961	E.S.		+	+	+	–
			E.C.S.		+		+	–
		1966	E.S.		+		+	–
			C.S.	+	+			–
	B	1961	E.S.					
			E.C.S.					
		1966	E.S.					
			C.S.					
	C	1961	E.S.			+	+	–
			E.C.S.					–
		1966	E.S.					–
			C.S.	+	+			–

Table 8:30. A survey of the significant differences in relative achievement within the quantitative domain between different background levels.

Sex	Model	Year	School	Differences between educational groups 1–2	1–3	2–3	Differences within group 3 Occupational diff. 3:12–3:34	Regional diff. 3:13–3:24
Boys	A	1961	E.S.		+	+	+	–
			E.C.S.	+	+		+	
		1966	E.S.	+	+			
			C.S.	+	+	+	+	
	B	1961	E.S.		+	+		
			E.C.S.		+	+	+	+
		1966	E.S.		+			
			C.S.	+	+	+	+	
	C	1961	E.S.					–
			E.C.S.					–
		1966	E.S.	+	+			
			C.S.					
Girls	A	1961	E.S.	+	+	+	+	–
			E.C.S.		+		+	–
		1966	E.S.		+			
			C.S.	+	+	+		
	B	1961	E.S.	+	+		+	
			E.C.S.		+		+	
		1966	E.S.					
			C.S.	+	+	+		
	C	1961	E.S.			+	+	–
			E.C.S.					–
		1966	E.S.					
			C.S.					

CHAPTER 9

RELATIVE ACHIEVEMENT, SCHOOL ADJUSTMENT, AND SPARE TIME INTERESTS

This chapter reports the relations between different types of relative achievement and the adjustment and interest variables described in Chapter 6. As mentioned earlier, only data referring to pupils in the comprehensive school in 1966 can be used. First will be reported the relations between the measures of relative achievement and the various measures of school adjustment and interest, with the pupils divided according to sex only, and then divided according to both sex and home background.

The relationships between relative achievement and different personality variables among boys and girls

Table 9:1 gives the relations between the various personality measures and relative achievement in the verbal domain for all boys. Relative achievement is estimated according to Models A, B and C. The relations are expressed in the form of correlations between the individual deviations from the respective within-groups regression line and the individual scores on each of the eight measures of school adjustment or spare time interests. Significant correlations ($p<.01$) are underlined.

Table 9:1. Correlations between personality measures and relative achievement within the verbal domain. Boys (N= 3045).

Model	School adjustment			Interest				
	1	2	3	Ve	Te	Ou	Cl	Do
A	.16	.17	.12	.13	–.07	.01	–.02	–.04
B	.10	.12	.05	.11	–.04	.00	–.02	–.02
C	.08	.09	.11	.06	–.05	.02	.01	–.04

Significant values underscored

It will be seen from the table that the correlations are all low, but that there are, nevertheless, significant correlations between all the measures of school adjustment and all the measures of relative achievement. If we first study scale 1, we find a significant and positive correlation of .16 between this scale and relative achievement estimated according to Model A. This means that boys with high scores on scale 1 tend to be above the regression line, when intelligence test Opposites is used as control variable and marks for

Swedish as criterion variable. This implies, in its turn, that boys with positive attitudes to further education get higher marks than might be expected from their intelligence, while the opposite is valid for boys with less positive attitudes. This trend, a weak one, is a consequence of two still weaker but statistically significant trends. The "study-ambitious" boys get somewhat higher scores on achievement tests than might be expected from their results on intelligence tests (r=.10), after which they are awarded somewhat higher marks than are really justified by their scores on achievement tests (r=.08).

The same pattern is also found in scale 2; the better the adjustment and the greater the confidence of boys in their school situation, the higher their relative achievement will be, and this is most marked when relative achievement is estimated according to Model A. In the same way, pupils interested in school work – high values on scale 3 – tend to be relatively successful at school, although the tendency is very weak in Model B.

Measures of interest usually reveal lower correlations than adjustment measures, and most of the correlations are non-significant. A consistent pattern can be discerned, however, in that boys with high verbal interests are awarded higher marks for Swedish with verbal ability kept constant than boys with low verbal interests.

The correlations calculated on the basis of the girls' results agree almost perfectly with those of the boys (Table 9:2). It will be observed, however, that scale 3 has lower correlations with all measures of relative achievement.

Table 9:2. Correlations between personality measures and relative achievement within the verbal domain. Girls (N= 2968).

Model	School adjustment			Interest				
	1	2	3	Ve	Te	Ou	Cl	Do
A	.16	.17	.06	.12	.00	.03	−.04	−.02
B	.11	.11	.00	.10	.04	.02	−.02	.00
C	.08	.10	.08	.06	−.04	.03	−.02	−.01

Significant values underscored

Within the quantitative domain there are fewer but stronger relations between school adjustment and relative achievement (Tables 9:3 and 9:4). Among both boys and girls, scales 1 and 2 have higher correlations with relative achievement estimated according to Models A and B than they have with the corresponding models within the verbal domain. On the other hand, correlations are very low between these scales and marks for mathematics when scores on achievement tests are kept constant. Similarly, scale 3 shows consistently low and, for girls, only non-significant correlations.

All measures of interest correlate weakly with all measures of relative achievement in the quantitative domain. It will be observed, however, that there are weak but positive correlations between verbal interests and relative achievement in this field, too, and that technical interests are at least not of negative influence.

Table 9:3. Correlations between personality measures and relative achievement within the quantitative domain. Boys (N= 3045).

Model	School adjustment			Interest				
	1	2	3	Ve	Te	Ou	Cl	Do
A	.25	.20	.09	.05	.00	−.02	−.04	−.03
B	.24	.20	.07	.07	.00	−.02	−.03	−.01
C	.05	.04	.04	−.02	.01	.01	−.02	−.06

Significant values underscored

Table 9:4. Correlations between personality measures and relative achievement within the quantitative domain. Girls (N= 2968).

Model	School adjustment			Interest				
	1	2	3	Ve	Te	Ou	Cl	Do
A	.23	.21	.02	.08	.01	−.02	−.09	−.04
B	.25	.20	.03	.08	.02	.01	−.09	−.02
C	.03	.05	.00	.03	.01	−.03	.00	−.01

Significant values underscored

The relationships between relative achievement and different personality variables among pupils with different home backgrounds

Are the relations or lack of relations mentioned above valid for all social strata, for only certain strata, or will the picture be quite different when pupils' home backgrounds are taken into consideration? This question will be answered by calculating the correlations between the personality measures and relative achievement within groups 1, 2, 3:1, 3:2, 3:3 and 3:4. The estimations of relative achievement in this section, therefore, will be based on the regression lines of the individual groups of boys and girls. If the regression line for the particular group is above the average within-groups regression line, it means that some of the earlier positive differences are now negative, and the opposite is the case if it is below the average line.

Table 9:5 reports the correlations in the verbal domain for the different groups of boys, and Table 9:6 gives the corresponding data for girls. A quick scrutiny of the tables reveals that the correlations between the personality variables and the discrepancy measures vary rather moderately between the different groups, and that the correlations computed for all boys and girls respectively seem to be valid for the individual groups, too. Some tendencies in the tables must be observed, however.

Among both boys and girls, significant correlations are lacking in group 1 between scale 1 and relative achievement regardless of model used, but are, however, present in most of the other groups. This may be due partly to the very positive attitudes towards higher education in group 1, which makes it more difficult for the first scale to discriminate between pupils with high and low relative achievement in this group. Scale 2 shows significant and positive correlations in all groups, while the relatively few significances in scale 3 are found mainly in the groups of boys. This scale differs from the other two, in that it has not a single significant correlation when relative achievement is estimated according to Model B.

Table 9:5. Correlations between personality measures and relative achievement within the verbal domain among boys from different background levels.

Background level	Model	School adjustment			Interest				
		1	2	3	Ve	Te	Ou	CI	Do
1	A	.08	.20	.07	.13	−.03	−.02	−.01	−.12
(N= 421)	B	.05	.19	.05	.09	.00	−.04	−.01	−.05
	C	.05	.07	.05	.08	−.03	.02	.00	−.11
2	A	.16	.16	.17	.26	−.07	−.04	−.02	−.01
(N= 510)	B	.05	.15	.09	.20	.02	−.04	−.08	−.03
	C	.15	.05	.14	.16	−.11	.00	.05	.01
3:1	A	.14	.18	.21	.13	−.13	−.06	−.09	−.05
(N= 348)	B	.10	.12	.07	.10	−.12	−.11	−.08	.00
	C	.06	.11	.21	.06	−.06	.04	−.03	−.07
3:2	A	.11	.15	.05	.10	−.08	−.01	.01	.03
(N= 401)	B	.04	.09	.02	.06	−.09	−.01	−.03	.04
	C	.07	.10	.04	.05	−.01	−.01	.05	.01
3:3	A	.19	.20	.09	.05	−.09	.02	.03	−.06
(N= 670)	B	.14	.12	.01	.02	−.07	.05	.00	.01
	C	.09	.14	.11	.03	−.06	−.02	.05	−.10
3:4	A	.15	.11	.11	.13	−.07	.10	−.01	−.06
(N= 695)	B	.14	.08	.07	.15	−.03	.07	.00	−.07
	C	.03	.06	.07	.01	−.07	.07	−.02	−.01

Significant values underscored

Table 9:6. Correlations between personality measures and relative achievement within the verbal domain among girls from different background levels.

Background level	Model	School adjustment			Interest				
		1	2	3	Ve	Te	Ou	CI	Do
1	A	.10	.17	.02	.15	−.01	.04	.00	.03
(N= 409)	B	.11	.10	−.02	.12	.11	.01	−.01	.00
	C	.00	.10	.06	.06	−.14	.04	.02	.04
2	A	.13	.11	.03	.11	.04	.11	−.11	−.05
(N= 504)	B	.08	.04	.00	.07	.06	.02	−.03	−.01
	C	.08	.09	.05	.07	.00	.13	−.11	−.05
3:1	A	.13	.25	.14	.03	−.03	−.06	.03	−.06
(N= 335)	B	.10	.18	.02	.05	−.05	−.04	−.03	−.06
	C	.07	.15	.16	−.01	.00	−.04	.07	−.02
3:2	A	.17	.22	.07	.12	−.05	−.01	.00	−.08
(N= 429)	B	.13	.21	.05	.13	.00	.05	−.05	−.05
	C	.08	.08	.04	.03	−.06	−.06	.06	−.05
3:3	A	.21	.12	.07	.16	.04	.01	−.02	.01
(N= 653)	B	.15	.09	.00	.14	.06	.01	.00	.03
	C	.12	.07	.09	.08	−.01	.01	−.03	−.02
3:4	A	.10	.16	.04	.07	−.05	.04	−.01	.01
(N= 638)	B	.07	.09	−.01	.05	−.02	.01	−.01	.00
	C	.05	.12	.06	.03	−.05	.04	.01	.02

Significant values underscored

The measure of verbal interest has low but positive correlations with relative achievement in all groups. Other measures of interest have consistently low, most often negative and almost exclusively non-significant correlations.

In the quantitative domain, there are significant correlations between the first two scales and relative achievement estimated according to both Model A and Model B in practically all groups (Tables 9:7 and 9:8). With this, however, the significant correlations are almost entirely exhausted, for, in the first place, these scales have only few significant correlations, if Model C is used to estimate relative achievement, and in the second the other measures of personality have extremely few significant correlations. It might possibly be emphasized that scale 3 has consistently positive, and in some cases significant, correlations with relative achievement in the groups of boys.

Table 9:7. Correlations between personality measures and relative achievement within the quantitative domain among boys from different background levels.

