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UTVÄRDERING GENOM UPPFÖLJNING

A LONGITUDINAL PROGRAM FOR STUDYING EDUCATION AND CAREER DEVELOPMENT

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A LONGITUDINAL PROGRAM FOR STUDYING EDUCATION AND CAREER DEVELOPMENT

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Evaluation Through Follow-up is a research program aiming at a continuous evaluation of the Swedish school system. The program was initiated by Statistics Sweden and the National Board of Education.

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ABSTRACT

Title: Evaluation Through Follow-up. A longitudinal program for studying education and career development

The report describes a program of longitudinal research started in 1961 and now including nationally representative samples from six birth cohorts in Sweden. The oldest group was born in 1948, the youngest in 1982. With one exception the samples consist of between 9 000 and 12 000 individuals, i.e. between 8 and 10 percent of their birth cohorts. The samples are being followed from the age of ten or thirteen through the educational system and to some extent also after entry into the labor market.

The basic data collections cover family background, intelligence, school achievement and responses to questionnaires about school adjustment, interests and educational and occupational plans. In the later cohorts also parents and teachers have contributed information by responding to questionnaires.

The follow-up data include choices and achievement at later stages in the educational system as well as out-of school information on, i.a., occupation, adult interests and self-rated competencies.

Both the initial data and the follow-up information have been utilized for analysis of a wide range of research questions. In a series of ten examples analytical metods and results are briefly described for a selection of topics, namely

* factors influencing the transition to academic upper secondary education in different birth cohorts;

* ability and achievement in relation to gender and social background;

* path models for upper secondary and higher education;

* groups deviating from the traditional career patterns;

* recruitment to science and technology;

* effects of financial aid for entry into higher education;

* selection effects in taking the admission tests to higher education;

* intelligence changes between birth cohorts;

* intelligence changes within individuals with different amounts of education; and finally

* long-term effects of education.

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Background

In an interview in connection with his retirement a Swedish professor of medicine stated that the personal identification numbers, used in all kinds of official registers, are 'Sweden's most important contribution to the world'. They make it possible to trace and locate all patients and check, for example, the results of different treatments. Even if this may be a facetious overstatement, a social scientist studying individual development over longer periods of time could easily agree. And especially if he or she had tried to do such studies also before the introduction of the identification numbers in the late 1940s. The present author belongs to that category.

The longitudinal program to be described stands and falls with the existence of an identification system, which makes it possible to follow large nation-wide representative samples through the educational system into adult age. The Swedish identification system is based on the birth dates: year, month and date give the first six digits, a three-digit code differentiates between all born on the same day, and a tenth digit (a function of the first nine) checks that the combination is correct. In the first two cohorts within the program - the cohorts born in 1948 and 1953 - the birth date also formed the sampling criterion. Everyone born on the 5th, 15th and 25th in any month of the year was included in the sample. This produced 10 percent samples of whole birth cohorts.

The program was initiated by a committee reorganizing the system of education statistics in Sweden in order to supply more relevant information for the evaluation of the school reforms that were taking place during the 1960s. Among other innovations they proposed a person-based system of data collection beginning at the age of 13 when the pupils normally were in grade 6 and had to make their first choice between a more theoretical and a general curriculum for the rest of their compulsory education. Data should be collected every fifth year for a 10 percent sample of the age cohort as described above. The data should comprise information available in the schools about background, type of education and school marks.

Then a group of researchers (Torsten Husén from education, Gösta Carlsson from sociology and myself) suggested that these administrative data should be complemented with more research-oriented information, for instance, questionnaires answered by pupils, scores from ability and achievement tests. This information could be used as a basis both for evaluation studies and for fundamental research on status attainment processes related to the reformed system of education. Even if the program primarily was planned for studies of educational and occupational careers it should be flexible enough to serve social research in general where background information and early performance of individuals could be interesting control and explanatory variables.

The collection of these additional data was supported by the Council for Social Science Research. The Department of Education at Göteborg University, in cooperation with Statistics Sweden, took on the administration and processing of the additional data. The data collection began in 1961.

The administrative collection of data on individual pupils by Statistics Sweden afforded the opportunity to start and still continue the longitudinal program. Without a close cooperation, until now for more than thirty-five years, with this agency the program would not have been possible at all. More detailed documentation of the program in general is found in Statistiska Centralbyrån (1976) and Härnqvist, Emanuelsson, Reuterberg and Svensson (1994).

The "piggy-backing" of research information on the administrative data collection was inspired by several sources. Gunnar Boalt (1947) followed a cohort of Stockholm pupils through the educational system. Torsten Husén (1950) started publishing follow-up results from a cohort in the city of Malmö, first studied in 1938 by Siver Hallgren. This formed the still ongoing Malmö project - perhaps the oldest longitudinal project in the field of education. Major reports from this project have been published by Husén (1969), Emanuelsson (1974), Fägerlind (1975), Furu (1985), Tuijnman (1989) and others.

Inspiration also came from the American Project Talent (Flanagan, 1962) which started in 1960 but was known to me from its planning stage through a visit in 1957 with its initiator John Flanagan. This project also became a warning: only one-third of the original gigantic sample could be reached in a follow-up after five years. There were no personal identification numbers to make use of in the United States!

Most important for my personal involvement in the longitudinal program, however, was my own experiences from a study of "reserves of ability" for higher education done in 1956-57 for a Swedish government commission on university education (Härnqvist, 1958). Nationally representative samples of pupils born in the 1930s were drawn from school registers for early grades. The students were then followed in different registers until 1956 and their educational attainment was compared to their early school marks with social background under control. Since no personal identification numbers were available in the school registers, the follow-up became a very complicated and time-consuming exercise. Even though such a *retrospective* longitudinal study proved to be feasible, I would never have dreamed of repeating it. Therefore the opportunity to work *prospectively* instead was a great challenge - an excitement that has not quite disappeared after all these years.

Cohorts and samples

The program was planned to include samples from every fifth cohort of 13 year old pupils, and so it began in 1961 and 1966. In the late 1960s, however, resistance arose against large scale collections of individual data. The supporting agencies showed only moderate interest in the program. Also the original team at the Göteborg department was rather exhausted after the first two waves of data collection. So the program was temporarily discontinued.

In the late 1970s new initiatives were taken, and a group under Ingemar Emanuelsson at the Stockholm School of Education in cooperation with Statistics Sweden took on the collection of data in 1980 for the 1967 birth cohort (Emanuelsson, 1979). Since then the five year intervals have been followed. From the 1977 cohort on, the administration is back at the Göteborg department under the direction of Sven-Eric Reuterberg and Allan Svensson who were involved already in the first two cohorts. Now the data from all cohorts are located in a data base at the Göteborg department.

The program has been economically supported by several research councils and foundations during its existence, among them the Council for Social Science Research, now part of the Swedish Council for Research in the Humanities and Social Sciences (HSFR), the Swedish Council for Planning and Coordination of Research (FRN), the Swedish Council for Social Research (SFR), the Bank of Sweden Tercentenary Foundation, the National Board of Education, and the National Board of Universities and Colleges.

An overview of the cohorts and sampling designs is presented in Table 1.

Table 1. Cohorts and samples in the longitudinal program.

Year of birth	Year of basic data collection	Grade	Sampling design	Sample sizes
1948	1961	Normally 6	Birth date	10 %=12 000
1953	1966	Normally 6	Birth date	10 %= 9 000
Normally 1967	1980	6	Class in grade 6	9 000
Normally 1972	1982, 1985	3, 6	Class in grade 3	9 000
Normally 1977	1987, 1990	3, 6	Class in grade 3	4 500
Normally 1982	1992, 1995	3, 6	Class in grade 3	9 000

The first two cohorts were sampled on an individual basis by means of the birth dates as described above. This implies that the pupils were found in different grades, around 90 percent however in grade 6 - the normal grade for the age. After the restart a multi-stage sampling of school classes (classrooms) has been used, first in grade 6, later on in grade 3. The cohorts will here be named after the birth year of the majority of pupils. In all cohorts except the 1977 cohort the sample size approximates 10 percent of the birth cohort in Sweden. The 1977 cohort sample approximates 5 percent.

Both sampling principles have their advantages and disadvantages. Sampling of *individual* pupils according to birth date in all local communities of the country gives a better coverage than class sampling in stagewise selected schools. On the other hand the thin and widespread sample makes the data collection very heavy to administer. Since most classes are represented by only two or three pupils, analysis of the impact of class composition becomes impossible and that of school characteristics difficult.

Sampling of *classes* facilitates the administration of the first data collection. It also makes analysis at class level possible for the grade where the sample is taken. In return statistical estimation with proper attention to the clustering effects becomes extremely complicated.

Information collected in the longitudinal program

An overview of the categories of information collected in the longitudinal program is presented below. It differentiates between basic data collected initially, i.e. in grade 3 and 6, and follow-up data at later points of time. Some basic instruments have been kept intact over the cohorts, for instance, the ability tests. Other instruments have been successively revised or complemented. The most important addition to the set of basic instruments was a questionnaire to the parents from the 1967 cohort on and a questionnaire to the teachers in the 1982 cohort.

Basic data

Administrative data from the schools, such as grade, class, school marks in different subjects (if available), achievement test scores (if available)
Father's and mother's education and occupation
Scores from verbal, inductive and spatial ability tests (identical in all cohorts)
Questionnaire responses from pupils on school adjustment, interests, educational and occupational plans etc. (varying between cohorts)
Questionnaire responses from parents on similar items (from the 1967 cohort on, varying between cohorts)

Questionnaire responses from schools and teachers on teaching and on class and school characteristics (from the 1982 cohort on)

Follow-up data from within the school system

Administrative data from the schools, similar to the basic data (yearly)
Questionnaire responses from pupils the year after the completion of compulsory school, similar to the basic data (from the 1967 cohort on, varying between cohorts)

Follow-up data from outside the school system

Questionnaire responses about adult education (only in the 1948 cohort)
Questionnaire and interview responses at the age of 32 about education, occupation, confidence in own capabilities etc (only in the 1948 cohort)
Scores from military classification tests (only men in the 1948 and 1953 cohorts)
Excerpts from the records on study finance (for the older cohorts, only temporarily available)
Excerpts from the register of higher education (for the older cohorts)
Excerpts from the census and income registers (for the 1948 and 1953 cohorts)

The follow-up data thus fall into two categories: such collected regularly from within the education system, and such collected as part of special research projects using the data base as a point of departure. The various combinations of regular and specially collected data are illustrated in the overview below and in a series of examples of results from such studies.

Research topics

A longitudinal data base like the one described here is valuable not only for longitudinal studies but also for cross-sectional analyses within each cohort and comparisons between cohorts. Such cross-sectional studies are, in fact, the only ones that can be done immediately with the basic data while waiting for follow-up information. The following paragraphs present selected examples from different categories of studies. Later on a few of them will be described in some detail.

Cross-sectional studies within a cohort

In grade 6 descriptive studies have regularly been done for a set of strategic variables such as home background, ability and achievement and their relation to the pupils' choices of subjects and courses for the upper stage of the compulsory school.

