Soc Indic Res (2008) 85:293–309
DOI 10.1007/s11205-007-9132-4

Are Father's or Mother's Socioeconomic Characteristics More Important Influences on Student Performance? Recent International Evidence

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Received: 10 April 2006 / Accepted: 25 April 2007 / Published online: 23 May 2007

Abstract Since the early 1970s the importance of mothers' socioeconomic characteristics on their children's educational and occupational attainment has been acknowledged. However, it is not clear if fathers' characteristics have a stronger influence because men usually have stronger attachments to the labour market, or alternatively mothers' characteristics are more important because of their greater role in children's socialization. This study addresses this question by comparing the influence of father's and mother's education and occupation on student performance in literacy and numeracy using data from 30 countries. The impact of mother's education is usually greater or comparable to that of father's education. In contrast, substantially stronger effects for mother's occupational status compared to father's were rare. In most countries the impact of mother's socioeconomic characteristics (education plus occupation) on student performance is comparable to that for father's. Of the four indicators of socioeconomic background, father's occupational status and mother's educational attainment tend to have stronger effects, although many countries do not conform to this pattern. There are indications that the relative importance of mother's characteristics have increased over time.

Keywords Mother's education · Mother's occupation · Socioeconomic inequalities · Student achievement · Cross-national comparisons · PISA

1 Introduction

In studies examining the influence of socioeconomic background on educational, occupational and other social outcomes several distinct approaches to the measurement of

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socioeconomic background have emerged. First, there is the conventional view that a family's socioeconomic background is best measured by father's occupation since in the vast majority of families it is still the adult male who over the lifecycle has the strongest attachment to the labour force (Goldthorpe 1983, 1984). A second approach uses the characteristics of the adult with the higher status (Erikson 1984). This approach—the dominance or power model (Korrup 2000: 36–37), assumes that the parent with the higher status determines the family's overall socioeconomic position. A third approach is the 'joined model' in which the occupational (or educational) levels of both parents are averaged (Korrup 2000: 36–37). Finally, the individual approach comprises separate measures for each parent. This approach tends to perform better on children's educational attainment than other models since there are a larger number of indicators of socioeconomic position (see Korrup 2000: 47).

Each approach has it problems. The conventional view is difficult to justify given the increasing proportion of married women in the labour force and their contribution to the family's economic circumstances, in addition to mothers' role in socialization. An early critique saw the conventional approach as scientific sexism (Acker 1973). Furthermore, it is not supported empirically. Analysing US data, Kalmijn (1994) found that mother's occupational status has a substantive effect on schooling. Importantly, he concludes that excluding mother's socioeconomic characteristics will substantially underestimate the effects of socioeconomic background. Both mother's education and occupation have sizable effects on their children's educational attainment, in addition to, or independent of, the effects of father's characteristics (Korrup et al. 2002). Furthermore, while it can be argued that married men have stronger attachments to the labour market than married women, thereby justifying the use of father's occupation, a similar argument is not applicable to parental education. If anything, mother's education is likely to be more important since, by virtue of time spent with their mothers, children are more exposed to their mother's values, aspirations and attitudes than that of their fathers.

Although the dominance model is often used in social science research, it under-estimates the proportion of students from low status or working class families since a sizable proportion of males working in manual occupations are married to women in higher status white-collar occupations. The joined model has similar problems. Averaging the father's and mother's occupational status or educational attainment will reduce the proportions of families at each end of whatever socioeconomic continuum is used. The problem with multiple variable approaches is that it makes cross-sample comparisons extremely difficult, so interesting questions on changes over-time or cross-national differences cannot be easily addressed.

The literature on the relative importance of mother's and father's socioeconomic characteristics is inconclusive. For the United States, Kalmijn (1994) concluded that mother' education was as important as father's education. In their three country study Korrup, Ganzeboom and Van Der Lippe (2002) did not conclude that one parent's characteristics were more important than the other, although inspection of the coefficients presented suggests that mother's education was more important than father's but father's occupational status was more important than mother's. The relative magnitudes of the effects were sensitive to the model estimated. For Australia, Crook (1995) analyzing educational attainment found stronger effects for mother's education than for father's education but stronger effects of father's occupational status.

International studies of student achievement potentially provide a better assessment of differences in the effects of father's and mother's characteristics since they include a large number of countries and the educational outcome is identical across countries, whereas

measures of years of schooling and participation at different levels of education are sensitive to the way national educational systems are organised. However, only in a limited number of these cross-national studies are the effects compared; and then only by bivariate methods. Also, there are concerns about the accuracy and comparability of the measures of parental occupation and education which tend to comprise very broad categories.

In the Second International Science Study conducted during the early 1980s, father's occupational status tended to show stronger correlations with student performance in science. In some instances the differences were substantial: 0.29 for father's occupation status and 0.19 for mother's in Australia; 0.23 and 0.17 in Italy; 0.22 and 0.13 in the Netherlands; and 0.28 and 0.23 for the United States. In no country was the correlation substantially stronger for mother's occupational status (Keeves and Saha 1992: 174). Unfortunately, more recent studies of student achievement such as the 1996 Third International Study of Mathematics study (TIMSS) and its descendants do not routinely collect data on parental occupation so the influence of mother's and father's occupation cannot be compared.