Background level	Model	School adjustment			Interest				
		1	2	3	Ve	Te	Ou	Cl	Do
1	A	.13	.20	.08	−.05	.04	.03	−.01	−.05
(N= 421)	B	.09	.18	.04	.00	.02	.00	−.01	.01
	C	.09	.06	.07	−.08	.04	.05	−.01	−.09
2	A	.22	.23	.15	.11	.01	−.10	−.02	−.08
(N= 510)	B	.20	.27	.11	.13	−.02	−.16	.01	−.07
	C	.07	−.02	.09	.00	.04	.06	−.04	−.03
3:1	A	.14	.21	.08	−.02	−.01	−.11	−.05	−.07
(N= 348)	B	.17	.19	.03	.00	.01	−.08	−.03	−.01
	C	−.01	.08	.09	−.01	−.04	−.07	−.04	−.09
3:2	A	.27	.11	.04	.03	−.07	−.06	−.04	.02
(N= 401)	B	.24	.06	.03	.04	−.04	−.02	−.01	.04
	C	.05	.07	.02	−.02	−.04	−.05	−.05	−.03
3:3	A	.22	.23	.12	.02	.02	.03	−.02	−.02
(N= 670)	B	.23	.24	.13	.08	.05	.04	−.01	.05
	C	.02	.02	.00	−.08	−.04	.00	−.02	−.09
3:4	A	.26	.14	.06	.06	.00	.09	−.04	−.02
(N= 695)	B	.23	.14	.06	.03	−.02	.09	−.07	−.01
	C	.10	.03	.01	.05	.03	.02	.03	−.02

Significant values underscored

Table 9:8. Correlations between personality measures and relative achievement within the quantitative domain among girls from different background levels.

Background level	Model	School adjustment			Interest				
		1	2	3	Ve	Te	Ou	Cl	Do
1	A	.20	.32	−.05	.02	−.07	−.05	−.05	−.11
(N= 409)	B	.23	.28	−.05	.00	−.08	.01	−.08	−.10
	C	.02	.14	−.01	.04	.00	−.10	.03	−.04
2	A	.20	.17	.05	.09	.04	.02	−.04	.05
(N= 504)	B	.21	.17	.04	.07	.07	.00	−.09	.02
	C	.03	.03	.03	.04	−.03	.04	.05	.05
3:1	A	.23	.26	.08	.10	.03	.05	−.06	−.02
(N= 335)	B	.23	.19	.05	.05	.01	.01	−.11	.01
	C	.06	.15	.06	.09	.03	.07	.05	−.04
3:2	A	.27	.25	−.01	.10	.01	−.02	−.07	−.06
(N= 429)	B	.27	.26	.03	.15	−.02	.08	−.01	−.02
	C	.05	.02	−.06	−.05	.04	−.13	−.10	−.06
3:3	A	.16	.16	.02	.10	.01	−.12	−.04	.02
(N= 653)	B	.20	.19	.03	.06	.00	−.07	−.02	.01
	C	.00	.00	.01	.07	.02	−.08	−.02	.02
3:4	A	.20	.12	.06	.04	−.02	.05	−.07	−.05
(N= 638)	B	.23	.13	.08	.06	.01	.07	−.11	−.02
	C	.02	.03	−.01	−.01	−.04	−.01	.04	−.04

Significant values underscored

Comments

Two school adjustment variables – scales 1 and 2 – have been found that show low but positive correlations with relative achievement within the two domains of subjects, for both sexes and within, generally speaking, all groups. Pupils from families with positive attitudes towards higher education, who feel confident and well-adjusted in school, thus tend to succeed relatively well in both Swedish and mathematics, and this is true of both boys and girls with greatly differing home environments. The results, which seem rather plausible, imply that these school adjustment variables are of general importance, which may explain why, in many contexts, positive attitudes to education and confident conduct have been found to have a beneficial effect on relative achievement (Hummel & Sprinthall, 1965; Perkins, 1965; Raph *et al.*, 1966, pp. 28–36; Khan, 1969).

In most of the twelve groups, however, the two variables show somewhat higher correlations with relative achievement in the quantitative domain. This may probably be due to varying reliability in the measures of discrepancy, but previous research results suggest that a positive attitude towards school and a feeling of confidence in the school situation are of somewhat greater importance for achievement in mathematics than in languages. Thus, Frankel (1960) found that mathematics was the most popular subject among boys who were well adjusted in the school situation and who planned a long, theoretical education. They also considered that mathematics was a much easier subject than English. On the other hand, mathematics was considered to be both difficult and dull by boys who were relatively negatively inclined towards school and who had low marks in relation to their level of intelligence. Impellizzeri *et al.* (1965) also found that mathematics was by far the least popular subjects among underachievers of both sexes. Further, it

seems as if uncertain and insecure pupils find mathematics especially difficult. Pupils with poor marks in mathematics but good ones in other subjects often show distinct signs of anxiety (Magne, 1967, p. 132; cf. also Lang *et al.*, 1969).

Characteristic of both the adjustment variables considered hitherto is that they are of importance for both boys and girls and of somewhat more importance in the quantitative domain. The third school adjustment variable, too, is of some importance for relative achievement, but it shows lower and less general correlations. A positive attitude towards homework and other school activities thus seems to have a favourable influence on relative achievement, but this tendency is more marked among boys than among girls, and somewhat more distinct in the verbal domain. The results are supported to some extent by previous research, in that Wilson & Morrow (1965) report that overachieving boys have better study habits and take more care with their homework than underachieving boys, while Lum (1960) found only slight differences between over- and underachieving girls in these respects.

Of the interest variables, the verbal scale reveals consistently low but positive correlations with relative achievement within the verbal domain. This implies that pupils with marked verbal spare-time interests find it somewhat easier than others to absorb the linguistic knowledge included in the subject Swedish, even when verbal ability is kept under control. The results seem feasible, and are supported to some extent by Frankel (1960) and Carmical (1964), who found that overachieving pupils were rather more interested in literature than underachievers.

If reading books, writing letters and similar verbal activities are of some importance for relative achievement, technical, outdoor, clerical and domestic interests, on the other hand, seem to have no influence in this context. It may be surprising to find that pupils greatly interested in technical activities gain no advantage from them in respect of relative achievement in the quantitative domain. This may be because both theoretically and practically inclined activities are included in the technical interests scale. In earlier studies, it has been found that overachievers are more interested in reading technical periodicals, constructing machines and solving mathematical problems, while underachievers prefer to devote their time to woodwork, painting and mending things (Frankel, 1960; Carmical, 1964).

In conclusion it must be stressed that when it is said that certain personality traits are of importance for or have a favourable influence on relative achievement, it does not mean that these personality traits have caused the relatively good achievement. It is only said that the pupils characterized by these traits succeed better in school than other pupils, even when consideration is paid to intellectual ability. On the other hand, we do not know, for example, whether pupils' confidence in the school situation is

the determinant or the result of the relatively good school performances. In any case, it is probably difficult to find any clear causal relationships in this context, and we must agree with Lavin's statement that:

> ". . . many relationships are not of the simple, mechanistic cause-and-effect variety. Instead, some variables may have a mutual effect upon one another. That is, an increase in one variable may result in an increase in the second variable, and the second variable, in turn, may bring about a further increase in the first variable. In short, we would have an interdependent or feedback relationship" (Lavin, 1965, p. 41).

Summary

It has been shown that some school adjustment and interest variables correlate significantly with pupils' achievement, although consideration is paid to intelligence, sex and home background. Pupils with a positive attitude towards higher education, and who claim to feel at home and confident in the school situation succeed better in both Swedish and mathematics than their results on intelligence tests give reason to expect, and this is valid for both boys and girls from greatly varying home environments. There are also tendencies suggesting that positive interest in school work and verbal activities in general lead to relatively good study results. These tendencies are weaker and less general, however.

CHAPTER 10

DISCUSSION

This chapter is devoted to discussion of the results obtained, in that an attempt is made to explain why substantial relationships have been found between relative achievement, sex and home background. Whether it is possible or even desirable to eliminate these relations will also be considered. The discussion will be based on the results valid for the comprehensive school in 1966, which, with a few exceptions, agree with the results obtained in the other types of school included in the investigation.

Why do relationships arise between relative achievement and certain background variables?

It has been shown in the present study that differences in relative achievement are considerable between boys and girls, and also between pupils from different home environments. An attempt will now be made to answer the question why certain categories of pupils are favoured and others handicapped in relative achievement. In this the results reported in Chapter 9 can be used to some extent, for some of the personality variables covary not only with relative achievement but also with various background variables.

WHY DO DIFFERENCES IN RELATIVE ACHIEVEMENT EXIST BETWEEN BOYS AND GIRLS?

The strongest relationship between sex and relative achievement was found in the verbal domain, in which girls are clearly superior to boys, regardless of which model is used to estimate relative achievement. The girls get better scores on achievement tests than might be expected from their intelligence level, after which they are awarded higher marks than are justified by these, in themselves, rather high results on achievement tests. These two co-operating trends contribute to their getting considerably higher marks than boys when intelligence is kept constant.

There are probably a number of factors contributing to the relatively good study results of girls in Swedish. One of these is undoubtedly their great interest in verbal activities in their spare time (p. 80), for it was shown in Chapter 9 that pupils very interested in reading, writing, solving cross-word puzzles, etc., get better results in Swedish than might be expected from their verbal ability.

How much of the difference in relative achievement between boys and girls can be attributed to differences in verbal spare time interests? To attempt to answer this question the relative achievements of boys and girls very similar in respect of verbal interests have been calculated. To be more exact, the pupils were divided into four "interest groups", each containing approximately one-fourth of the pupils, but differing greatly in proportions of sexes. The schedule below gives the scores of the four groups on the verbal interest scale, the proportion of boys and girls in each group, and the relative achievement of the groups calculated according to Model A and expressed in percentage of the standard deviation around the common regression line of the sexes. For comparison, the values for all boys and girls are given.

Interest in verbal activities	Range	Per cent of pupils			Relative achievement within the verbal domain calculated according to Model A		
		Both sexes	Boys	Girls	Boys	Girls	Diff.
Very low	10–27	22	34	9	−46	+ 7	−53
Low	28–32	25	31	20	−30	+19	−49
High	33–37	26	22	31	−18	+25	−43
Very high	38–50	27	13	40	− 2	+40	−42
Total	10–50	100	100	100	−28	+28	−56

As was expected from the coefficients in Tables 9:1 and 9:2, relative achievement improves among both boys and girls as we go from the group with the least to the one with the most interest in verbal activities. It is also shown, however, that the differences between boys and girls in relative achievement decline when consideration is paid to differences in verbal spare-time interests. The decreases are very moderate, it is true, but, nevertheless, the differences between boys and girls are reduced by about one-fifth. Thus, the greater interest in book reading, letter writing, and other verbal activities among girls seems, to some degree at least, to explain their superiority in relative achievement within the verbal domain. It also seems as if girls make greater use of their literary interests when it is a question of transforming their verbal ability into linguistic knowledge, than when it comes to transforming linguistic knowledge into high marks, for the verbal interest scale correlates somewhat higher with relative achievement with Model B than with Model C.

Another factor that may be of importance in this context is that girls value verbal subjects, Swedish and foreign languages, higher than boys do. This has been demonstrated in a study by Andersson (1969, p. 302). In this, four questions were set to about 6000 fifteen-year-olds in Gothenburg concerning their attitudes towards eight school subjects, among them Swedish, English

and mathematics. It will be seen from the schedule below that girls value languages higher and mathematics lower than boys do, although mathematics has relatively high status among both boys and girls.