In the first cohorts such comparisons were developed into analytic studies. Svensson (1964, 1971) studied over- and under-achievement in grade 6 as related to intelligence, gender and social background. Härnqvist (1966) and Reuterberg (1968) compared the choices in the traditional and reformed systems of compulsory education which at that time existed side by side. A large number of minor studies were done by undergraduate students in their third semester of *pedagogik*.

Other cross-sectional studies related ability and achievement to family size and social background (Gustafsson & Svensson, 1982), and differences in achievement were studied between pupils born early and late in the year (Svensson, 1993).

Murray (1998) used the 1972 cohort sample for comparing home and school background of young drivers involved in traffic accidents with that of a normal sample of their age group.

Cross-sectional comparisons between cohorts

The three ability tests have been used in identical form for all cohorts. This has made it possible to study ability changes in representative samples over a period from 1961 to 1985. The analyses were initiated for the 1948 and 1953 cohorts by Stahle (1973; also Härnqvist & Stahle, 1977) who related the changes to ecological characteristics of different types of local communities. Emanuelsson, Reuterberg and Svensson continued the series of comparisons, most recently in a paper from 1993 which included the 1977 cohort.

Longitudinal studies

The ability scores were in focus also in one of the first longitudinal studies within the program. Individual changes in ability were studied from the age of 13 within the 1948 cohort to age 18 in the military conscription tests for males. The changes were related to the amount and type of education obtained between the two measurements (Härnqvist, 1968). This analysis was broadened and continued with more sophisticated methods by Balke-Aurell (1973, 1982).

A great number of studies in different cohorts have related the choice and attainment in upper secondary education to background, ability and achievement in the compulsory school, for instance, Bengtsson (1972), Härnqvist and Svensson (1980) and Härnqvist (1995). Some recent studies of this topic developed path models covering several stages of the educational system (Härnqvist, 1994a). In a special project on long-term effects of education these models also included information on careers and competencies in adult age (Härnqvist 1989, 1994b).

Several studies have dealt more specifically with the recruitment to university education (i.a., Svensson, 1980). A large part of these analyzed the effects of the system of study finance on the recruitment and degree completion of university students (i.a., Reuterberg & Svensson, 1983, 1990, 1994; Reuterberg, 1984, 1986).

Rubenson (1972, 1975) focused on the other end of the educational distribution and studied the recruitment to adult education among persons with low general education. Emanuelsson and his coworkers at the Stockholm School of Education studied the development over time among low-ability pupils (i.a., Emanuelsson & Sonnander, 1990).

Two dissertations have dealt with those who did not continue in upper-secondary (Murray, 1994) or higher education (Hammarström, 1996). Another dissertation studied the educational and occupational adjustment of social case workers (Björkdahl Ordell, 1990). Economists Björn Gustafsson (1990) and Christian Kjellström (1977) used the 1948 cohort for studying factors determining adult income.

The longitudinal information has also been used for examining specific subjects or programs within the school system. Pettersson (1990) focused on the development of achievement in mathematics. Reuterberg modeled the relations between confidence and achievement in mathematics over the school years (1996). Svensson (1995, 1996) studied factors that hinder the choice of science programs in upper secondary education among high ability students.

Reuterberg and Mäkitalo in a series of studies (1994, 1996) used the longitudinal information to study selection effects among university applicants in taking the Swedish Scholastic Aptitude Test (SweSAT).

Murray and Sandqvist (1990) and Sandqvist (1995) related ability and achievement to the family composition.

In the next sections some examples are presented with brief information about problems, design, variables, methods and results.

Example 1: The transition to upper secondary education in different birth cohorts

As mentioned above a study of "reserves of ability" for higher education (Härnqvist, 1958) was an important source of inspiration when the longitudinal program started in 1961. The problem was to estimate the proportion of a cohort capable to pass a theoretical upper secondary education among those who had finished school with only compulsory or lower secondary education.

The design of the study built on an hypothesis (Ekman, 1951) that practically all able pupils from upper middle class had the opportunity to apply for admission into upper secondary schools (*gymnasia*) while those from the lower classes only rarely had been given that chance. School marks from an early stage (here grade 4) were used as predictor of capability against which the transition could be analyzed for upper middle class pupils and the rest of the cohort.

A sample was taken including every fourth class (classroom) in grade 4 in 1944/45; however, only the boys since the collection of transition data had to depend on information in military registers. The total sample comprised about 1 700 classes and 10 000 pupils. Follow-up information was obtained retrospectively for about 9 500, most of them born in 1934.

Figure 1 shows the transition rate to academic upper secondary education in relation to average school marks in grade 4 for boys from upper middle class (SES 1) and for boys from lower middle class (SES 2) and working class (SES 3) taken together.

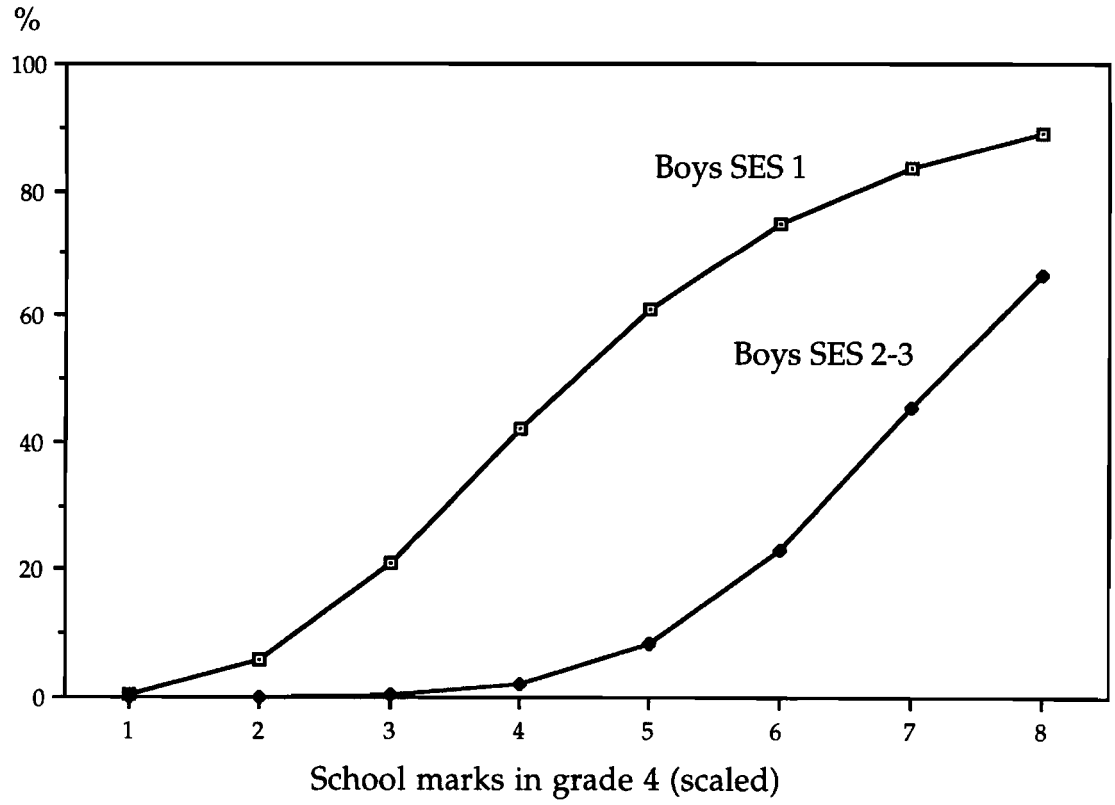

Figure 1. Probability to start upper secondary education (Born 1934).

The curves are based on the percentages of pupils beginning academic upper secondary education at different levels of school marks. The observed

percentages are smoothed by means of a logarithmic function which, however, comes very close to the observed frequencies.

The transition rates are strongly related to the predictor (school marks). As expected they differ widely between the social classes. The maximum difference is about 50 percentage points around level 5 on an 8-point scale.

The second part of the analysis is presented in Figure 2, which shows the completion rates among those who had started upper secondary education. Even in that respect the rates are rather steep functions of the school marks eight or nine years earlier, but the difference is at most between 5 and 10 percentage points. The curves even cross each other at lower levels, but the observed percentages below level 5 are based on very small frequencies and rather unreliable.

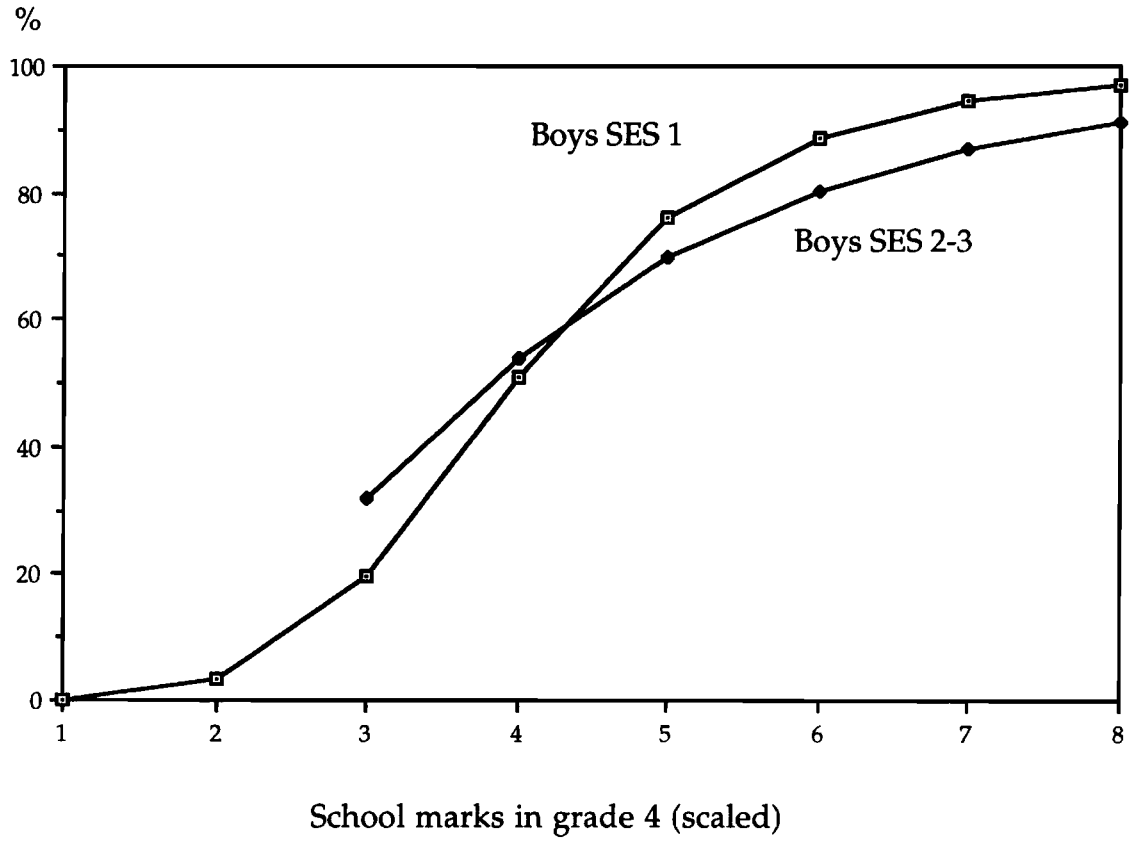

Figure 2. Probability to complete academic upper secondary education (Born 1934).