In contrast to parental occupation, most international studies of student achievement collect data on both father's and mother's education. In the First International Science Study conducted in 1970 and 1971, father's education showed a slightly stronger relationship with science test scores than mother's education. Across participating countries the mean correlation between test score and father's education was 0.17 compared to 0.15 for mother's education (Comber and Keeves 1973: 259). In Germany, Hungary and the United States, the correlation for father's education was substantially larger than that for mother's education. In other countries (Australia, England, Finland, Italy, Japan, the Netherlands, New Zealand, Scotland, Sweden and the United States) the correlations were of a similar magnitude. In the second international science study there were stronger correlations with students' scores in science for father's education than mother's in Australia, Sweden and the United States. In the other countries the relative magnitudes of the correlations were similar.

Recent work by economists addressing whether mother's education has a casual relationship with educational attainment undermines the widely held view that mother's education is important. Behrman and Rosenzweig (2002) analysing data from the Minnesota Twins registry found that father's education had a stronger effect than mother's on years of schooling. However, when using the twin data to control for unmeasured endowments (such as mother's and father's ability), the effect of mother's education was negative, whereas that for father's education remained positive, albeit weaker. Plug (2004) analysing data on adoptees concluded that there was no association between mother's (but not father's) education and their children's schooling once taking into account inherited abilities and assortative mating[1]. A similar study using Swedish data found that the effect of father's education on their adopted children's years of schooling was statistically significant but not mother's education. However, the two measures of parental education had comparable effects on attending university (Bjorklund et al. 2006).

It would be misleading to argue that these studies suggest that mother's education is unimportant to children's education; they are in essence indicating that the effect of mother's education can be attributed to parental ability and other unobserved background factors whereas the effect of father's education cannot. So the effect of mother's education is not because of the knowledge gained from formal schooling but the factors associated

[1] Assortative mating is the tendency for the reproductive pairing of individuals to have more traits in common than would likely be the case if mating were random. This is especially the case for education.

with years of education such as cognitive ability, attitudes and behaviours about education and possibly parenting styles. In other words there may be no effect of mother's education on children's education *per se*,[2] but there are effects of the factors associated with mother's education. So these studies do not mean mothers and their education should not be considered in the analysis of their children's educational outcomes.

Theoretically, it can be hypothesised that with the increasing labour force participation of women and their greater prominence of successful women as role models, the influence of mothers' socioeconomic characteristics on their children is increasing. If this were true, it would follow that in more economically developed countries or in more socially 'progressive' countries such as the Scandinavian countries, the influence of mother's characteristics would be stronger. On the other hand, increased time at work could mean that women have less time be closely involved in their children's education; so their socioeconomic characteristics have become no more important compared to that of their male partners. A further consideration is, are the effects of parents' socioeconomic characteristics subject specific, are mother's characteristics more important for the reading and the humanities and men's for mathematics? There is a tendency for high status men to be jobs with a higher mathematical component than comparable women (for example, engineering, computer programming) which may be borne out by distinctive patterns for student achievement in reading and mathematics.

The purpose of this paper is to compare the influence of father's and mother's socioeconomic characteristics on student performance using recent data on student achievement from 30 countries. The influence of mother's socioeconomic characteristics is compared vis-à-vis father's characteristics using appropriate measures and multivariate techniques. A series of comparisons are made of the effects on student performance (or tests scores) of father's and mother's educational attainment, occupational status, socioeconomic characteristics (a combination of educational attainment and occupational status) and of the four separate indicators of socioeconomic background. Two measures of student performance are analyzed: reading literacy and numeracy, since it is possible that the effects of mother's characteristics are stronger for reading and father's characteristics are stronger for mathematics. These analyses address the following research questions:

1. Is mother's education a stronger influence on student performance than father's education?
2. Is father's occupation a stronger influence on student performance than mother's occupation?
3. Are father's socio-economic characteristics a stronger influence on student performance than mother's?
4. Is the relative importance of parent's characteristics different between reading and mathematics? It is plausible that father's characteristics are stronger for mathematics but weaker for reading literacy.
5. Of the four indicators of socioeconomic background, father's and mother's occupation and education, which have the stronger effects on student performance?
6. Is the patterning of effects of parental characteristics on student achievement across countries consistent with economic, cultural or other differences between countries?

[2] This conclusion must remain tentative since it is based on few studies. The finding that mother's education has similar effects to father's education on university education among adoptees suggests mother's education may have a direct causal effect in some contexts.