Questions	Per cent who answered					
	Swedish		English		Mathematics	
	Boys	Girls	Boys	Girls	Boys	Girls
1. Which of these school subjects do you like best?	3	5	13	20	21	17
2. If you could get top marks for one of these subjects, which of them would you choose?	3	7	13	24	74	55
3. Which of these subjects do you think is the finest?	6	10	17	25	45	31
4. Which of these subjects do you think those at home think is the finest?	8	11	16	22	62	48

Other factors that contribute to the girls' favourable study results in the verbal domain, especially their high marks in relation to their scores on achievement tests, are that girls take more care with their homework and that they are more interested in school work than boys are (p. 80; cf. also Andersson *et al.*, 1967, p. 53). In support of this interpretation is, among other things, the fact that pupils who have a positive attitude towards schoolwork – high scores on scale 3 – tend to get higher marks for Swedish than other pupils when scores on achievement tests are kept constant (Tables 9:1 and 9:2). If marks are regarded as a function of the interaction between teacher and pupil, it seems as if girls, to a greater extent than boys, possess the qualities required to satisfy the teacher's expectations on a gifted pupil. Thorndike expresses this as follows:

> "Most of the 'underachievers' in a mixed group are boys; more of the 'achievers' are girls. Through some combination of industry, docility, and agreeableness girls manage to make a more favorable impression on their teachers than boys do – a differential that is not generally maintained on coldly impersonal standardized achievement tests" (Thorndike, 1963, p. 18).

Within the quantitative domain, the relation between sex and relative achievement is more complicated. When sex differences in the intelligence test, Number series, are taken into consideration the differences between boys' and girls' knowledge of mathematics are very small, as expressed in school marks. Behind this "harmonious" situation, however, are concealed two

clearly significant trends, but in opposite directions. At equal intelligence, boys score higher on achievement tests; when scores on achievement tests are the same, girls get higher marks.

Most remarkable seems to be that boys, in one of the cases, show higher relative achievement, which is very seldom reported. It is probable that the boys' relatively good scores on achievement tests in mathematics are associated with their greater security in the school situation, as this is expressed in scale 2, for there are distinct positive relations between this scale and relative achievement estimated according to Model B in the quantitative domain (Tables 9:3 and 9:4). Being less anxious in the school situation, boys seem to find it easier to acquire the skills in mathematics measured by achievement tests. To this must be added that boys are more interested in and have a more positive attitude towards the subject (cf. schedule p. 124), which probably also favours the learning of mathematics.

That boys, in spite of their feeling of security and their positive attitudes towards mathematics, get lower marks for the subject than justified by their scores on achievement tests may be because they devote less time to homework, and because their attitudes towards their teachers are less positive than the girls' (Johannesson, 1960, p. 74; Andersson, 1969, p. 301). As in the verbal domain, girls seem to have been diligent in school and established contacts with their teachers in such a way that they are awarded relatively high marks. There may also be a halo effect here, in so far as the high marks awarded to girls for Swedish and other verbal subjects have a favourable influence on their marks for mathematics.

WHY DO DIFFERENCES IN RELATIVE ACHIEVEMENT EXIST BETWEEN PUPILS WITH DIFFERENT HOME BACKGROUNDS?

The results of the present investigation agree with earlier research, for substantial relationships were found between relative achievement and parents' level of education. In both the verbal and quantitative domains, children of parents with a high education are awarded higher marks, and children of parents on a low level of education lower marks than might be expected from their scores on intelligence tests. Great differences exist between the two domains, however, both in respect of the strength of the relationships and the way in which they arise.

Within the verbal domain the differences in scores on achievement tests are small and non-significant between children of parents at different levels of education when consideration is paid to the great differences in verbal ability. On the other hand, there are greater differences between the educational groups in marks than justified by the differences in achievement test results.

The explanation of the lower marks awarded to group 3 for Swedish than expected from scores on intelligence tests, does not, therefore, seem to be that pupils in group 3 find it difficult to convert their verbal intelligence into linguistic knowledge, but rather that they find it difficult to express their knowledge in such a way that they are awarded marks corresponding to this knowledge.

The relations between parents' level of education and children's relative achievement in the verbal domain are rather moderate, however, although there are significant differences between groups 1 and 3 among both boys and girls when marks are used as criterion. That pupils from lower strata find it difficult to obtain marks corresponding to their scores on achievement tests may perhaps be explained on the basis of Bernstein's theory of social learning (Bernstein, 1961), which maintains that the working-class child cannot use the *formal language* a subordinate should use to a superior. This may lead to imperfect communication between the teachers and the pupils from lower strata, which probably has a detrimental effect on the pupils' marks, particularly when linguistic knowledge is evaluated. Further, the more positive attitude towards theoretical education and the greater confidence in the classroom that are characteristic of pupils from group 1 (Table 6:4) probably contribute towards explaining the differences in relative achievement between the educational groups. Evidence supporting this interpretation is that pupils from groups 2 and 3 with high scores on the first two school adjustment scales have relatively high marks for Swedish (p. 116), i.e. the pupils from lower strata who have the school attitudes and the confidence that are usually more common in higher strata get better results than other pupils from lower strata.

Within the quantitative domain, differences in intelligence between pupils from different educational groups are far smaller than in the verbal domain. On the other hand, the differences in marks are about as great within both domains. This implies that a very marked relationship is present between parents' level of education and the pupils' relative achievement within the quantitative domain, and at equal intelligence pupils from group 1 are awarded much higher marks than pupils from group 3.

When these results are scrutinized it may be tempting to suspect that the teacher has allowed himself to be influenced by the good linguistic knowledge in group 1, or by other irrelevant factors when awarding marks for mathematics. This is by no means so, however. The poor marks for mathematics in group 3 seem to be due to the inability of the pupils to convert their quantitative ability into good scores on achievement tests in mathematics, while the teacher awards the marks justified by the results of these tests.

Why, then, are the differences between the scores of groups 1 and 3 on the

achievement test in mathematics so great, although the differences have been eliminated in an intelligence test, which correlated highly with this achievement test? To a greater extent than within the verbal domain, the superiority of group 1 may probably be explained from its higher average on school adjustment scales 1 and 2. Living in a home where attitude towards theoretical education is positive and having oneself a feeling of well-being and confidence at school seem to be of greater importance in the quantitative domain (p. 119).

Can the low relative achievement of group 3 be explained solely on the basis of the low average of this group on the two adjustment scales? To obtain an answer to this question, an estimate has been made of the relative achievement of pupils with about the same attitudes towards school, but who belong to different educational groups. Pupils whose values are above the total mean in both scales 1 and 2, i.e. pupils with at least 6 points on scale 1 and at least 7 points on scale 2, have been chosen. Of the boys in group 1, *59* per cent are included in this "positive group", of group 2 *49* per cent, and of group 3 *33* per cent. The corresponding figures for girls are *51, 40* and *26* per cent. The schedule below gives the relative achievement of these categories within the quantitative domain, estimated according to Model B and expressed in percentages of the standard deviations around the regression line for each sex. The values for all pupils in the respective group are given for comparison.

Background-level	Relative achievement within the quantitative domain calculated according to Model B			
	Boys		Girls	
	Positive group	Total	Positive group	Total
1	+61	+46	+53	+34
2	+42	+12	+39	+11
3	+18	−12	+28	−10
1–3	+43	+58	+25	+44

The schedule shows that the differences between educational groups decline when consideration is paid only to the values of the "positive groups". The reductions between groups 1 and 3 vary between 15 and 19 units, and imply that the differences between the groups of boys are reduced by one-quarter, and between the groups of girls by rather more than one-third. The results suggest, therefore, that the differences in relative achievement within the quantitative domain between different educational strata may be explained to some extent, but not wholly, by differences in attitudes and personality traits measured by scales 1 and 2.

What other factors may be of importance in this context? Why do

differences still persist in scores on achievement tests in mathematics between groups 1 and 3, in spite of consideration being paid not only to intelligence but also to some personality variables of great importance for achievement in this subject? It may be that the greater part of the remaining difference between the groups can be explained by the varying amount of help and stimulus the pupils receive at home. This help, which is of great significance for those wishing to acquire the specific knowledge included in the subject mathematics (Magne, 1967, p. 148), is probably available to a smaller extent to pupils in group 3. Both parents in group 3 have only an elementary school education, and most of them attended school for six or seven years only, and are lacking, therefore, in the knowledge required to help their children.

In relation to the differences between the educational groups – especially between groups 1 and 3 – the differences in relative achievement within group 3 are very small. This is true of both boys and girls, and within both the verbal and the quantitative domains. In general, however, children of white-collar workers have somewhat better results than children of manual workers, and children in rural areas somewhat better results than those in urban areas. If pupils are classified according to both father's occupation and degree of urbanization of place of residence, it implies that children of office workers and self-employed fathers living in rural areas form a rather favoured group with a relative achievement level about the same as that of educational group 2. On the other hand, the far greater group of pupils whose fathers are manual workers and who are living in large urban centres are seriously handicapped in relative achievement.

The small differences existing in group 3 between children of white-collar and manual workers are probably due to, among other things, the fact that the former are from homes with a somewhat more favourable attitude towards school. The regional differences in relative achievement seem, as mentioned earlier, to be connected with a tendency towards more generous marking in rural areas, i.e. in regions without senior secondary schools. This tendency has become considerably weaker during the 1960's and the weak relationship between place of residence and relative achievement in the comprehensive school can be partly explained by the greater interest shown in homework and other school activities by pupils in rural areas (p. 79).

Should attempts be made to eliminate the relationships between relative achievement and different background variables?

Even though, in the future, very reliable instruments become available, it will probably always be impossible to obtain perfect correlation between measures of intelligence and achievement, since they do not measure – and

are not intended to measure – exactly the same functions. Some pupils will, therefore, achieve more in school and others less than might be expected from their level of intelligence, i.e. the concept of relative achievement will always be valid. Since this relative achievement is not simply a consequence of errors of measurement in the control and criterion variables, it must also be assumed that it covaries with some other variables. With what variables may relative achievement be allowed to covary? It would be best, of course, if it were related only to variables that are not quite impossible to modify, e.g. ambition and study habits. But may it be allowed to covary with such variables as sex and home background? This problem will be discussed in the next sections.

SHOULD DIFFERENCES IN RELATIVE ACHIEVEMENT BETWEEN BOYS AND GIRLS BE ELIMINATED?

In order to answer this question, the two domains will be treated separately, beginning with the quantitative domain. There seems to be little cause to worry about the existing sex differences here, since the distinct relationships, although in opposite directions, between sex and relative achievement according to Model B and Model C respectively, result in very small sex differences when relative achievement is estimated according to Model A. Thus, when intelligence is equal, there is only a weak tendency towards higher marks for girls. This tendency also implies that girls, who have somewhat lower quantitative ability, are awarded marks as high as those given to boys, i.e. the weak tendency favours the group that is handicapped somewhat in the initial situation.

The case is different in the verbal domain. Differences between boys and girls are slight in verbal intelligence, but girls get higher scores on achievement tests, and much higher marks than boys, which results in very strong relationships between sex and relative achievement in this domain. It would, therefore, be desirable to a greater extent than has been possible in the present study, to ascertain *which* differences between boys and girls contribute to the better relative achievement of the girls. The next step would be to attempt to introduce or increase among boys the interests, habits, attitudes or other mechanisms found that help pupils to get along well in the school situation.

This research should not, however, be given high priority, for women must still be regarded as being handicapped in respect of education; their superiority in marks tends to disappear and change into inferiority in the senior secondary school (Holter, 1961, p. 154; Husén, 1969, p. 265), women still find it more difficult to pursue their studies to a lower academic degree

than men do (Husén & Boalt, 1967, p. 207), and still more difficult to take a higher degree (Statistiska centralbyrån, 1970, pp. 18–20) – not to mention how difficult it is for a woman to reach the highest posts in society. I think, therefore, that we may tolerate the differences between the thirteen-year-old girls and boys in relative achievement, not only in the quantitative, but also in the verbal domain.

SHOULD DIFFERENCES IN RELATIVE ACHIEVEMENT BETWEEN PUPILS WITH DIFFERENT HOME BACKGROUNDS BE ELIMINATED?