The transition rates for upper middle class in combination with the completion rates for the lower classes were utilized to estimate the unused potential or "reserve" for an education qualifying for university entrance, i.e. among pupils from the lower classes who never had entered upper secondary education. The graduation from upper secondary education in the sample from the 1934 cohort amounted to 8 percent. If the estimated

reserve also could be recruited, the graduation might increase to about 25 percent of a cohort.

The reserve study in the 1934 birth cohort has been referred to in some detail as a background to a replication in the 1972 cohort (Härnqvist, 1995). In between the two cohorts Swedish society had changed in many respects and several reform interventions had been made in order to diminish the socioeconomic differences in recruitment to theoretical education. What happened over these 38 years?

Figure 3 shows the transition rates in the younger cohort divided into social classes in the same way as before. Now information is available also for the girls. Instead of the early school marks the sum of the verbal and inductive ability scores was used as predictor - a choice that would have been preferable also in the 1934 cohort but such information did not exist then. The term academic upper secondary education as used here refers to the 3- and 4-year theoretical lines in the comprehensive *gymnasieskola* that was introduced in 1971.

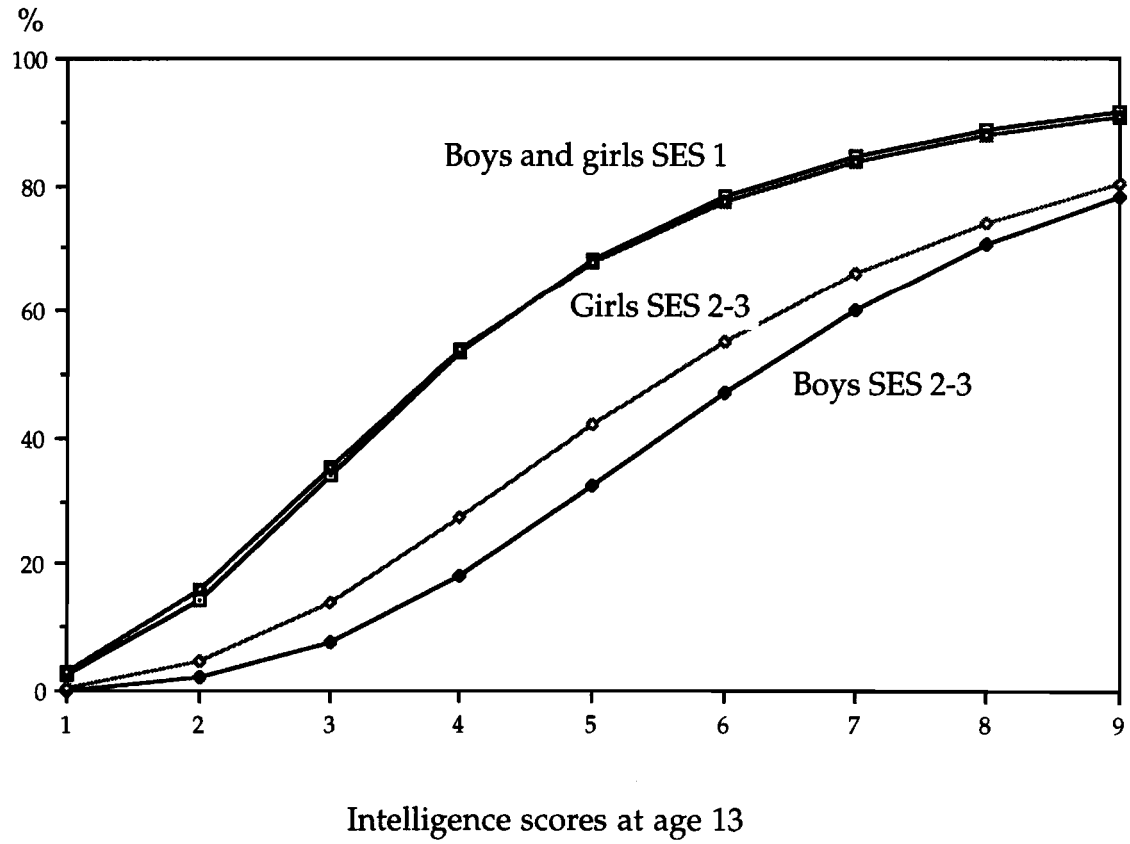

Figure 3. Probability to start academic upper secondary education (Born 1972).

The transition curves have a similar form as in the 1934 cohort but somewhat less steep and considerably higher on the percentage scale. For

boys the maximum difference between social classes is about 35 percentage points at the middle of the ability distribution. For girls it is smaller - between 20 and 25 percentage points. In the upper middle class the curves for boys and girls coincide.

Figure 4 shows the completion rates for the 1972 cohort. As the *gymnasieskola* of 1971 had no final examinations with pass and fail consequences, completion as such is rather insensitive to ability differences. In order to increase the comparability with the 1934 cohort an arbitrary cutoff mark was introduced in the analysis, namely the average mark of 3 on a 5-point marking scale at completion.

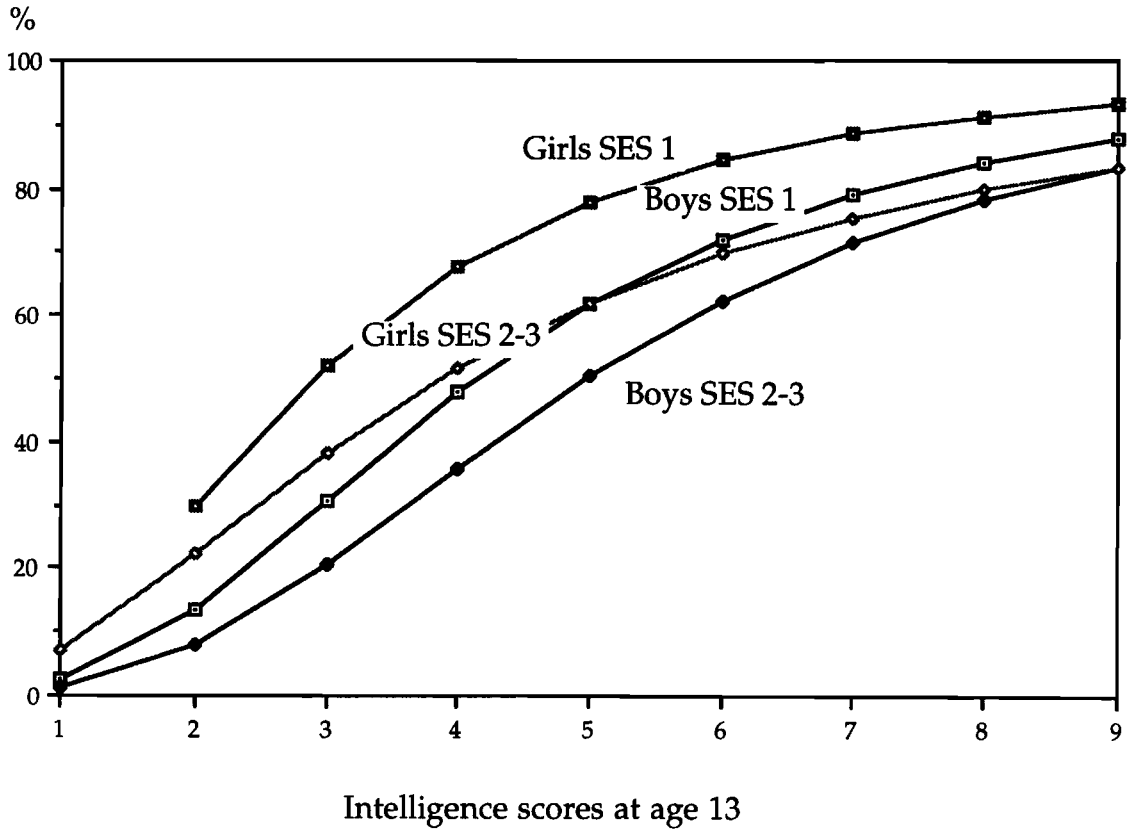

Figure 4. Probability to complete academic upper secondary education (Born 1972).

The curves in Figure 4 thus show the rates of students completing with an average mark of 3 or higher. With this restriction imposed the curves become rather similar to the ones in Figure 2. With a lower cutoff mark the curves would have been higher on the percentage scale and less steep than shown here.

The social classes differ both among girls and boys but the differences are smaller than in Figure 3 - maximum 10 to 15 percentage points for the girls

and somewhat less for the boys. In both social classes girls perform considerably better than boys with the same ability test scores.

In the sample from the 1972 cohort 36 percent completed an upper secondary education on a theoretical line. There is still a "reserve" in the same sense as for the 1934 cohort but much smaller. If this unused potential were added, the graduation might increase to around 50 percent.

In a later study Härnqvist (1997) compared all six available cohorts - born from 1934 to 1977 - where transition to upper secondary education with an academic orientation had taken place. Since the average transition incidence varied from about 10 percent among boys in cohort 1934 to 45 percent among girls in cohort 1977, a direct comparison of percentage differences between socioeconomic strata would be complicated and problematic. Instead the method of logistic regression with computation of odds and odds quotients between strata was used.

The *odds* measure is the percentage in a certain group transferring to upper secondary education divided by the percentage not transferring. As an example the distribution 50/50 equals 1, for 75/25 = 3 and for 25/75 = 0.33.

The *odds quotient* is a quotient between the odds for two compared sub-groups, for instance, boys from upper middle class and boys from working class.

The *logistic regression* estimates the relative importance of ability, social background, and gender for the transition probabilities irrespective of the average transition incidence.