Although we may show a certain amount of indulgence towards the relation between sex and relative achievement, we cannot do so in respect of parents' education and relative achievement. Here the relationship is to the disadvantage of children of parents with low education, and such children are handicapped in both the initial and the final situations. They are handicapped in the initial situation because they usually have much lower scores on the intelligence tests, and they are handicapped in the final situation in that, at all school marks levels, they begin and succeed in completing a higher education to a considerably smaller extent than others (Härnqvist, 1966; Reuterberg, 1968; Hörlyk & Kvist, 1970). The inferiority of group 3 in relative achievement is thus one of the links in a long chain of handicaps – and it is a fundamental duty of society to endeavour to break every link in this chain.

Is it possible to eliminate or at least reduce the relationship between relative achievement and parents' level of education? One difficulty is that marks are affected by, in addition to intelligence, such factors as positive attitudes towards school and theoretical education, confident behaviour in the school situation, etc., and as long as these traits are more common among children of highly educated parents, their children will be favoured also in relative achievement.

One possibility of reducing the relationship between parents' level of education and pupils' relative achievement would be to take more account of pupils' ability to work together, their flexibility and creativity, when marks are awarded (cf. Härnqvist, 1969 c, p. 12). These traits are probably less socially loaded (cf. Rubenowitz, 1963, pp. 194–198; Larsson & Sandgren, 1968, p. 180), but are of very great importance, not least when a person has left school and entered the labour market. Great importance is also assigned to the encouragement of these characteristics in the general regulations for the comprehensive school (Läroplan för grundskolan, 1962, pp. 13–18), but since, for various reasons, it is very difficult to measure them with the help of standardized tests, they probably do not have any appreciable effect on pupils' marks in the school of today. If these personality traits are to have

any great influence on the evaluation of pupils' achievements in school, it will probably be necessary to introduce rather different instruction and other evaluation instruments than those available now – changes that will demand very much work and will take a very long time to realize.

Another possibility of helping pupils from a less favoured social background would be to give them special remedial instruction, from the beginning of school, in the subject or subjects which will probably be troublesome for most of these pupils in higher classes (cf. p. 31). Unfortunately, this solution, too, is a long-term one, and gives little help to pupils who have passed through several classes of the comprehensive school.

What immediate help can be given to pupils from the less favoured groups, i.e. children of parents with a low-level education in general, and children of manual workers in large towns in particular, so that they can succeed better at school? In the first place, I consider it very urgent to draw the attention of education authorities and teachers to the existence of considerable differences in marks between pupils from different social strata, even when consideration has been paid to the great differences in intelligence. Further, people must learn that these differences have arisen in different ways; within the verbal domain, pupils from lower social strata are awarded relatively low marks, because they find it difficult to transform their scores on achievement tests into good marks; within the quantitative domain because it is difficult for them to convert their intelligence into good scores on achievement tests. Thus, the social handicap is present at different levels within the two domains, and this must be taken into consideration when attempts are made to help the underprivileged groups.

To some extent, at least, information on the actual situation should be of value to pupils from lower strata. When teachers become aware that these pupils are handicapped in relative achievement, and at which level these handicaps are in the various subjects, they will, perhaps, devote more attention to these pupils, and give them special help in the learning of the knowledge and skills they find especially difficult. In the subject Swedish they seem to need help with such skills as are taken into consideration when marks are being awarded, such as cannot be measured by standardized achievement tests, e.g. oral presentation and composition.

In mathematics the pupils need the teachers' help much more, above all in the basic mathematical skills which are measured by standardized achievement tests.

Of course, too much cannot be expected of an "information campaign", but increased research must be encouraged, too. In particular, the great and for many undoubtedly astonishing differences in relative achievement within the quantitative domain should be the starting point for further research. The following questions should be given high priority.

1. In 1969, some changes were made in the general objectives of the comprehensive school (see Dahllöf, 1970), and at about the same time a somewhat different kind of instruction in mathematics was introduced. Have these changes caused a decrease or an increase in differences in relative achievement between pupils with different home backgrounds?
2. In the present study, attention has been drawn to some of the factors, among them a rather slight interest in theoretical studies and a certain anxiety in the school situation, which contribute to pupils' from lower social strata getting poorer scores on achievement tests of mathematics than might be expected from their level of intelligence. What other factors are behind the relatively poor achievement test results?
3. It has been shown that pupils from lower social strata find it rather difficult to achieve good results in achievement tests of mathematics. On the other hand, it has been impossible to ascertain whether they found it more difficult to follow the teaching in, for example, geometry than in mathematical reasoning. The following question, therefore, remains to be answered: Have pupils in group 3 general difficulties in mathematics or are their difficulties confined to certain areas of mathematics?
4. Finally, the most urgent research task: What concrete procedures should be applied to raise the level of knowledge of mathematics among the underprivileged groups? What is to be done to prevent differences in knowledge of mathematics between the various strata from not, at least, becoming greater than the differences that can be attributed to differences in quantitative ability?

Summary

In this chapter an attempt has been made to explain why there are great and systematic differences in relative achievement between pupils with different backgrounds. I am well aware that it has been possible only to a limited extent to elucidate this complex problem. Much more research will be required to find out exactly why girls are more successful at school than boys, and why pupils from higher social strata succeed better than those from lower strata, in spite of the fact that consideration is paid to differences in intelligence. It is particularly important to obtain a complete solution of the last-named problem, for only then can effective help be given to pupils from lower strata – pupils handicapped in so many other respects that they really should be helped to get school marks more in line with their intelligence.

CHAPTER 11

SUMMARY

The investigation presented here is part of a larger research project, the Individual Statistics Project. The main problem dealt with in this investigation may be formulated as follows: *How is relative achievement associated with sex and home background?* This means that a study has been made to ascertain what differences there are in achievement between boys and girls, and between pupils from different social strata when differences in intelligence are taken into consideration.

The study is based on information from two samples, comprising pupils born on the 5th, 15th and 25th of any month in the year 1948 or 1953. The data were collected during the spring terms of 1961 and 1966 respectively, when the pupils were in grade 6 of the compulsory school. The samples, each containing about 8000 pupils, may be regarded as being representative of all Swedish thirteen-year-olds in grade 6 when the collections of data were made.

In 1961, compulsory education was divided into two types of school, the elementary school and the experimental comprehensive school, and in 1966 into the elementary school and the comprehensive school. Since these systems differ to some extent, and a number of changes were made between 1961 and 1966, separate analyses were made for pupils attending:

I. Elementary school 1961 (N=5828)
II. Experimental comprehensive school 1961 (N=3077)
III. Elementary school 1966 (N=1500)
IV. Comprehensive school 1966 (N=6144)

Within each of these categories a division was made according to sex and home background; in the latter, parents' level of education was decisive.

Group 1. Father and/or mother with matriculation examination or equivalent education.
Group 2. Father and/or mother with only lower secondary school certificate or equivalent education.
Group 3. Father and mother with only elementary school education.

Since group 3 contained about 75 per cent of the pupils, this group was subdivided for some analyses according to father's occupation (manual workers/other workers) and possibilities of obtaining higher education in place of residence (urban/rural areas).

In order to avoid as far as possible the difficulties and arbitrariness attendant on the choice of measures of intelligence and achievement in this type of study, a number of so-called external or canonical factor analyses was

made, in which different intelligence tests, standardized achievement tests and marks were involved. The analyses gave a very clear structure, in that the covariation between most of the variables could be assigned to either a verbal or a quantitative factor. With this as point of departure the work was devoted to studying relative achievement within the verbal and the quantitative (numerical) domains.

Table 11:1. Combinations of control and criterion variables.

Domain	Model	Control variable	Criterion/Control variable	Criterion variable	Approximative correlations
		Intelligence test	Achievement test	School mark	
	A	Opposites		Swedish	.65
Verbal	B	Opposites	Swedish		.75
	C		Swedish	Swedish	.85
	A	Number series		Mathematics	.65
Quantitative	B	Number series	Mathematics		.70
	C		Mathematics	Mathematics	.85

As shown in Table 11:1, three combinations of control and criterion variables were used in each domain. In the verbal domain, a start was made with a vocabulary test, Opposites, as a measure of intelligence and marks for Swedish as measure of achievement (Model A). Then marks were exchanged for a standardized achievement test (Model B), and finally the achievement test was used to measure intelligence and marks as measure of achievement (Model C). In the same way, in the quantitative domain, a reasoning test, Number series, was used as measure of intelligence, and marks for mathematics as measure of achievement, while the achievement test of mathematics had to serve as measure of both criterion and control variable. It will be seen from the table that the strength of the correlations increases within both domains from Model A to Model C.

The relations between relative achievement and different background variables were calculated by the help of the method of analysis of covariance. By making separate analyses within the verbal and the quantitative domains, and by being able in both domains to "divide" the relationship between scores on intelligence tests and marks into two steps, it was possible to get a rather detailed picture of how sex and social background covary with relative achievement.

The results obtained from the comprehensive school are shown very schematically in Figures 11:1 and 11:2, and are summarized below.

1. The girls were far superior to the boys in relative achievement within the verbal domain, and their superiority can be seen clearly in all the models

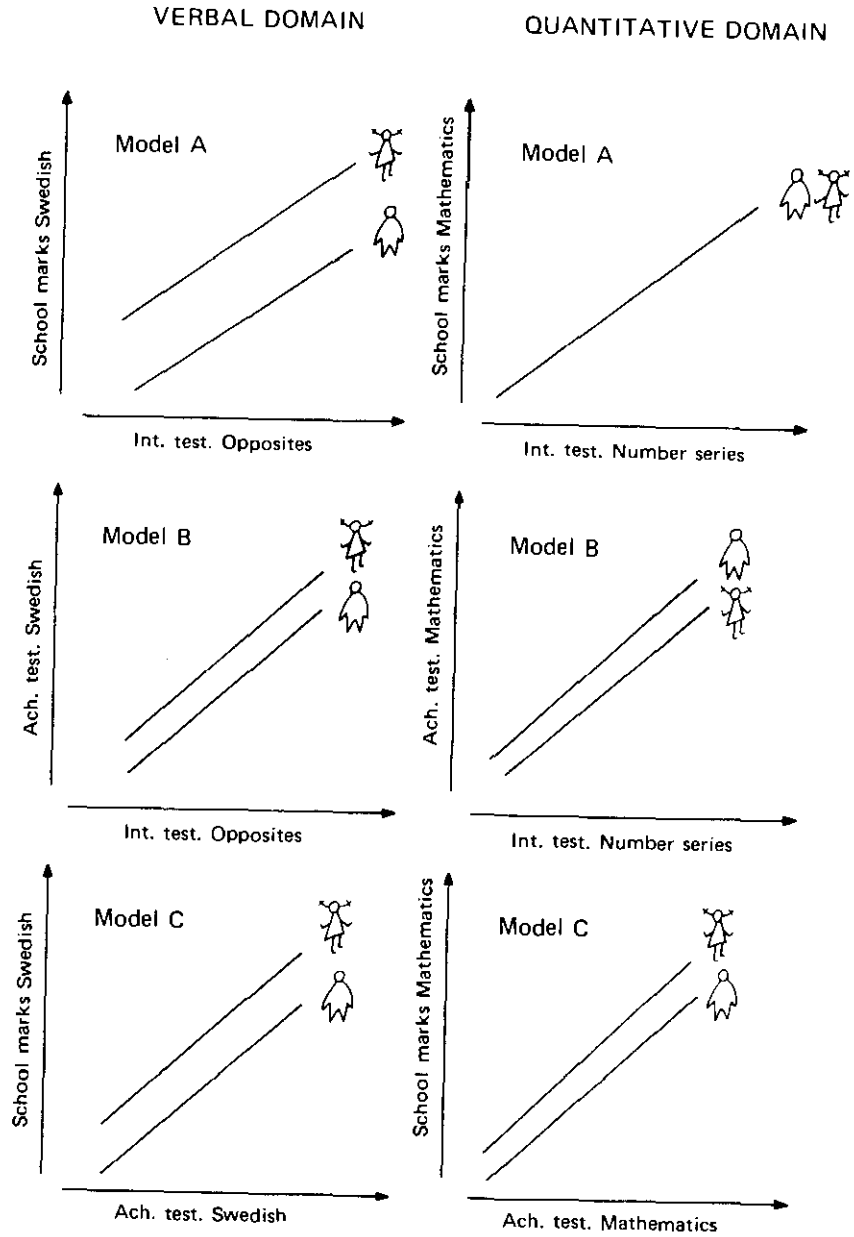


Fig. 11:1. Comparisons between boys and girls in relative achievement.

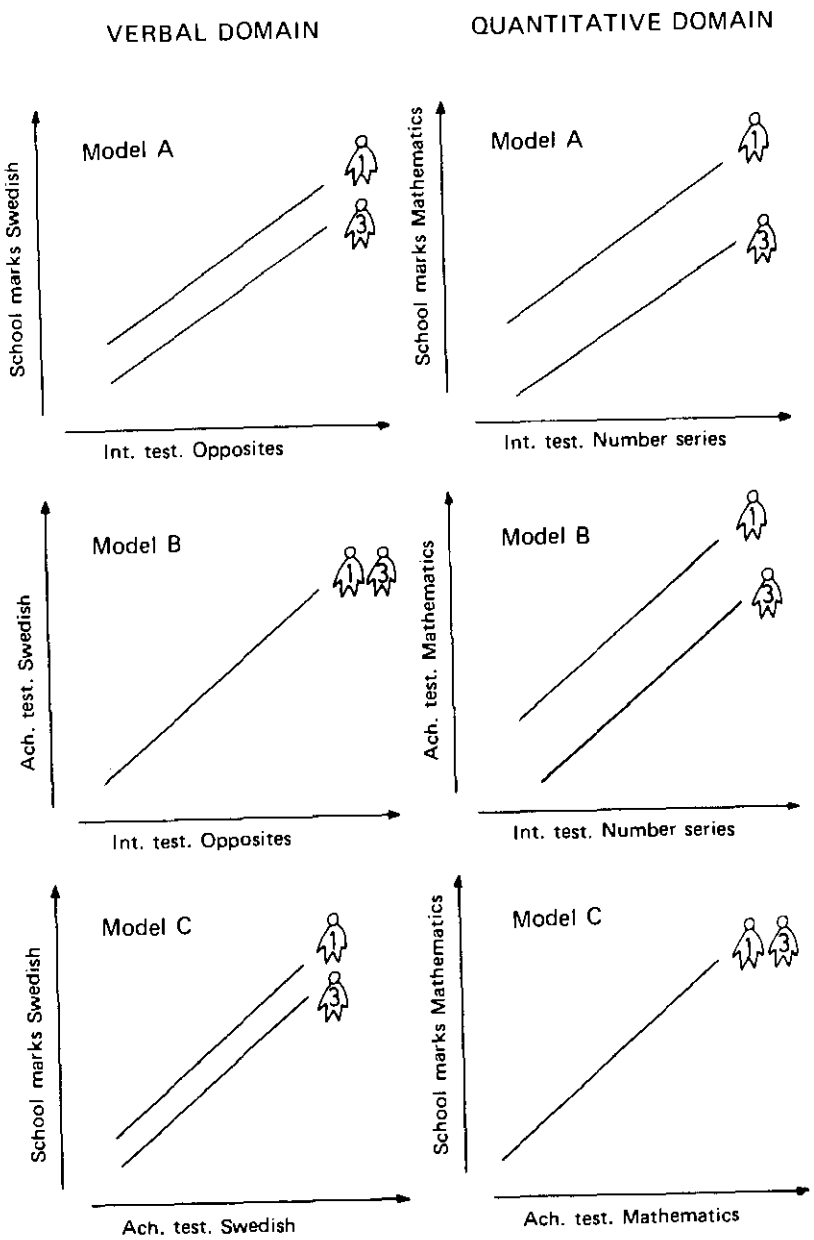


Fig. 11:2. Comparisons between groups 1 and 3 in relative achievement.

used to estimate relative achievement. Thus, they have higher scores on achievement tests than could be expected from their intelligence (Model B), after which they are awarded higher marks than justified by these, in themselves, very high achievement scores (Model C). These two co-operating trends cause girls to get clearly higher marks in Swedish than boys when verbal intelligence is kept constant (Model A).

2. Within the quantitative domain, the relationship between sex and relative achievement is more complicated. When sex differences in the intelligence test, Number series, are taken into consideration, the differences between boys' and girls' knowledge of mathematics are very small, as expressed in school marks. Behind this "harmonious" situation, however, are concealed two clearly significant trends, although in different directions. At equal intelligence, boys score higher than girls on achievement tests; when scores on achievement tests are equal, girls are awarded higher marks.
3. Pupils with highly educated parents (group 1) get higher marks for Swedish than pupils whose parents have only an elementary school education (group 3), even when the great differences in verbal ability have been allowed for. This is true of both boys and girls, and is due mainly to the fact that group 1 pupils are awarded higher marks than expected from their scores on achievement tests. On the other hand, the differences are small and non-significant between the groups in achievement test scores with intelligence kept constant.
4. There are very great differences between group 1 and group 3 in the quantitative domain, when relative achievement is estimated according to Model A. As in the verbal domain, boys and girls from group 3 have difficulty in obtaining marks corresponding to their intelligence, but here it is not because they are given marks that are too low in relation to their scores on achievement tests. The reason for their low marks seems instead to be inability to convert their intelligence into good achievement test scores. The differences between groups 1 and 3 are very small when relative achievement is estimated according to Model C, but very great when Model B is used.
5. Within both the verbal and the quantitative domains, group 2 occupies an intermediate position, i.e. its relative achievement is higher than that of group 3 but lower than that of group 1.
6. In relation to the differences between the groups the differences in relative achievement within group 3 are very small. This is true of both boys and girls and in both the verbal and the quantitative domains. Generally speaking, however, children of white-collar workers get somewhat better results than children of manual workers, and children in rural areas somewhat better results than children in urban areas.

The results obtained are not restricted to pupils of the comprehensive school in 1966, but are in good agreement with those found in elementary school 1961, experimental comprehensive school 1961, and elementary school 1966. The differences in relative achievement within the verbal domain declined somewhat, however, between boys with different home backgrounds during the five-year period.

In this investigation an attempt has also been made to answer the question: *What relations are there between relative achievement and certain personality variables, when sex and home background are kept under control?*

In this part of the study, based on data from the comprehensive school only, three school adjustment and five interest scales were used. The adjustment measures give information on the family's attitude towards higher education, the pupil's feeling of security at school and the pupil's interest in school work. The interest measures tell us about the attitudes towards spare time activities within the verbal, technical, outdoor, clerical and domestic areas.

The product-moment correlations between the individual deviations from each of the six regression lines and the individual score on each of the eight personality measures were calculated. When these calculations were made, the subjects were first divided according to sex only, and then according to both sex and home background. This procedure made it possible to ascertain whether the correlations between different types of relative achievement and certain personality variables varied between pupil groups with different backgrounds.

The correlations between the eight personality variables and the different measures of relative achievement were consistently low. The results imply, however, that pupils with a positive attitude towards higher education, and who claim to feel at home and confident in the school situation succeed better in both Swedish and mathematics than their results on intelligence tests give reason to expect, and this is valid for both boys and girls from greatly varying home environments. There are also tendencies suggesting that positive interest in school work and verbal activities in general lead to relatively good study results. These tendencies are weaker and less general, however. The correlations found are of interest, partly because they explain, to a certain extent, the differences in relative achievement between pupils with different backgrounds.

The superiority of the girls in relative achievement within the verbal domain may thus be explained partly by their more positive attitude towards school work and the fact that they spend more of their spare time in verbal activities than boys do. In the same way, the relatively good achievement in Swedish and mathematics of pupils from group 1 may be explained partly by their coming from homes with very favourable attitudes towards theoretical education and their feeling of greater security in school.

The report closes with a discussion of whether attempts should be made to eliminate the relationships between relative achievement and different background variables. For various reasons it seems most urgent to reduce the relations between relative achievement and parents' level of education, and some suggestions are made on how to help pupils from lower strata to get school marks more in line with their intelligence.

APPENDICES

INDIVIDUAL STATISTICS REPORTS

Nos. 7, 15 and 35 are in English, no. 14 in French and the rest in Swedish.

1. Svensson, A. (1961): *Design and variables of the Individual Statistics Project.* Rapporter från Pedagogiska institutionen, Göteborgs universitet. (Mimeographed)
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17. Balke-Aurell, G. & Jernstig, M-L. (1968): *What factors affect changes in intelligence between the ages of 13 and 18 years in senior secondary school students?* (Mimeographed)
18. Ling, L-E. (1968): *Intelligence and adjustment in under-age boys.* (Mimeographed)
19. Ehnrot, E. & Olsson, L. (1968): *What factors affect changes in intelligence between the ages of 13 and 18 years among boys with only elementary school education.* (Mimeographed)
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21. Dandenell, A. & Meurling, B. (1968): *What relations are there between mother's and father's education and a child's intelligence and scholastic achievement?* (Mimeographed)
22. Rovio-Johansson, A. (1968): *Individual Statistics Project 1966. Instruments, population and material.* Rapporter från Pedagogiska institutionen, Göteborgs universitet. (Mimeographed)
23. Carlsund, A. (1968): *Choice of theoretical courses by pupils in grade 6 from different school systems and social groups.* (Mimeographed)
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25. Reuterberg, S-E. (1968): *Choice of theoretical education in relation to social and regional background factors.* Licentiatavhandlingar från Pedagogiska institutionen, Göteborgs universitet. (Mimeographed)
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33. Hammarström, M. & Hjalmarsson, L. (1970): *How stable are the educational and occupational plans of teenage girls?* (Mimeographed)
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35. Svensson, A. (1971): *Relative Achievement. School performance in relation to intelligence, sex and home environment.* Stockholm: Almqvist & Wiksell.

Table II:1. Intelligence test Opposites: means and standard deviations for different background levels in 1961.

Background level	Elementary school						Experimental comprehensive school					
	Boys			Girls			Boys			Girls		
	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
1	254	26.41	6.35	246	28.22	6.11	187	27.14	6.13	184	27.28	6.55
2	316	24.92	6.42	312	24.51	6.70	200	24.64	5.86	223	24.78	6.11
3:1	291	23.43	6.26	278	23.66	6.82	230	24.22	5.76	232	23.69	6.21
3:2	711	22.38	6.54	677	22.30	6.68	192	22.29	6.89	157	22.85	6.67
3:3	562	22.01	6.18	548	21.47	6.05	421	22.65	5.79	456	22.27	6.20
3:4	816	21.12	6.04	817	20.87	6.33	269	20.93	6.05	326	21.29	6.39
Total	2950	22.69	6.48	2878	22.62	6.75	1499	23.36	6.30	1578	23.27	6.57

Table II:2. Intelligence test Opposites: means and standard deviations for different background levels in 1966.

Background level	Elementary school						Comprehensive school					
	Boys			Girls			Boys			Girls		
	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
1	47	28.06	6.23	64	26.88	6.97	432	28.08	5.12	421	27.84	6.10
2	93	25.29	6.34	106	24.92	6.93	520	25.95	5.88	521	26.20	5.96
3:1	48	24.40	5.35	56	23.20	7.10	352	25.05	5.79	344	24.82	6.26
3:2	211	22.32	6.47	212	23.36	6.20	403	23.83	6.38	438	24.47	6.40
3:3	94	22.45	5.94	82	22.91	6.41	685	23.33	6.01	669	23.23	6.06
3:4	238	22.73	5.75	249	22.53	6.37	705	22.76	5.95	654	23.40	5.90
Total	731	23.35	6.26	769	23.54	6.63	3097	24.57	6.15	3047	24.77	6.29

Appendix 2

Table II:3. Intelligence test Number series: means and standard deviations for different background levels in 1961.