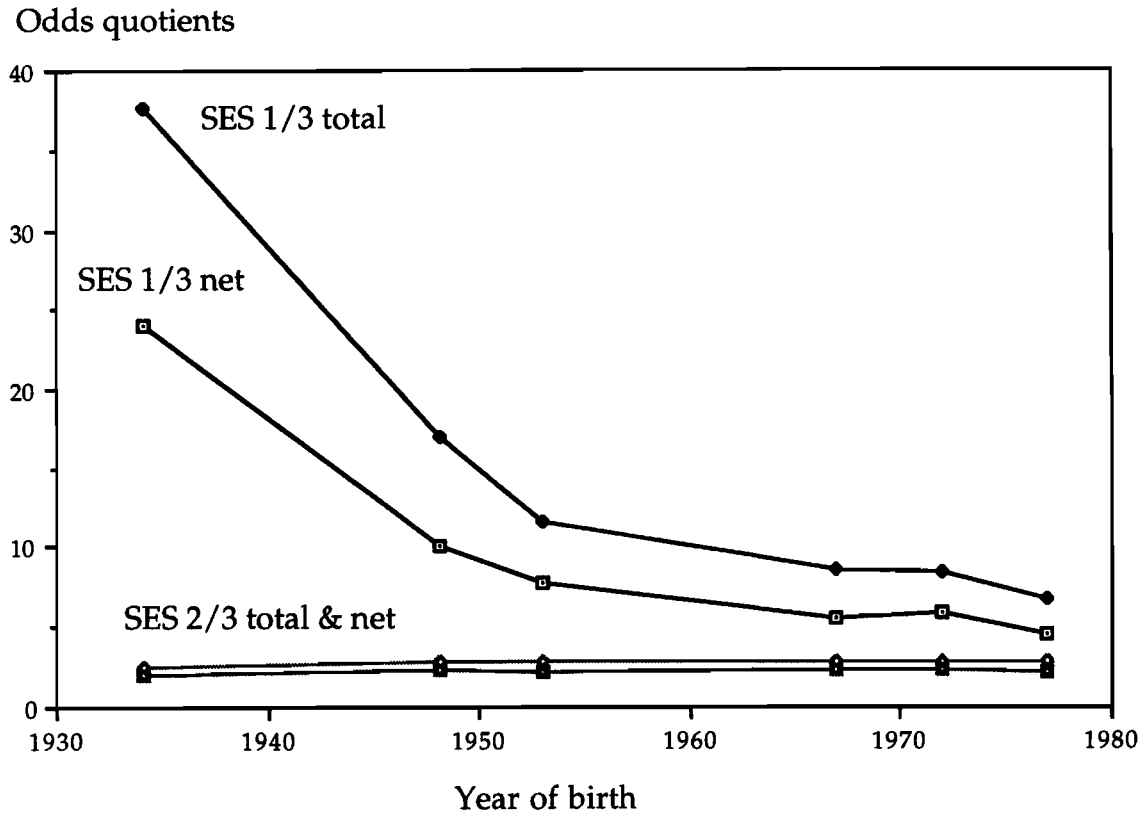

Figure 5. Starting academic upper secondary education. Odds quotients between SES groups.

In Figure 5 the odds quotients between socioeconomic groups are presented for all six cohorts. The diagram contains four different curves. The two upper ones show the odds quotients between SES 1 and SES 3, the two lower ones between SES 2 and SES 3. In each combination the curve for *Net effect* indicates the odds quotients between the two strata when ability and gender effects are held constant by means of logistic partial regression. The other one, for *Total effect*, indicates the odds quotients between strata when these ability and gender effects are not kept under control.

The *total* curve for SES 1/3 begins in the 1934 cohort with the extremely high odds quotient of 38. This means that the probability of starting upper secondary education was 38 times as high for boys from upper middle class than for boys from working class. (As mentioned above the 1934 sample only consisted of boys.) This total effect of social class was to some extent due to ability differences as measured by school marks in grade 4. When these were controlled for (the *net* effect), the odds quotient was reduced to 24 in the 1934 cohort which still is extremely high. The basis for these calculations has been shown already in Figure 1 but then without the separation into lower middle and working class boys.

There were good reasons for pooling the two lower SES groups because they were rather similar and has remained so over time. This is shown in the

two lower curves where the odds quotients for SES 2/3 are in the range of 2 and 3 with the total effect only slightly above the net effect.

The comparison shows a dramatic trend over time in an equalizing direction between the extreme strata (SES 1 and 3) - from a net effect of 24 down to 5. The main reduction occurs between the three early cohorts and almost levels out for those born in 1953 or later.

Between the cohorts of 1934 and 1953 several important changes in the school system occurred. The number of schools with academic upper secondary programs (*gymnasia*) increased heavily and were to a large extent located in cities and towns where such programs were not available for the 1934 cohort. Compulsory schooling was increased to nine years and organized in comprehensive schools with academic and general programs from age 13 side by side. For the 1948 cohort the implementation of comprehensive compulsory schools had reached about a third of the age group. In the 1953 cohort the majority were in schools that gave access to upper secondary education.

The later cohorts - from 1967 to 1977 - have attended upper secondary schools with academic and vocational programs side by side. The comprehensive organization of these schools was expected to further equality of participation in university-preparatory education. In a longer perspective this does not seem to have happened to any considerable extent when social strata are concerned. But it has certainly had an effect on differences between boys and girls. Through the 1953 cohort boys dominated in academic upper secondary education. In the comprehensive gymnasium, visited by a majority of the 1967 to 1977 cohorts, girls have chosen academic programs to a larger extent than boys - and as shown above (Figure 4) they also tend to achieve better than their male equals.

*

This first example bridged between the "prehistory" of the longitudinal program and the latest cohorts. It used some of the most central variables in the program: social background, early individual performance, and educational choice and attainment at upper secondary level - from the 1948 cohort on also gender. It demonstrated a striking stability in the social processes that govern the individual's passage through the educational system but also a decrease over time in their impact.

Example 2: Ability and achievement in relation to gender and social background

In his dissertation Allan Svensson (1971) used the basic data collection for the 1948 and 1953 cohorts to analyze the concepts of over- and under-achievement in school. These concepts are usually defined as positive and

negative discrepancies between school achievement and ability measured with intelligence tests. Svensson prefers the more neutral term relative achievement and tries to locate where, in the interplay between different measures of ability and achievement, differences in that respect occur.

The basic data included a verbal (Opposites) and an inductive (Number Series) ability test, nation-wide used achievement tests in Swedish and mathematics, and school marks in the same two subjects. The relations between these six variables were illustrated in the model shown in Figure 6.

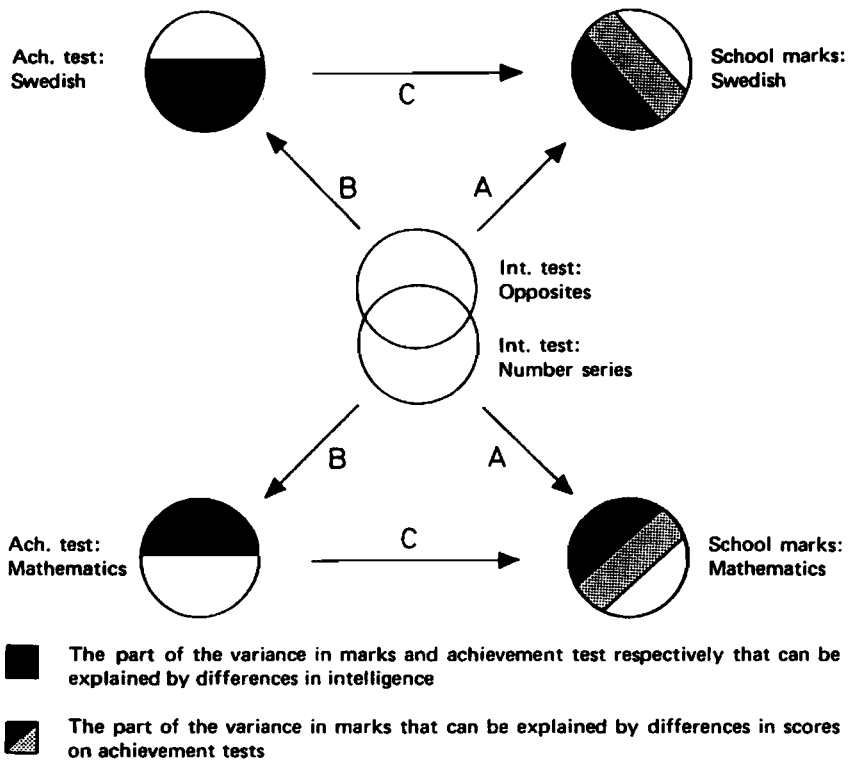

Figure 6. Model of the relations between ability, achievement and school marks in terms of shared variance (Svensson, 1971, p. 64).

In the center two overlapping circles show the relations between the intelligence tests. The Opposites scores roughly explain half of the variance in the achievement test for Swedish and the Number Series scores half of the variance in mathematics. Relations also exist between achievement tests and school marks in the same subject. Part of these relations can be brought back to the relation between the intelligence and achievement tests. These interdependencies can also be visualized as a chain with intelligence at one end and school marks at the other, with the achievement tests occupying a mediating position.

end and school marks at the other, with the achievement tests occupying a mediating position.

In his further analysis Svensson used gender and social background as classification variables. The relations between the different variables were examined by means of covariance analysis.

Svensson illustrated his findings in the form of pairwise regression lines for boys and girls (Figure 7).

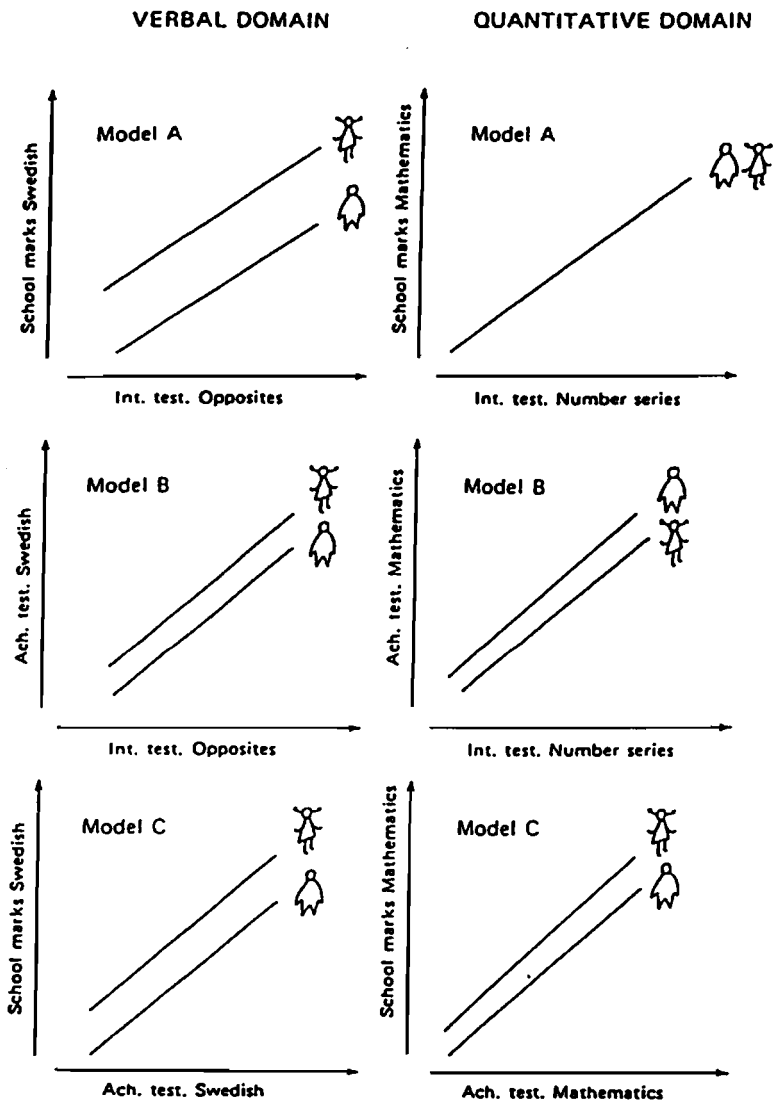

Figure 7. Comparisons between boys and girls in relative achievement (Svensson, 1971, p. 135).

In the *verbal* domain girls get higher school marks than boys when the verbal ability test is controlled for (Model A). This difference sums up differences in the same direction in the other two links of the chain (Models B and C). In other words, girls read and spell better in the achievement tests than expected from the Opposites scores, and with the same results on the achievement test they get higher marks from the teacher.

In the *quantitative* domain the picture is different. Model A shows no difference between boys and girls, i.e. on average they get school marks as predicted from the Number Series test. Behind this result, however, two differences that compensate for each other are concealed. The girls get lower scores on the math achievement test than expected from their inductive ability. On the other hand the teacher gives them higher school marks than their achievement scores predict.

Similar comparisons were made between pupils from upper middle class and working class homes. In both domains the social background means a difference between measured ability and school marks in favor of the higher group - more so in mathematics than in Swedish. In Swedish the difference originates from the relation between achievement tests and school marks, while in mathematics the discrepancy comes from the relation between measured ability and measured achievement.

The relative superiority of girls and middle class pupils in school marks is well known from many investigations. But the analysis of where in the chain from ability measures to school marks this superiority enters is still a rather unique contribution to the study of relative achievement.

In the first two cohorts Allan Svensson studied the achievement in Swedish and mathematics more closely in grade 6. Sven-Eric Reuterberg (1996) used the 1967, 1972 and 1977 cohorts to model the development in mathematics longitudinally from grade 3 to grade 9, also in relation to gender and social background. He studied three aspects of the development: achievement measured by tests and school marks, the choice between courses in mathematics and the pupils' self-evaluation of math competence.

For his analyses he used stepwise partial regression with the variables introduced in chronological order. The main results were illustrated in path models with the significant relations represented by arrows. Figure 8 shows the final model for math achievement.

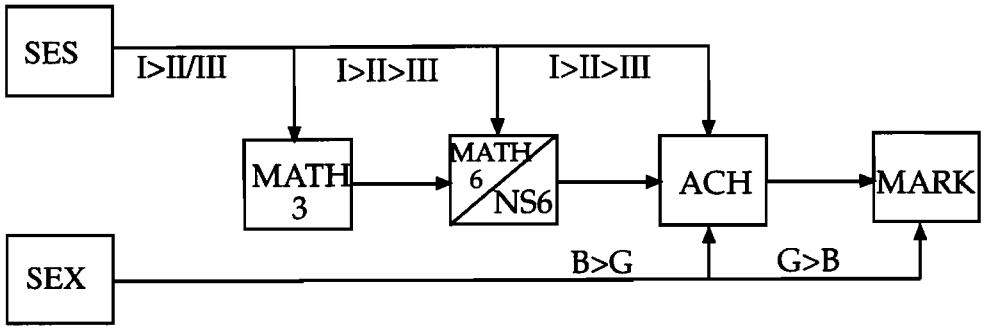

Figure 8. Gender and socioeconomic differences in math achievement in compulsory school (Reuterberg, 1996, p. 83).

Social background influenced the measured math achievement in all three grades both directly and indirectly via the positive relations between the successive measurements. However, it had no additional direct influence on the final school marks. Gender did not influence math achievement until grade 9 when boys scored higher than girls in the math test and girls got higher marks than the math test predicted.

In grades 7, 8 and 9 the pupils could choose between a general and a more advanced course in mathematics. In grade 7 about 75 percent of the pupils chose the advanced course, in grade 9 the proportion had decreased to about 55 percent. Social background influenced this choice in both grades - more so after the attrition from the advanced course. No gender differences remained when math achievement was controlled for.

The pupils' self-evaluations of math competence, on the other hand, were independent of social background but influenced by gender. At the same level of math achievement girls rated their math competence markedly lower than boys did.

The results as described here were similar in all three cohorts. In general they also supported Svensson's findings 25 years earlier - another indication of the stability of the processes studied.

Example 3: A path-model for upper secondary and higher education

In several studies Härnqvist modeled the passage through the educational system as related to home background and ability, i.e. the intermediate steps in the chain from explanatory to criterion variables in Example 1. As a basis for these studies a theoretical model was gradually developed. Its components are presented in Figure 9.

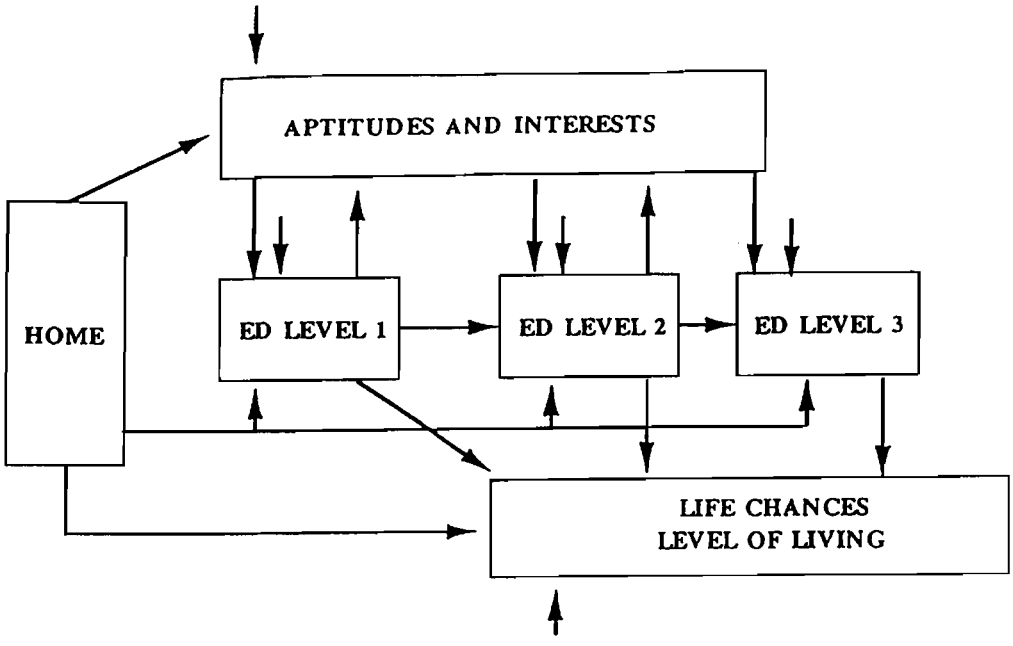

Figure 9. Conceptual model of the chain between background, education and adult performance.

The model illustrates the following processes:

* Home background, for instance, the parents' educational and occupational status, influences the characteristics of the individual such as aptitudes and interests but also the choices within the educational system.

* The educational system is divided into stages. At each stage the individual characteristics influence the level of attainment which in turn has an impact on the transition to the next level and also successively modifies the characteristics with which the individual enters the next stage.

* The individual leaves the educational system with different levels of attainment which in turn influence his or her life chances and level of living.

In a study within the 1967 cohort Härnqvist (1994a) developed path models where relations in the theoretical model were operationalized. The path models were tested in confirmatory analyses by means of LISREL7 (Jöreskog & Sörbom, 1990). Figure 10 presents a path model for males.

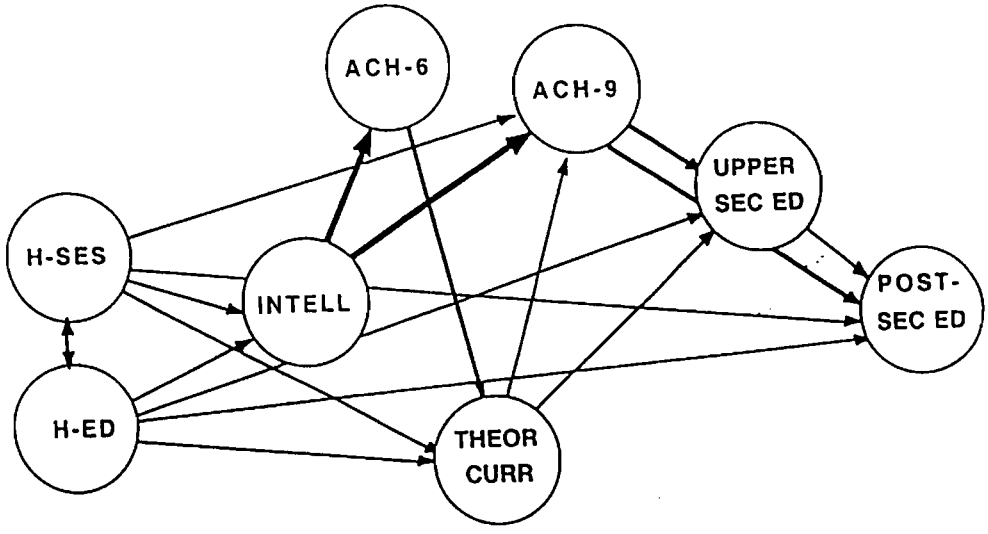

Figure 10. Path model of the relations between background, education and adult performance (Males).

The circles stand for variables and the arrows for significant partial regressions when the variables are introduced in order from left to right. The two measures of home background, parents' occupation (H-SES) and education (H-ED) were strongly interrelated but even so they behaved somewhat differently in relation to the other variables.

The individual characteristics were represented by a factor based on the three ability tests (INTELL). All influences from the home variables on achievement in grade 6 (ACH-6, an average for Swedish, mathematics and English) were mediated by INTELL. INTELL also influenced ACH-9 both directly, and indirectly through ACH-6 and theoretical choices (THEOR).

THEOR and ACH-9 influenced the choice of line in upper secondary education. ACH-9 influenced the choice of post-secondary education both directly and indirectly through the choice of upper secondary line.

Most influences from home background on later stages of education were mediated by achievement and choices in compulsory school but there was a weak direct relation with the choice of post-secondary education; for parental occupation also with choice of upper secondary line.

The total model explained 53 percent of the variance in upper secondary education and 31 percent of the variance in post-secondary education. A similar model for females explained somewhat less of these variances (45 and 27 percent).

A path diagram like this helps to structure the influences between different variables. Other methods are needed to give a more concrete picture of the size of impact. One attempt is made in Table 2 which was arranged so as to emphasize the impact of social background under equal conditions in other variables.

Table 2. Percentage of students starting academic upper secondary education in different combinations of explanatory variables.

			Females			Males		
PERF-6	THEOR	ACH-9	H-SES minus	H-SES plus	Diff	H-SES minus	H-SES plus	Diff
-	-	-	1	3	2	1	2	1
+	-	-	4	11	7	9	15	6
-	+	-	4	7	3	8	15	7
+	+	-	11	26	15	18	29	11
-	-	+	12	20	8	18	42	24
+	-	+	38	61	23	41	70	29
-	+	+	50	56	6	55	73	18
+	+	+	66	81	15	71	87	16

The longitudinal sample was divided in plus- and minus-groups on four variables, strategic for the choice of upper secondary education of a theoretical kind, namely socioeconomic level, performance in grade 6 (based on both ability and achievement measures), theoretical choices in grade 7 and school marks in grade 9. The division into plus- and minus-groups was located as closely as possible to the middle of the distributions. This produced 16 subgroups for each of male and female students. In each subgroup the percentage of students starting academic upper secondary education was tabulated.