Background level	Elementary school						Experimental comprehensive school					
	Boys			Girls			Boys			Girls		
	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
1	254	23.50	7.12	246	23.02	7.60	187	24.60	7.60	184	22.64	7.02
2	316	21.85	7.70	312	21.48	6.94	200	21.96	7.50	223	20.99	7.39
3:1	291	20.33	7.92	278	19.81	7.40	230	21.59	7.09	232	19.58	7.73
3:2	711	20.24	7.32	677	20.01	7.31	192	20.06	7.54	157	20.43	7.11
3:3	562	19.77	7.92	548	18.05	7.42	421	19.96	7.46	456	18.14	7.48
3:4	816	18.64	7.55	817	17.94	7.39	269	18.90	7.14	326	18.27	7.73
Total	2950	20.17	7.71	2878	19.45	7.52	1499	20.88	7.57	1578	19.53	7.62

Table II:4. Intelligence test Number series: means and standard deviations for different background levels in 1966.

Background level	Elementary school						Comprehensive school					
	Boys			Girls			Boys			Girls		
	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
1	47	24.98	7.69	64	21.34	7.30	432	24.80	7.22	421	23.60	7.41
2	93	22.14	8.07	106	21.51	6.93	520	22.98	7.91	521	22.07	7.56
3:1	48	20.81	7.84	56	19.36	7.97	352	21.48	7.43	344	20.94	7.92
3:2	211	19.46	7.84	212	19.95	7.19	403	20.87	7.76	438	21.38	7.50
3:3	94	19.14	7.10	82	19.18	8.23	685	20.08	7.78	669	19.39	7.08
3:4	238	18.99	7.43	249	18.51	7.64	705	20.06	7.64	654	19.41	7.67
Total	731	20.05	7.79	769	19.69	7.54	3097	21.48	7.83	3047	20.89	7.64

Appendix 3

QUESTIONNAIRE SCHOOL

Each question is to be answered "yes" or "no". The answer in parentheses after the question is the one for which a point is awarded. The numeral before the question gives the position in the questionnaire.

Scale 1

2. Do your parents think that going to a higher school will give a more secure future? (yes)
5. Do you think it will be nice to finish school and start working? (no)
8. Do those at home think you should take the matriculation examination later? (yes)
11. Do you think it is pleasanter to remain in school than to begin working? (yes)
14. Do your parents think that one can get along well nowadays without a higher education? (no)
17. Do you think it more important to earn a lot of money than to get a high education? (no)
20. Do your father and mother consider that lack of education is a serious handicap if one wants to get on in life? (yes)
23. Do your parents consider that one has little use of a formal education at work? (no)
26. If you could choose between school and a job, would you choose school? (yes)
29. Do your father and mother think you should go to another school when you have finished the compulsory school? (yes)

Scale 2

3. Do you think that tests in school are too difficult? (no)
6. Do you often sit worrying about things at school? (no)
9. Do you think it unpleasant to answer questions in school? (no)
12. Do you sometimes feel lonely in school? (no)
15. Do you sometimes find it difficult to give the right answer when the teacher asks you a question? (no)
18. Do you easily give up when you find a task difficult at school? (no)
21. Are you sometimes afraid you will not know your lessons? (no)

24. Do you often get tired when you have tests at school? (no)
27. Do you often think you are a failure at school? (no)
30. Would you like to attend another school instead of the one you are at now? (no)

Scale 3

1. Do you sometimes read books other than text-books about things you have studied at school? (yes)
4. Do you think you learn new things in a pleasant way at school? (yes)
7. Do you think you get too much homework? (no)
10. Is it unpleasant to go to school in the mornings? (no)
13. Do you like tests at school? (yes)
16. Do you think time passes too slowly at school? (no)
19. Do you sometimes skip homework you think is dull? (no)
22. Do you often sit thinking of other things when you should be writing or doing mathematics at school? (no)
25. Do you think you have to learn a lot of unnecessary things at school? (no)
28. Do you think homework dull? (no)

QUESTIONNAIRE SPARE TIME ACTIVITIES

For each activity, the pupil is to indicate whether he/she finds the activity: very interesting (++), interesting (+), dull (−) or very dull (−−). At the scoring, the alternatives were awarded the points 5, 4, 2 and 1. The numeral before the activity refers to the position in the questionnaire.

Verbal activities

5. Writing a compositon about a winter sport
10. Solving cross-word puzzles
15. Reading books
20. Learning a foreign language
25. Writing short stories
30. Reading foreign books
35. Visiting a library
40. Writing letters
45. Editing a school magazine
50. Writing the text for an advertisement

Technical activities

4. Building a model railway
9. Visiting a museum of technology
14. Repairing a bicycle
19. Finding out how a washing-machine is made
24. Building a radio set
29. Mending a mechanical toy
34. Helping to build a television set
39. Reading about space ships
44. Making a high-jump hurdle
49. Building models

Outdoor activities

1. Participating in voluntary gymnastics
6. Taking part in a bicycle race
11. Training the high jump
16. Taking part in a winter sport
21. Working as a trainer of athletes
26. Playing basket-ball for a club
31. Cross-country running
36. Visiting an athletics event
41. Sailing
46. Taking part in some branch of athletics

Clerical activities

2. Working at a post-office
7. Working in a shop, selling clothes
12. Writing invoices
17. Working as head of a department in an office
22. Selling bread
27. Calculating the costs of an outing
32. Selling tickets for an athletics event
37. Working in an office
42. Working as cashier in a touring club
47. Sorting post

Domestic activities

3. Cooking foreign dishes
8. Using washing-up machines
13. Making clothes
18. Visiting an exhibition of furniture
23. Cooking a school meal
28. Working as a chef in a hotel
33. Frying sausages for guests
38. Using kitchen machines
43. Baking bread
48. Furnishing a flat

Table IV:1. Means and standard deviations of the adjustment measures among pupils from different background levels. Possible range 0 to 10.

Sex	Background level	N	Scale 1 M	Scale 1 S.D.	Scale 2 M	Scale 2 S.D.	Scale 3 M	Scale 3 S.D.
Boys	1	421	7.18	1.81	7.26	2.06	5.40	2.46
	2	510	6.58	2.18	6.90	2.24	5.61	2.55
	3:1	348	6.10	2.33	7.11	2.00	5.58	2.40
	3:2	401	5.31	2.40	6.83	2.10	5.64	2.55
	3:3	670	5.57	2.42	6.61	2.26	5.21	2.54
	3:4	695	5.38	2.36	6.62	2.23	5.76	2.43
	Total	3045	5.94	2.37	6.84	2.18	5.53	2.50
Girls	1	409	6.91	1.93	6.77	2.26	5.73	2.39
	2	504	6.54	2.30	6.39	2.21	5.82	2.48
	3:1	335	5.63	2.45	6.38	2.32	5.65	2.49
	3:2	429	5.51	2.43	6.09	2.19	6.32	2.35
	3:3	653	5.40	2.37	5.95	2.25	5.83	2.46
	3:4	638	5.05	2.41	5.96	2.26	6.24	2.37
	Total	2968	5.76	2.42	6.20	2.26	5.94	2.44

Table IV:2. Means and standard deviations of the interest measures among pupils from different background levels. Possible range 10 to 50.

Sex	Background level	N	Verbal M	Verbal S.D.	Technical M	Technical S.D.	Outdoor M	Outdoor S.D.	Clerical M	Clerical S.D.	Domestic M	Domestic S.D.
Boys	1	421	30.79	6.20	38.18	6.76	37.72	7.54	24.62	6.41	25.89	7.43
	2	510	31.11	6.42	38.05	6.91	38.48	7.41	25.63	6.68	25.42	7.24
	3:1	348	30.61	6.67	37.70	7.19	38.57	7.40	25.72	6.47	25.43	7.18
	3:2	401	29.14	6.38	39.08	5.83	39.98	6.65	24.75	6.40	23.88	7.02
	3:3	670	29.74	6.58	38.14	6.45	38.86	6.83	26.24	6.24	25.20	7.30
	3:4	695	29.60	6.67	39.09	5.90	39.81	6.47	25.84	6.40	24.93	7.07
	Total	3045	30.07	6.54	38.39	6.48	38.93	7.04	25.55	6.45	25.11	7.22
Girls	1	409	36.00	5.73	24.68	7.88	33.75	7.91	26.18	6.99	34.20	6.52
	2	504	36.00	5.88	23.95	7.74	34.10	8.22	28.06	7.27	34.83	6.13
	3:1	335	35.58	5.99	23.01	6.79	34.12	7.45	29.84	6.54	34.71	6.06
	3:2	429	35.66	5.69	23.52	7.70	35.46	7.45	29.41	6.67	35.63	6.28
	3:3	653	35.54	6.02	23.17	7.34	34.51	7.70	30.82	7.03	35.90	5.86
	3:4	638	35.52	6.03	23.11	7.39	34.77	8.10	30.74	6.77	36.00	6.18
	Total	2968	35.65	5.94	23.51	7.51	34.48	7.86	29.35	7.08	35.27	6.21

Correcting analysis of covariance for unreliability of the control variable

To give more detailed information on the correction method suggested by Härnqvist (1968), and its consequences in the various stages of an analysis of covariance, an example, based on the values obtained in the elementary school in 1961, will be given. Only the data for boys will be used, with marks for Swedish as y-variable and the intelligence test Opposites as x-variable.

In this case, the within-groups correlation is .629 and the within-groups regression .163. This coefficient of regression has been used to determine the slope of the broken line (Fig. V:1) giving information on the expected y-means of the groups on the basis of the *observed* results in the x-variable. If, instead, the expected y-means on the basis of *true* values in the x-variable are required, the coefficient of regression must be divided by the within-groups reliability of the x-variable:

$$b_{wc} = \frac{b_w}{r_{xx_w}}$$

where $r_{xx_w} = 1 - \dfrac{s^2_{x_T}\ (1 - r_{xx_T})}{s^2_{x_w}}$ (Guilford, 1954, p. 392)

and

b_w = the within-groups regression
b_{wc} = the within-groups regression corrected
r_{xx_w} = the within-groups reliability in x
r_{xx_T} = the reliability for the total sample in x
$s^2_{x_w}$ = the within-groups variance in x
$s^2_{x_T}$ = the total variance in x

In this example

$$r_{xx_w} = 1 - \frac{41.957\ (1-0.871)}{39.449} = 0.863$$

and

$$b_{wc} = \frac{0.163}{0.863} = 0.189$$

This corrected coefficient of regession determines the slope of the unbroken line in Figure V:1 and gives information on the y-means expected

from the true x-values. As shown in the figure, the steeper slope of the corrected line implies that the differences between the observed and the expected means usually decrease, which in its turn means that differences become smaller between the adjusted means (Table V:1), i.e. that greater consideration is paid to the differences in the x-variable when the adjusted y-means are estimated.