The most favorable combination of explanatory variables has plus in all four variables. In that group 81 percent of the females and 87 percent of the males chose a theoretical line. In the least favorable group (minus in all four variables) only 1 percent did so and no difference between genders occurred. In between the extremes the trends were rather regular.

In the next step the difference between plus- and minus-group was calculated pairwise with the other explanatory variables held constant. Then the average difference for the explanatory variables became as follows.

	Females	Males
School marks grade 9	40	45
Theoretical choices grade 7	19	20
Performance grade 6	18	16
Socioeconomic level	10	14

The school marks in grade 9 were most predictive for choice of line in upper secondary school. The plus- and minus-groups in that variable differed with

40 to 45 percentage units. Socioeconomic level as such had the least impact but still some.

On average over the 16 combinations males were 6 percentage points higher than females, but since more females than males belonged to the plus-groups in achievement the gross effect came out in the opposite direction.

The 1967 cohort was the first one where sampling was done at class level. This made it possible to analyze the impact of class composition variables. A first step was to establish the variance proportions that were accounted for at individual and group level. This was done with the HLM technique (Bryk & Raudenbusch, 1992).

It turned out that the non-random variation between classes (classrooms) *within* schools was less than one percent of the total variance in a number of strategic variables. The variance component for schools (each school represented by one or several classes), however, was quite substantial for variables such as socioeconomic status (11 %), ability and achievement in grade 6 and theoretical choices before grade 7 (7 to 8 %). For school marks in grade 9 and for transfer to upper secondary and higher education the school variance was smaller, but before these variables were measured many grade 6 classes from 1980 had been reorganized and some students even moved to other schools.

The HLM analysis also makes it possible to measure the effect of class composition on individual level variables. Here it was found that the average socioeconomic level of the class had a positive effect on the proportion of theoretical choices before grade 7, over and above what the individual characteristics of the pupils predicted. The average achievement level of the class, on the contrary, had a negative impact. The higher this level was in a class, the lower proportion of the pupils made theoretical choices (when individual ACH-6 and H-ED were controlled for). It seems that the pupils judged themselves i relation to their position in the class and underestimated their chances in a more competitive environment. These results are provisional and have to be cross-validated. They suggest, however, that there are interesting contextual effects to be taken into account.

Example 4: Analysis of extreme groups

Within the 1967 cohort that was studied in Example 3 two dissertations have treated groups that in different ways deviate from the normal pattern. Åsa Murray (1994) focused on pupils that at the age of 20 had not entered or completed upper secondary education. Margareta Hammarström (1996) studied the characteristics of high ability students that did not go to higher education.

Nearly 2 000 pupils out of 9 000, i.e. 22 percent, were found in Murray's target group. Half of them never started upper secondary school, half of them dropped out before completion. They often came from homes lacking a tradition of formal education. They experienced difficulties already in compulsory school and took part in special education. In some respects, however, they did not differ too much from those who completed a two-year vocational line. School fatigue was the reason most commonly given by themselves for stopping after compulsory school or dropping out. Only few reported that they had quitted school because they had found jobs or because they would look for employment. Among the different school factors, low marks in science had the strongest effect on the boys' transition to upper secondary school and lack of theoretical courses in grades 7 - 9 on the girls' transition.

A follow-up of the target group was done in 1991 when they were 24 years old. The questionnaire mainly dealt with their occupational situation. Among the respondents, unfortunately only half of those in the original sample, the employment situation was rather satisfactory but this was before the recession and the increasing youth unemployment later in the 1990s.

Hammarström also studied about 2 000 students but those who were in the highest third according to the ability test in grade 6. Half of the group had started higher education at the age of 25, the other half had gradually changed to less theoretical alternatives. This stepwise attrition in the intellectually well qualified group is illustrated in Figure 11.

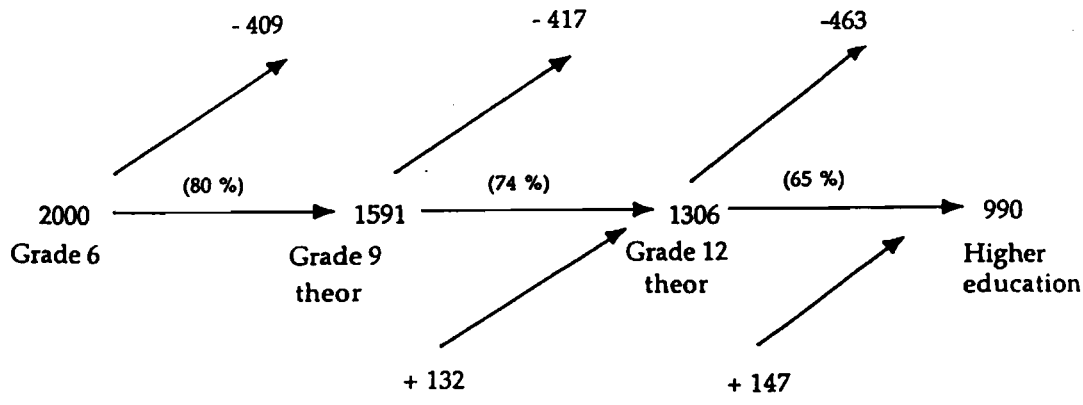

Figure 11. Flows of high ability pupils from grade 6 in compulsory school to higher education (Hammarström, 1996, p. 186).

A fifth of the group did not choose the set of theoretical courses in grades 7 - 9. A fourth of the remaining students did not choose a 3 or 4 year upper secondary line. In the next step from upper secondary to higher education a third stayed behind. The losses were to some extent compensated for by students reaching upper secondary or higher education on less regular paths. The successive attrition was clearly related to family background and school adjustment.

At age 25 the persons in the target group of 2 000 answered a questionnaire about *why* or *why not* they had entered higher education. On the facilitating side parental support for going to higher education was the strongest among the reported motives - six-seven times as frequent in the beginning group as in the abstaining group. On the restraining side the strongest motive for not continuing was that they had found a good job directly after upper secondary school. Next among the restrictions came that they needed to complete their marks in order to get admitted. For girls also their family situation and concern about studying on loans were often reported.

Example 5: Recruitment to science and technology

Two reports by Svensson (1995, 1996) are responses to a public concern about insufficient recruitment to science and technology programs at upper secondary and post-secondary levels. Svensson used information about the 1972 cohort in trying to estimate the proportion of students that in spite of satisfactory ability did not choose that kind of program.

As ability measure he used the inductive reasoning test (Number Series) in grade 6 which in several studies had shown high correlations with math achievement as well as with achievement and ability in general. The test scores among those who at the age of 20 had completed an upper secondary education on the science and technology lines (here called the ST group) were tabulated and the average score for that group was used as a cutoff score for a group of potential science and technology students (the PST group) among the rest of the 1972 cohort sample (see Figure 12).

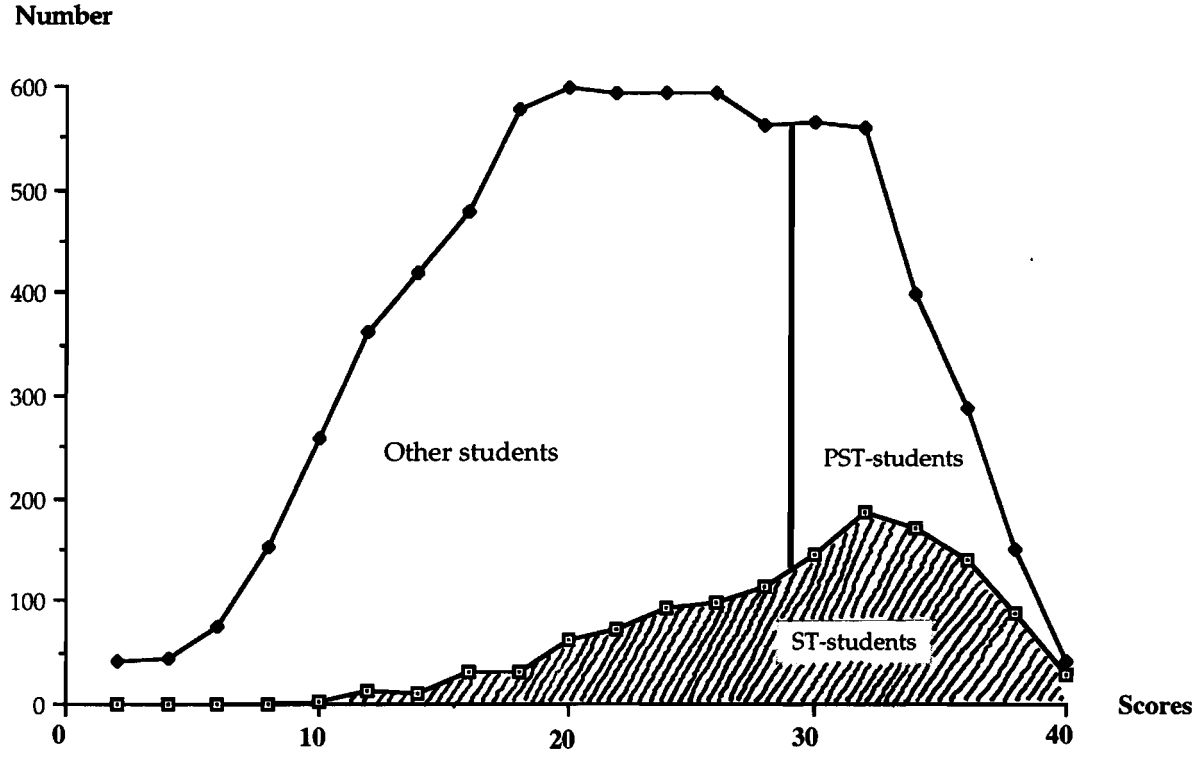

Figure 12. Score distribution of ST, PST and other students in the Inductive Reasoning test in grade 6 (Svensson, 1995, p. 10).

The ST group comprised 22 percent of the males and 11 percent of the females. In the rest of the sample 16 percent of the males and 18 percent of

the females scored above the cutoff line and thus were placed in the PST group. In the analysis the ST and PST groups were compared in a great number of variables. Some of the most striking findings will be summarized here.

The ST students, and in particular students on the science line, more often came from upper middle class homes than the PST students.

In grade 3 the ST and PST groups were rather similar both in their ratings of achievement in different school-related skills and in their scores on math tests. In grade 6 differences began to appear in math ratings - more so among girls, while math scores differed for both genders.

In grade 7 the students could choose an advanced or a general course in math. ST and PST students did so roughly to the same extent but a substantial proportion of the PST students switched back to the general course before grade 9. Their math achievement and math marks in grade 9 were much lower than for the ST students. Also in other indicators the difference between ST and PST students increased dramatically in grades 7 through 9.