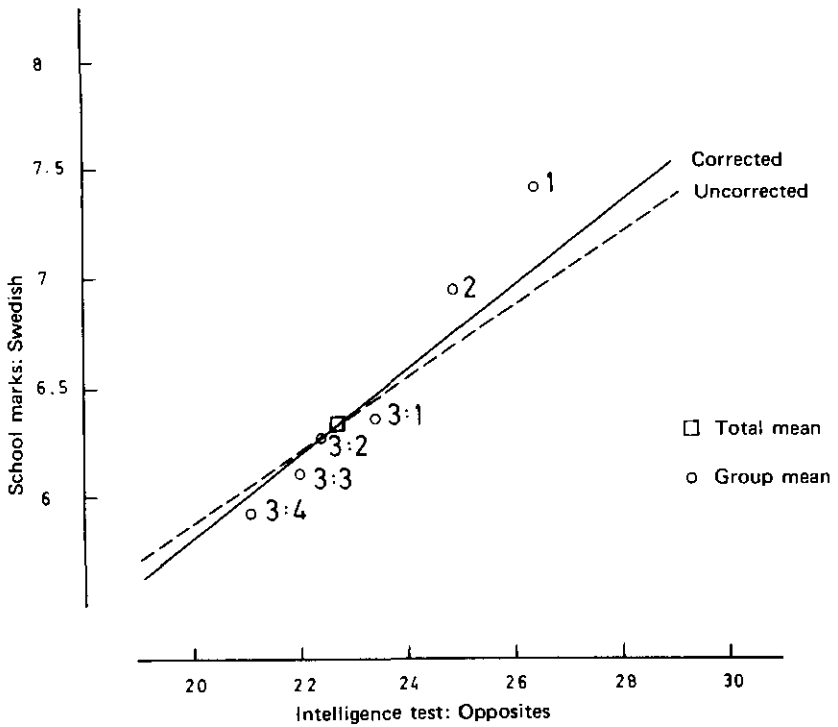

Fig. V:1. Comparison between corrected and uncorrected regression lines. Boys. Elementary school 1961.

Table V:1. Adjusted means estimated by uncorrected regression (UC) and regression corrected for lack of reliability (C).

Estimate	Background level					
	1	2	3:1	3:2	3:3	3:4
UC	6.797	6.596	6.215	6.319	6.204	6.184
C	6.701	6.538	6.196	6.327	6.222	6.225

The standard deviation around the uncorrected within-groups regression line was calculated according to the following formula:

$$s'_{yw} = s_{yw}\sqrt{1-r_w^2}$$

and around the corrected line:

$$s'_{ywc} = s_{yw}\sqrt{1-\left[\frac{r_w}{\sqrt{r_{xx_w}}}\right]^2}$$

where

s'_{yw} = the standard deviation around an uncorrected within-groups regression line

s'_{ywc} = the standard deviation around a corrected within-groups regression line

s_{yw} = the within-groups standard deviation in y

r_w = the within-groups correlation

This gives the following values:

$$s'_{yw} = 1.631\sqrt{1-0.629^2} = 1.267$$

$$s'_{ywc} = 1.631\sqrt{1-\left[\frac{0.629}{\sqrt{.863}}\right]^2} = 1.200$$

If the differences between the observed and the expected values – i.e. the differences between the adjusted means and the total mean – are expressed as percentages of the standard deviation around the respective regression line, the differences will be greater when the uncorrected line is taken as starting point (Table V:2), in spite of the fact that the standard deviation is somewhat lower around the corrected line. This lower standard deviation is a consequence of the fact that the correlation coefficient, too, has been corrected for unreliability in the x-variable.

Table V:2. Differences between the adjusted group means and the total mean estimated by uncorrected regression (UC) and regression corrected for lack of reliability (C).

Estimate	Background level					
	1	2	3:1	3:2	3:3	3:4
UC	+38	+22	– 8	0	–9	–11
C	+32	+18	–10	+1	–8	– 8

The reduced differences between the adjusted means of the groups are also expressed in a reduced F ratio. When correction was made for unreliability in the x-variable, the F ratio sank from 12.679 to 9.079, which is still a significant value, however.

Among the group differences studied, all but one declined (Table V:3). This means that four of the five t values are reduced, but the significant differences between groups 1 and 3 and 2 and 3 respectively remain.

Table V:3. Differences among adjusted group means estimated by uncorrected regression (UC) and regression corrected for lack of reliability (C).

Comparison	Estimate			
	UC		C	
	diff	t	diff	t
1–2	0.201	1.881	0.163	1.611
1–3	0.562	6.606	0.450	5.588
2–3	0.361	4.680	0.287	3.930
3:12–3:34	0.097	1.855	0.065	1.313
3:13–3:24	−0.039	0.705	−0.059	1.127

The following formula, from Lindquist (1956, p. 327), was used in the t-tests:

$$t = \frac{\bar{Y}'_1 - \bar{Y}'_2}{\sqrt{\sigma^2_{\bar{Y}'_1 - \bar{Y}'_2}}}$$

where

$$\sigma^2_{\bar{Y}'_1 - \bar{Y}'_2} = \left[\frac{1}{n_1} + \frac{1}{n_2} + \frac{(\bar{X}_1 - \bar{X}_2)^2}{ss_{xw}}\right] \cdot s'^2_{yw}$$

$\bar{Y}'_{1\,..\,2}$ = the adjusted group mean in y;

$\sigma^2_{\bar{Y}'_1 - \bar{Y}'_2}$ = the error variance of the difference between the adjusted group means;

$\bar{X}_{1\,..\,2}$ = the group mean in x ;

ss_{xw} = the sum of squares within-groups in x

$n_{1\,..\,2}$ = number of pupils in the group

When testing the differences in the right-hand column of Table V:3, consideration was paid to the fact that we are concerned with both adjusted and corrected values. When the error variances were calculated for these differences, ss_{xw} was multiplied by r_{xx_w} and s'^2_{yw} was replaced by s'^2_{ywc}, which reduced the error variances somewhat.

Appendix 6

Table VI:1. Verbal achievement: means and standard deviations for different background levels. Elementary school 1961.

Background level	Boys					Girls				
	School mark (Range: 0–12)			Achievement test (Range: 22–154)		School mark (Range: 0–12)			Achievement test (Range: 22–154)	
	N	Mean	S.D.	Mean	S.D.	N	Mean	S.D.	Mean	S.D.
1	254	7.41	1.64	98.12	15.62	246	8.13	1.47	103.12	15.46
2	316	6.96	1.65	94.27	16.37	312	7.36	1.49	94.00	16.17
3:1	291	6.34	1.74	89.53	16.88	278	6.89	1.62	91.73	15.88
3:2	711	6.27	1.65	86.10	16.49	677	7.00	1.56	89.13	16.22
3:3	562	6.09	1.58	86.71	15.62	548	6.33	1.50	86.41	14.80
3:4	816	5.93	1.59	82.76	16.12	817	6.53	1.55	85.69	15.48
Total	2950	6.32	1.69	87.54	16.79	2878	6.86	1.62	89.61	16.36

Table VI:2. Verbal achievement: means and standard deviations for different background levels. Experimental comprehensive school 1961.

Background level	Boys					Girls				
	School mark (Range: 0–12)			Achievement test (Range: 22–154)		School mark (Range: 0–12)			Achievement test (Range: 22–154)	
	N	Mean	S.D.	Mean	S.D.	N	Mean	S.D.	Mean	S.D.
1	187	7.40	1.60	99.93	15.17	184	7.73	1.61	100.11	16.24
2	200	6.58	1.58	93.09	14.98	223	7.09	1.56	93.99	15.56
3:1	230	6.43	1.63	90.21	15.46	232	6.68	1.54	90.75	15.05
3:2	192	6.05	1.67	84.98	18.45	157	6.97	1.46	91.25	14.61
3:3	421	5.95	1.57	86.30	15.03	456	6.32	1.54	87.07	14.69
3:4	269	5.71	1.56	82.72	16.16	326	6.36	1.59	85.42	16.04
Total	1499	6.26	1.67	88.69	16.78	1578	6.72	1.62	90.18	15.99

Appendix 6

Table VI:3. Verbal achievement: means and standard deviations for different background levels. Elementary school 1966.

Background level	Boys					Girls				
	School mark (Range: 0–12)			Achievement test (Range: 0–204)		School mark (Range: 0–12)			Achievement test (Range: 0–204)	
	N	Mean	S.D.	Mean	S.D.	N	Mean	S.D.	Mean	S.D.
1	47	7.66	1.34	136.26	25.33	64	7.97	1.38	139.41	26.72
2	93	6.90	1.68	125.35	29.65	106	7.45	1.54	130.33	26.87
3:1	48	6.17	1.71	114.08	27.20	56	6.75	1.40	122.50	28.38
3:2	211	6.18	1.57	111.89	29.71	212	7.20	1.48	124.16	25.98
3:3	94	5.89	1.55	111.02	26.96	82	6.45	1.67	117.24	30.31
3:4	238	5.93	1.57	109.97	27.88	249	6.83	1.52	117.67	27.38
Total	731	6.25	1.64	114.58	29.22	769	7.07	1.60	123.32	27.97

Table VI:4. Verbal achievement: means and standard deviations for different background levels. Comprehensive school 1966.

Background level	Boys					Girls				
	School mark (Range: 1–5)			Achievement test (Range: 0–103)		School mark (Range: 1–5)			Achievement test (Range: 0–103)	
	N	Mean	S.D.	Mean	S.D.	N	Mean	S.D.	Mean	S.D.
1	432	3.54	0.90	62.81	14.33	421	3.91	0.82	65.82	15.13
2	520	3.23	0.92	58.02	15.12	521	3.61	0.85	61.74	14.53
3:1	352	3.04	0.95	55.32	15.77	344	3.37	0.88	57.67	14.99
3:2	403	3.01	0.95	53.13	15.96	438	3.50	0.91	58.27	15.88
3:3	685	2.80	0.93	51.62	15.30	669	3.20	0.91	54.58	14.81
3:4	705	2.83	0.89	50.46	15.02	654	3.26	0.86	55.12	14.94
Total	3097	3.04	0.95	54.61	15.77	3047	3.44	0.91	58.36	15.50

Appendix 6

Table VI:5. Quantitative achievement: means and standard deviations for different background levels. Elementary school 1961.

Background level	Boys					Girls				
	School mark (Range: 0–6)			Achievement test (Range: 10–70)		School mark (Range: 0–6)			Achievement test (Range: 10–70)	
	N	Mean	S.D.	Mean	S.D.	N	Mean	S.D.	Mean	S.D.
1	254	3.78	1.00	46.75	9.08	246	3.89	0.92	46.08	8.43
2	316	3.56	1.06	45.28	9.34	312	3.47	0.95	41.74	8.72
3:1	291	3.16	1.07	42.24	10.11	278	3.24	0.99	41.33	8.54
3:2	711	3.21	1.06	41.17	9.43	677	3.33	0.98	40.10	8.99
3:3	562	2.97	1.11	40.78	9.50	548	2.88	0.99	37.80	8.73
3:4	816	3.00	1.03	39.04	9.21	817	3.00	1.00	37.90	8.75
Total	2950	3.19	1.09	41.53	9.72	2878	3.21	1.03	39.85	9.07

Table VI:6. Quantitative achievement: means and standard deviations for different background levels. Experimental comprehensive school 1961.

Background level	Boys					Girls				
	School mark (Range: 0–6)			Achievement test (Range: 10–70)		School mark (Range: 0–6)			Achievement test (Range: 10–70)	
	N	Mean	S.D.	Mean	S.D.	N	Mean	S.D.	Mean	S.D.
1	187	3.81	1.00	47.59	9.04	184	3.61	1.02	44.74	8.96
2	200	3.31	1.04	43.76	9.26	223	3.29	1.01	41.90	8.98
3:1	230	3.23	1.05	42.89	9.09	232	3.08	1.02	40.12	8.86
3:2	192	3.14	1.10	40.50	10.32	157	3.51	0.94	41.92	8.55
3:3	421	2.92	1.02	40.40	8.82	456	2.87	1.02	38.14	9.11
3:4	269	2.80	1.06	38.05	9.74	326	3.01	1.00	37.70	9.44
Total	1499	3.14	1.09	41.72	9.73	1578	3.14	1.04	40.02	9.34

Appendix 6

Table VI:7. Quantitative achievement: means and standard deviations for different background levels. Elementary school 1966.