A third of the male PST students completed a 3 year upper secondary education on other lines and a fifth did not complete upper secondary education at all in spite of high ability. The female PST students fared better in both respects. The ST students started post-secondary education to a greater extent than the other groups and a very large proportion of the T (technology) students chose civil engineering or other types of technical post-secondary education.

In conclusion, the choices at upper secondary stage were very important for the recruitment to science and technology, and the largest "reserve" of able students for such education should be found among girls from working class families.

Example 6: Financial aid and recruitment to higher education

In a series of studies Reuterberg and Svensson used the longitudinal data for analyzing the effects of student financial aid on the recruitment to post-secondary education in Sweden. A measure of the recruitment effect among students in higher education was based on the responses 'No, probably not' and 'No, definitely not' to the the question 'If there had been no student aid available when you entered higher education, would you have begun to study at all?'

Reuterberg and Svensson (1994) compared the recruitment effect among higher education students in four cohorts - the 1948 and 1953 samples in the longitudinal program and similar samples taken by Statistics Sweden of

students born in 1963 and 1968. The participation in higher education in these cohorts was studied in 1970, 1975, 1985 and 1990. Figure 13 shows the recruitment effect of state-supported financial aid in different socioeconomic groups among these students.

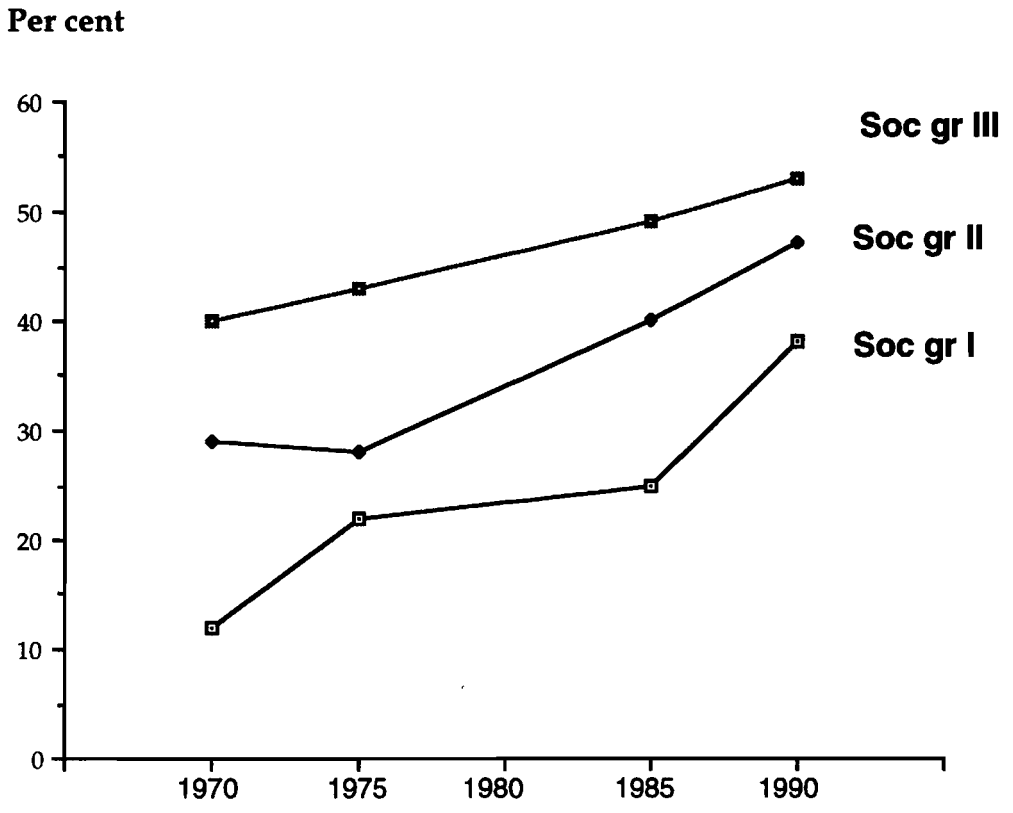

Figure 13. Recruitment effects among students from different socioeconomic groups (Reuterberg & Svensson, 1994, p. 38).

On average the recruitment effect increased over time. There is also a substantial difference related to social background in all cohorts. The effect was strongest among working class (III) and least strong among upper middle class (I) students. In each year the effect was 5 to 10 percentage units higher among female than male students.

In a multivariate analysis of the recruitment effects in the 1990 sample, main effects were found for socioeconomic group, age at entry and length of study program; in addition also an interaction between social class and age showing that the equalizing effect was somewhat stronger among older students.

In an earlier paper Reuterberg and Svensson (1990) showed that changes in the general pattern of selection to higher education make comparisons of

recruitment effects over time complicated. In the oldest cohort which started higher education around 1970 the main point of selection was between compulsory school and upper secondary education. A majority among those going to upper secondary education continued to higher education almost irrespective of social background. Later on the enrolment in upper secondary school increased very much, while the proportion among those who continued in higher education decreased, especially in lower strata. In all social groups the students became more dependent on financial aid and the differential recruitment effect diminished.

If the recruitment effect instead is estimated in relation to all in upper secondary education that fulfill the entrance requirements for higher education, the picture therefore becomes different. On average the effect was 14 percentage units in the 1948 cohort and 12 in the 1953 and 1963 cohorts. In the oldest group there was a differential effect related to socioeconomic group which thereafter disappeared.

The qualified group that did not enter higher education was also studied. When they rated the importance of various obstacles to their participation in higher education the economic obstacles received most votes (Table 3).

Table 3. The most important obstacles to higher education among those who had not entered or did not plan to enter higher education.

Obstacle or reason	Total	SES I	SES II	SES III
I don't want to acquire the debts involved in accepting financial aid	63	54	61	65
I would not be able to live on the financial aid that is available	57	51	59	58
I am not interested in further studies	45	34	39	50
My previous training and/or my grades were not good enough	29	28	25	31
Higher education will not improve my chances on the labor market	26	22	27	27

The ranking was similar in all socioeconomic groups but the percentages for economic obstacles somewhat higher in the lower strata.

Example 7: Selection effects in taking the Scholastic Aptitude Test

The Scholastic Aptitude Test (SwSAT) is part of the admission procedure to higher education in Sweden. The test has regularly showed better scores for male than female applicants. Different changes in the test, especially in the choice of items on general information, have been made in order to render it neutral to gender but with meager outcomes. The remaining differences are not necessarily due to test bias however. Since the test is optional and a complement or an alternative to school marks from upper secondary education, also self-selection to the test is likely to take place. This selection has been studied by Mäkitalo (1994), Reuterberg (1994) and Mäkitalo and Reuterberg (1996).

The data base for the 1972 birth cohort made it possible to identify the test-takers and compare them with the remainder of the representative sample as to gender, socioeconomic background, ability and achievement. The analyses were made by means of multiple regression. For technical reasons a rather complicated and intuitively backward method had to be employed. In simplified terms, gender, test-taking, in some instances also socioeconomic status and type of upper secondary program, were used to predict ability test scores, achievement test scores and school marks in compulsory school. The interaction effects between the "explanatory" variables were used to measure the differential selection effects of gender and socioeconomic status.

As expected the test-taking groups were superior to the rest of the sample in practically all measures, but the males constituted a more highly selected group than the females. A closer analysis indicated that this gender difference was located mainly among those who had chosen non-theoretical programs in upper secondary school, while the differential gender effect was very small for those with a theoretical program. For males the differential effect was strongest in math and science achievements which may account for their better scores on SwSAT in the natural science domain, but the results did not to the same extent support their superiority in the verbal scores.

*

The last few examples came from studies that took their point of departure in problems in educational planning which the data base afforded a possibility to analyze with advanced scientific methods. For instance the study in Example 3 was a direct input into the work of a government commission on social bias in recruitment to higher education. Example 5 is being used as background information for national agency groups working on improving science education. The studies presented in Example 6 contributed to the evaluation of the system of student financial aid as a background to reform proposals. Example 7 has a direct bearing on the admission procedures to higher education. Several other studies have had a similar backgrund - a topical planning problem which thanks to the

accumulated longitudinal information could be studied without delay on representative samples and with advanced analytical methods.

The next and last examples have their origin in fundamental scientific problems which the data base afforded unique possibilities to enlighten.

Example 8: Intelligence changes between cohorts

The three ability tests (Opposites, Metal Folding, and Number Series) have been used under identical conditions in all six cohorts. This has made it possible to study changes over a long period of time. Such studies were started by Gun Stahle and reported in her thesis for the licentiate degree (1973, also in Härnqvist & Stahle, 1977).

The average scores in all tests increased from the 1948 to the 1953 cohort and most markedly so for the girls for whom the increase amounted to a fifth of the initial standard deviation of total scores. In the spatial visualization test Metal Folding a gender difference in favor of boys was considerably reduced between the two cohorts.

These changes were correlated with characteristics of the geographical areas where the pupils went to school. All local communities in Sweden were categorized according to population density in combination with location in the country. Among such 'ecological units' 46 contained more than 30 cases of each gender and were used in the analysis. On average these cells had around 100 boys and 100 girls for which average ability scores were computed.

In addition the ecological units were characterized by indices derived from census data and indices aggregated from the information collected in the project. Several such indices increased over the five year period. For instance, the coverage of the nine year comprehensive school, then under implementation, increased from 30 to 80 percent, and the number of TV licenses increased from 141 to 267 per thousand inhabitants. Also the percentage of parents with secondary education and the occupational activity of mothers changed in the positive direction.

The comparisons indicated that the relations between test score means and population density decreased over the interval - Sweden had become more homogeneous in that respect, perhaps due to the ongoing changes in education and mass communication. It further seemed to be the girls that had gained most by such changes. It was even possible to directly relate the increase in spatial ability among girls to the implementation of the comprehensive school (with density under control) - a school with a curriculum that stressed gender equality both on an ideological and practical level.

The studies of changes in ability have continued in several steps. Emanuelsson, Reuterberg and Svensson (1993) brought them up to the 1977 cohort. Table 4 summarizes the results expressed as differences between cohorts measured in units of the standard deviation for the first cohort in each compared pair.

Table 4. Changes in test scores between 1961 and 1990.

Test	Year of testing	Boys	Girls
Opposites	1966-1961	+0.22	+0.25
	1980-1966	-0.16	-0.08
	1985-1980	+0.06	+0.04
	1990-1985	-0.08	-0.15
	1990-1961	+0.04	+0.06
Number Series	1966-1961	+0.10	+0.15
	1980-1966	+0.28	+0.31
	1985-1980	+0.03	-0.04
	1990-1985	+0.04	-0.02
	1990-1961	+0.44	+0.39
Metal Folding	1966-1961	+0.11	+0.19
	1980-1966	+0.17	+0.29
	1985-1980	+0.17	+0.18
	1990-1985	-0.10	-0.18
	1990-1961	+0.35	+0.47

Over the whole time span of 29 years quite substantial increases occurred in the scores of the reasoning and spatial tests. In reasoning the changes mainly took place between 1961 and 1980. In spatial ability they continued until 1985. The overall increase was somewhat greater in reasoning for boys and in spatial ability for girls. In the verbal test the only major positive change was between the first two cohorts. After that a negative trend took over. An analysis of the vocabulary test at item level indicated that some words tended to become obsolete and thus more difficult over time while others became easier. Evidently comparisons over longer periods of time with the same set of vocabulary items are difficult.