Background level	Boys					Girls				
	School mark (Range: 0–6)			Achievement test (Range: 0–70)		School mark (Range: 0–6)			Achievement test (Range: 0–70)	
	N	Mean	S.D.	Mean	S.D.	N	Mean	S.D.	Mean	S.D.
1	47	4.23	0.81	44.66	11.87	64	3.84	0.93	39.81	12.07
2	93	3.54	1.01	38.96	12.82	106	3.63	0.90	36.61	12.01
3:1	48	3.33	0.88	36.29	10.94	56	3.23	0.89	33.00	12.87
3:2	211	3.20	1.12	35.00	13.82	212	3.40	0.99	34.61	12.67
3:3	94	3.00	1.01	32.17	12.09	82	3.21	1.06	32.10	12.15
3:4	238	3.04	1.03	32.82	12.20	249	3.16	1.00	32.00	12.79
Total	731	3.24	1.07	35.14	13.02	769	3.36	1.00	34.09	12.71

Table VI:8. Quantitative achievement: means and standard deviations for different background levels. Comprehensive school 1966.

Background level	Boys					Girls				
	School mark (Range: 1–5)			Achievement test (Range: 0–70)		School mark (Range: 1–5)			Achievement test (Range: 0–70)	
	N	Mean	S.D.	Mean	S.D.	N	Mean	S.D.	Mean	S.D.
1	432	3.86	0.94	45.65	12.00	421	3.69	0.94	41.32	12.26
2	520	3.44	1.01	40.22	12.87	521	3.38	0.93	37.39	12.49
3:1	352	3.24	1.03	37.36	12.75	344	3.19	0.91	34.73	11.90
3:2	403	3.18	1.03	35.84	14.02	438	3.26	0.96	34.92	13.04
3:3	685	2.97	1.04	34.21	13.62	669	2.98	0.93	32.15	12.20
3:4	705	2.98	1.02	33.68	12.82	654	3.02	0.96	32.25	12.52
Total	3097	3.23	1.06	37.26	13.67	3047	3.22	0.97	35.02	12.80

DATA FROM THE ANALYSES OF COVARIANCE

This appendix reports the average within-groups regressions corrected for unreliability in the x-variable (b_{wc}), and used when marks are employed as y-variable and intelligence test as x-variable (Model A), achievement test as y-variable and intelligence test as x-variable (Model B), and marks as y-variable and achievement test as x-variable (Model C). Further, the adjusted group means ($\bar{Y}'_1$ ... $\bar{Y}'_{3:4}$), calculated with the aid of these regression coefficients, the total means ($\bar{Y}_{tot}$) and the standard deviations around the respective regression lines (s'_{ywc}), are given. If there are significant differences between the adjusted – and for unreliability in the x-variable corrected – values, they are indicated by the F ratios being underlined.

Table VII:1. Verbal achievement: within-groups regressions, adjusted group means, total means, standard deviations around the within-groups regression lines and F ratios. Elementary school 1961.

	Boys			Girls		
	Model A	Model B	Model C	Model A	Model B	Model C
b_{wc}	0.189	2.203	0.092	0.184	2.177	0.088*
$\bar{Y}'_1$	6.70	89.91	6.44	7.10	90.91	6.93
$\bar{Y}'_2$	6.54	89.34	6.35	7.01	89.87	6.97
$\bar{Y}'_{3:1}$	6.20	87.88	6.16	6.70	89.45	6.70
$\bar{Y}'_{3:2}$	6.33	86.76	6.40	7.05	89.81	7.04
$\bar{Y}'_{3:3}$	6.22	88.21	6.17	6.54	88.90	6.62
$\bar{Y}'_{3:4}$	6.23	86.20	6.37	6.85	89.48	6.88
$\bar{Y}_{tot}$	6,32	87.54	6.32	6.86	89.61	6.86
s'_{ywc}	1.20	9.76	0.79	1.08	8.67	0.77
F	9.08	9.16	9.86	18.17	1.87	21.93

* The regression coefficients differ between subgroups 1–3:4 (F=3.45).

Table VII:2. Verbal achievement: within-groups regressions, adjusted group means, total means, standard deviations around the within-groups regression lines and F ratios. Experimental comprehensive school 1961.

	Boys			Girls		
	Model A	Model B	Model C	Model A	Model B	Model C
b_{wc}	0.199	2.304	0.092	0.184	2.221	0.089
$\bar{Y}'_1$	6.65	91.22	6.37	7.00	91.22	6.85
$\bar{Y}'_2$	6.33	90.14	6.18	6.82	90.65	6.76
$\bar{Y}'_{3:1}$	6.26	88.24	6.29	6.60	89.83	6.63
$\bar{Y}'_{3:2}$	6.27	87.46	6.39	7.05	92.19	6.88
$\bar{Y}'_{3:3}$	6.10	87.94	6.17	6.51	89.29	6.60
$\bar{Y}'_{3:4}$	6.19	88.32	6.25	6.72	89.82	6.78
$\bar{Y}_{tot}$	6.26	88.69	6.26	6.72	90.18	6.72
s'_{ywc}	1.14	9.38	0.76	1.12	8.10	0.83
F	5.93	4.72	3.58	8.96	3.89	4.94

Table VII:3. Verbal achievement: within-groups regressions, adjusted group means, total means, standard deviations around the within-groups regression lines and F ratios. Elementary school 1966.

	Boys			Girls		
	Model A	Model B	Model C	Model A	Model B	Model C
b_{wc}	0.191	3.843	0.049	0.170	3.544	0.047
$\bar{Y}'_1$	6.76	118.15	6.60	7.40	127.58	7.21
$\bar{Y}'_2$	6.53	117.91	6.38	7.22	125.45	7.12
$\bar{Y}'_{3:1}$	5.97	110.08	6.19	6.81	123.71	6.79
$\bar{Y}'_{3:2}$	6.38	115.85	6.32	7.23	124.78	7.16
$\bar{Y}'_{3:3}$	6.07	114.50	6.07	6.56	119.45	6.74
$\bar{Y}'_{3:4}$	6.05	112.38	6.16	7.00	121.26	7.09
$\bar{Y}_{tot}$	6.25	114.58	6.25	7.07	123.32	7.07
s'_{ywc}	1.15	18.26	0.80	1.10	16.74	0.85
F	5.81	2.42	3.88	6.67	3.04	4.64

Table VII:4. Verbal achievement: within-groups regressions, adjusted group means, total means, standard deviations around the within-groups regression lines and F ratios. Comprehensive school 1966.

	Boys			Girls		
	Model A	Model B	Model C	Model A	Model B	Model C
b_{wc}	0.108	2.180	0.052	0.104	2.126	0.050
$\bar{Y}'_1$	3.16	55.14	3.11	3.59	59.30	3.53
$\bar{Y}'_2$	3.09	55.00	3.06	3.46	58.70	3.44
$\bar{Y}'_{3:1}$	2.99	54.27	3.00	3.36	57.57	3.40
$\bar{Y}'_{3:2}$	3.08	54.73	3.08	3.53	58.92	3.50
$\bar{Y}'_{3:3}$	2.94	54.30	2.96	3.36	57.85	3.39
$\bar{Y}'_{3:4}$	3.02	54.39	3.05	3.40	58.03	3.42
$\bar{Y}_{tot}$	3.04	54.61	3.04	3.44	58.36	3.44
s'_{ywc}	0.70	9.50	0.51	0.65	9.00	0.49
F	6.31	0.73	6.10	9.20	2.43	6.08

Table VII:5. Quantitative achievement: within-groups regressions, adjusted group means, total means, standard deviations around the within-groups regression lines and F ratios. Elementary school 1961.

	Boys			Girls		
	Model A	Model B	Model C	Model A	Model B	Model C
b_{wc}	0.096	0.919	0.107*	0.083	0.836	0.108
$\bar{Y}'_1$	3.47	43.69	3.22	3.59	43.09	3.22
$\bar{Y}'_2$	3.40	43.74	3.16	3.30	40.04	3.27
$\bar{Y}'_{3:1}$	3.14	42.09	3.08	3.21	41.03	3.08
$\bar{Y}'_{3:2}$	3.21	41.10	3.25	3.28	39.63	3.30
$\bar{Y}'_{3:3}$	3.01	41.15	3.05	2.99	38.97	3.10
$\bar{Y}'_{3:4}$	3.14	40.45	3.26	3.13	39.16	3.21
$\bar{Y}_{tot}$	3.19	41.53	3.19	3.21	39.85	3.21
s'_{ywc}	0.80	6.66	0.49	0.79	6.49	0.45
F	16.47	17.34	18.51	20.84	16.31	17.40

* The regression coefficients differ between subroups 1–3:4 (F=3.64).

Table VII:6. Quantitative achievement: within-groups regressions, adjusted group means, total means, standard deviations around the within-groups regression lines and F ratios. Experimental comprehensive school 1961.

	Boys			Girls		
	Model A	Model B	Model C	Model A	Model B	Model C
b_{wc}	0.094	0.921	0.111	0.088	0.891	0.105
$\bar{Y}'_1$	3.46	44.16	3.16	3.34	41.98	3.11
$\bar{Y}'_2$	3.20	42.77	3.08	3.16	40.60	3.10
$\bar{Y}'_{3:1}$	3.16	42.23	3.10	3.08	40.07	3.07
$\bar{Y}'_{3:2}$	3.22	41.25	3.28	3.43	41.12	3.31
$\bar{Y}'_{3:3}$	3.00	41.24	3.06	2.99	39.39	3.06
$\bar{Y}'_{3:4}$	2.99	39.87	3.21	3.12	38.83	3.26
$\bar{Y}_{tot}$	3.14	41.72	3.14	3.14	40.02	3.14
s'_{ywc}	0.80	6.67	0.41	0.79	6.43	0.49
F	10.54	10.44	10.01	9.96	7.49	11.22

Table VII:7. Quantitative achievement: within-groups regressions, adjusted group means, total means, standard deviations around the within-groups regression lines and F ratios. Elementary school 1966.

	Boys			Girls		
	Model A	Model B	Model C	Model A	Model B	Model C
b_{wc}	0.086	1.138	0.073	0.080	1.100	0.068
$\bar{Y}'_1$	3.81	39.05	3.53	3.71	38.00	3.46
$\bar{Y}'_2$	3.36	36.58	3.26	3.49	34.62	3.46
$\bar{Y}'_{3:1}$	3.27	35.42	3.25	3.26	33.37	3.31
$\bar{Y}'_{3:2}$	3.26	35.67	3.21	3.38	34.32	3.37
$\bar{Y}'_{3:3}$	3.08	33.21	3.22	3.25	32.66	3.34
$\bar{Y}'_{3:4}$	3.13	34.03	3.21	3.26	33.30	3.31
$\bar{Y}_{tot}$	3.24	35.14	3.24	3.36	34.09	3.36
s'_{ywc}	0.81	9.50	0.51	0.79	9.69	0.54
F	6.28	3.46	3.23	4.34	2.88	1.75

Appendix 7

Table VII:8. Quantitative achievement: within-groups regressions, adjusted group means, total means, standard deviations around the within-groups regression lines and F ratios. Comprehensive school 1966.

	Boys			Girls		
	Model A	Model B	Model C	Model A	Model B	Model C
b_{wc}	0.093	1.261	0.073	0.082	1.164	0.069
$\bar{Y}'_1$	3.55	41.47	3.25	3.47	38.17	3.26
$\bar{Y}'_2$	3.30	38.33	3.23	3.29	36.02	3.22
$\bar{Y}'_{3:1}$	3.24	37.36	3.24	3.19	34.68	3.21
$\bar{Y}'_{3:2}$	3.24	36.61	3.28	3.22	34.36	3.26
$\bar{Y}'_{3:3}$	3.10	35.99	3.19	3.10	33.91	3.18
$\bar{Y}'_{3:4}$	3.11	35.48	3.24	3.14	33.97	3.21
$\bar{Y}_{tot}$	3.23	37.26	3.23	3.22	35.02	3.22
s'_{ywc}	0.75	9.16	0.45	0.73	9.13	0.46
F	23.18	26.64	2.47	14.70	14.82	2.28

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