Other comparisons indicated that the differences between socioeconomic groups were very stable over time. Gender differences, on the other hand, varied. In the first part of the period girls came closer to boys in spatial and reasoning tests but then lost part of that gain. In the verbal test girls and boys

differed very little to begin with, then the girls got ahead for some time and later on lost most of the gain.

Example 9: Intelligence changes within individuals

In Sweden all young men at the age of 18 are examined for enrolment to compulsory military training. They take ability tests similar to those used at age 13 in the longitudinal program. This situation was utilized for comparing test score changes between 13 and 18 in relation to educational and occupational experience in between.

Härnqvist (1968) studied the 1948 cohort. The scores at both occasions were combined according to a canonical analysis resulting in two components - a general component and a component contrasting spatial vs. verbal and reasoning abilities. The educational level reached at age 18 was categorized from compulsory education only to theoretical upper secondary education.

The main results referred to the first component, a measure very similar to an IQ. Since the scale was based on different items at the two occasions it was not possible to assess absolute changes but only relative ones.

The scores at the second occasion (age 18) were regressed on the age 13 scores with the sample divided according to education. As a rule subgroups with theoretical education above compulsory level changed in positive direction, the ones that stopped with only compulsory education changed in negative direction. The size of the changes was in the order of a third of the standard deviation upwards for upper secondary education and a third downwards for compulsory only. In IQ terms it meant a gap of about 10 units between the two groups at 18 when the initial differences were controlled for. This gap was interpreted as an effect of non-compulsory secondary education.

In her dissertation Gudrun Balke-Aurell (1982) elaborated the study of ability changes in several ways. She replicated the earlier study in the 1953 cohort with strikingly similar results. As a complement to the simple regression between canonical factors she also introduced additional predictor variables in multiple regressions of the outcome at age 18. As an alternative she also applied path analysis with LISREL to study the changes. Finally she built out the study of the contrast of verbal-reasoning vs. spatial ability with categorizations of educational as well as occupational experience between the two test administrations.

With minor variations the different approaches substantiated the original results that theoretical upper secondary education meant an increase in measured general intelligence. Furthermore she showed that differences in type of education and occupation were followed by changes on the scale from verbal-reasoning to spatial components of intelligence. Even though these changes to some extent might have been an effect of self-selection they

remained when a number of potentially important factors were kept under control.

Example 10: Long-term effects of education

Härnqvist (1977) observed that very little empirical research had been done in order to assess long-term effects of education with control for input variables such as home background and intellectual level. The longitudinal program described here fulfills several of the requirements for such studies.

The studies of changes in ability as effects of education, referred to in the previous example, can be regarded as a first approach to the topic. Then a follow-up in 1980 of the 1948 cohort was done with the express purpose to study enduring effects of education in a broad set of variables. The project was called LING and it still continues.

The design of the project was guided by a model similar to that presented in Figure 9 but with a stress on adult competence and what in the model is called life chances and level of living. Educational level was the main independent variable with selection and self-selection to education controlled by means of background, ability and achievement in earlier stages of education.

The follow-up data in the early 1980s when the participants were 32 years old were collected through questionnaires and interviews. No formal measurement of adult competence was feasible in that context. Instead self-reported capabilities in various domains were used as dependent variables. Occupation, income and working conditions, interests and social network were other aspects of the level of living studied in the follow-up.

Path-analysis according to LISREL was the main analytical tool in a report (Härnqvist, 1989, also 1994) from which some selected results will be summarized.

In Tables 5 - 7 different aspects of self-rated skills were regressed on home variables (H1 and H2), general ability and achievement level at age 13 (GL), verbal (V*) and spatial (S*) skills, educational plans at age 13 (PL), educational level reached at age 32 (ED), self-directed work conditions (S-D) and advancement prospects (ADV).

Table 5 presents the results for different aspects of self-rated verbal and linguistic skills at age 32. One interesting finding was that the home variables and the general ability level had no direct influence on the ratings. Their impact took the way through educational plans and educational level. Contrary to that, the early verbal skills (V*), measured as a residual from the general level, influenced the ratings at age 32 over and above what was mediated by plans and education. Educational level had its strongest

influence on the self-rated reading and writing skills among men (+0.52). Also the work conditions (when the prior variables were controlled) had a strong impact on self-rated speaking and writing skills in Swedish language - for men with good advancement prospects (+0.44) and for women with self-directed work (+0.42).

Table 5. Self-rated verbal and linguistic skills. Regression on background, education and work.

Gender	Skills	SES	GL	V*	S*	PL	ED	S-D	ADV
Men	General			.16		.18	.20	.22	
	Read/write			.19			.52		
	English			.22		.32			.14
	Speak/write Sw								.44
Women	General					.19	.24		
	Read/write			.35			.17		
	English			.29			.22		
	Speak/write Sw							.42	

Table 6 presents the corresponding results for civic competence which refers to a person's self-reported resources in dealing with public authorities in order to get what is due to her or him, whether it is material help or immaterial right. Two aspects could be separated, a general competence, and as a residual an assertive competence, for instance, appeal against income taxation. Here the socioeconomic status of the home (H1) had a direct influence on the ratings, but in different directions for the two factors. Both for men and women there was a negative relation to the general competence, which in the measurement was somewhat biased towards the help-seeking side, and a positive relation to the assertive competence. Educational level had little to do with these ratings, work conditions much more so.

Table 6. Self-rated civic competence. Regression on background, education and work.

Gender	Skills	SES	GL	V*	S*	PL	ED	S-D	ADV
Men	General	-.10		.12				-.12	.12
	Assert	.15		.12				.26	
Women	General	-.13					-09	.12	.12
	Assert	.10						.12	.12

A third aspect was everyday practical skills which were divided into domestic and mechanic skills (Table 7). Among men self-rated domestic skills were positively and mechanic skills negatively related to educational level. The residual for spatial ability (S*) was positively related to mechanic skills among men and negatively related to domestic skills among women. Women from higher social strata were more confident about their mechanic competence than their sisters from lower strata.

Table 7. Self-rated everyday practical skills. Regression on background, education and work.

Gender	Skills	SES	GL	V*	S*	PL	ED	S-D	ADV
Men	Domestic						.19		
	Mechanic				.24		-.18		
Women	Domestic				-.36				
	Mechanic	.13							

Taken together, these comparisons between self-rated adult competence and background factors showed a very distinctive pattern. Verbal and linguistic skills were clearly related to educational level, early verbal ability and work situation. Civic competence was related to home background and work conditions but only marginally to education. Practical skills were related to early spatial ability. Where home and education entered the model for practical skills they rather indicated gender-role attitudes than competence as such.

Discussion and conclusions

The previous sections have presented an overview of the longitudinal program and examples of research carried out on within its framework. Now I should like to make some personal comments on its strengths and weaknesses based on my more than thirty-five years of involvement with the program.

The backbone of the program is the recurrent collections of basic data for large national samples of pupils at a strategic time in their school education. The response rate has, in general, been high and the representativity of the samples good, both when based on birth dates as in the first cohorts and later on stepwise cluster sampling.

The selection of initial data to be collected has remained fairly constant over the different birth cohorts and has proved to be strategic in relation to the pupils' future attainments in the educational system. The measurement

characteristics of the basic ability tests used are strong which is of particular importance when they are to be used as explanatory variables in predictions over time.

The initial collection of data on interests and other self-reported and 'softer' traits has varied more between the cohorts and has, in general, contributed less to the predictions. On the other hand, the concentration on later attainment has left large domains of individual development uncovered both in the initial and in the follow-up variables which makes this longitudinal program different from, for instance, the Metropolitan project and the project Individual Development and Adjustment (IDA).

The decision by Statistics Sweden to start new waves of collection of individual data every fifth year was taken for granted also by us at the start. In the intensive period of educational reforms during which the program was initiated this certainly was a reasonable decision. But for us who took on the responsibility for the "piggy-backing" of research information on the administrative data, this became too ambitious under the economic tight and provisional conditions that the work began. We managed to do two cohorts but - for several other reasons too (cf. above) - not a third one five years thereafter as initially planned. When the program started anew with the 1967 cohort the five year periodicity was reintroduced. Now after four additional waves it may be time to seriously discuss whether this periodicity is optimal. And the reasons do do so have become stronger than before because, from the 1972 cohort on, "piggy-backing" data have been collected both in grade 3 and grade 6.

With this scheme, data collections are done twice during each period of five years for around 9 000 pupils in more than 400 classes in nearly 300 schools all over the country. In addition questionnaires are sent individually to all parents. All these data then are registered for computer analysis. The whole operation is financed by yearly project money, in later years from the Swedish Council for Planning and Coordination of Research (FRN). No permanent staff charged with this data collection and processing is available. The operation is led by one of the researchers in the team, on temporary leave from a teaching position and at the side of own research within the program. Also the other researchers in the program share their time between research and teaching.

In the first years of the program it was rather easy to recruit undergraduate and graduate students to use the data for their own research. A great number of studies were done by third semester students in education as well as candidates for the licentiate and doctor degrees. In later years a majority of students in education have tended to do research based on personal interviews and analyzed with qualitative research methods. A few of us who have been in the program since its initiation answer for an unduly large proportion of the more traditional longitudinal research which the examples above bear witness of. But we are too few (and soon too old) to make efficient use of all the interesting information that is found in

the data base. A new wave every tenth year and only one "piggy-backed" data collection during the first six school years would seem to be a more reasonable scheme.

Remedies should also be sought for the relative scarcity of graduate students interested in analyzing the data. All of them need not to be found in an education department. Already from the start it was stressed that the data base should be regarded as a national resource, and to some extent the data have been shared with people in other departments. Moreover the data from the first two cohorts are available in unidentified form from the Swedish Social Science Data Service. This sharing of data with other disciplines and departments should be promoted.

Follow-up information has been collected both routinely by Statistics Sweden and made available to the program, and in special projects with their own budgets from government agencies, research councils and foundations. As pointed out above the program's data base has made it possible to treat a great number of topical problems more rapidly and with a more adequate analysis than otherwise possible.

Considering the rather opportunistic (in a good sense) and serendipitous start of the program and its for many years precarious economy, the program has performed quite well both as a source of information for educational planning and as basic research. This is due to several circumstances.

First of all we have had a very fruitful cooperation over the years with our partner Statistics Sweden and also with the Ministry of Education and the national agencies of education and higher education. In general the program has fared well also in its relations to the Data Inspection Board.

Our own department has provided a good environment for the program, not least by being at the forefront in building up computer facilities and competence. Most members of the leading team have been active in the program from its very beginning - a continuity necessary for a longitudinal program but difficult to achieve in a university department where projects and programs usually span over rather limited periods of time.

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