2 Data and Measures

The data analyzed is from the OECD's 2000 Program for International Student Assessment (PISA) study that examined student achievement in reading, mathematics and science of over 172,000 15-year-old students in 6,000 schools in 32 countries. Participating countries include the OECD countries (except Turkey), and several non-OECD countries: Brazil, Latvia and Russia. Within each country, a two-stage sampling procedure was employed, first randomly selecting schools with probabilities proportional to size and second, randomly selecting 15-year-old students. In some countries schools were stratified by type or location. Details on the sampling and response rates for both schools and students are documented in the initial and technical reports (OECD 2001, 2002). Japan was excluded from these analyses because there was too much missing data on parental occupation and education. Liechtenstein was also excluded because of the small sample size.

2.1 Measures

The outcome measures investigated are reading and mathematics achievement scores. Item Response Theory (IRT) modeling was used to create scores standardized to an international (OECD) mean of 500 and standard deviation of 100. Students' scores are in the form of five plausible values rather than a single score. Further details are available from the PISA technical report (OECD 2002).

Information on parents' occupation was obtained by two questions that asked students about their mother's and father's main job and what they did in their main job. The responses were coded according to the International Standard Classification of Occupation 1988 (ISCO-88), as provided by the International Labour Office. ISCO-88 is a four-digit hierarchical coding schema comprising 390 different occupational categories. Parent's occupation was scaled by the International Socioeconomic Index (ISEI), which ranges from 0 to 100 based on ISCO-88 occupational codes. Ganzeboom and Treiman (1996) provide details on its construction and lists ISCO-88 occupational titles with their respective ISEI scores.

Information on the educational attainment of each parent was elicited by two questions. The first asked for the level of school education completed. A follow-up question was then asked about whether the parent had completed any tertiary qualifications. The responses to these questions were classified according to the International Standard Classification of Education (ISCED) schema developed by the OECD (1999).

The resulting measure of parental educational attainment comprised eight categories: No Schooling, Primary School, Middle Secondary School, Higher Secondary School (Non-Academic), Higher Secondary School (Academic), Tertiary Education (Non-Academic), and Tertiary Education (Academic). Scores for each category were constructed through optimal scaling techniques estimating scores which maximizes the relationship between parents' education and student achievement across the three domains within countries.

Father's socioeconomic characteristics comprise father's occupational status and father's education; mother's socioeconomic characteristics comprise mother's occupational status and education. These composite measures were constructed using the sheaf variable technique (see Whitt 1986), which maximises the combined relationship of the constituent variables with the dependent variable. The resultant single sheaf variable explains exactly the same amount of variance as do the constituent variables in parallel OLS regression analyses. The sheaf variables used the ISEI index for the measures of parental occupation

and the optimal scaling measures of parental education. These resultant measures were centred at the country means and standardized with a mean of zero and a standard deviation of one. The sheaf variables were constructed within countries, not across the pooled dataset.

In the tables of results the regression coefficients for socioeconomic background variables reflect the average change in student achievement score for a one standard deviation difference in the corresponding independent variable. The standard errors associated with the regression coefficients have been adjusted to take into account of the cluster design of the sample and sample strata (if used in the sample selection). Each regression coefficient and associated standard error was calculated by averaging the results obtained from separate analyses of the five plausible values. All analyses were weighted to reflect population distributions (OECD 2002) and reweighted back to the origin sample size. The analyses did not include control variables since socioeconomic background is theorised as prior to more immediate influences such as attitudes to school and modes of learning. All students were 15 years old so there was no need to control for age[3].

The two composite variables comprised only the variables with non-missing data. For example, mother's socioeconomic characteristics comprised only mother's education for cases where data on mother's occupation was missing. For the analyses comparing the effects of father's and mother's occupational status (presented in Tables 2 and 4), if mother's occupation was missing, the case was assigned the mean value (zero) and the dummy variable indexing cases with no mother's occupation was scored one (and zero for cases not missing on mother's occupation). Comparison of the coefficient obtained from this procedure to list-wise deletion of cases missing on mother's occupation revealed very little difference in the magnitudes of the coefficients (Compare respectively, Tables 2 and 4 with Tables A1 and A2 in the Appendix).

3 Results

3.1 Parental Education

Table 1 presents the results of regression analyses of reading and mathematics score on father's and mother's education. The intercept is the estimate for a student's score whose parents have mean levels of education for that country. The estimates should be interpreted as the average change in mean score for a one standard deviation increase in parental education. The adjusted R square values summarise the strength of the relationship. Across these countries, on average, 12% of the variation in student performance was accounted by parental education. This varied from around 20% or more in Belgium, Hungary, Mexico and Switzerland to only 5 or 6% in Latvia, Russia and Sweden.

In many countries the effects of father's and mother's education on reading and mathematics scores are comparable (Table 1). Only in two countries are the effects of father's education substantially stronger than that for mother's education: Australia where the effect of father's education on reading was 23 score points compared to 11 for mother's education and the Czech Republic (25 and 19 score points). In Italy, Luxembourg, New Zealand, Norway and the United States the effect of father's education was between 3 and 5 score points greater than that for mother's education. However, in a larger number of countries the effects of mother's education on reading are stronger. Large differences of

[3] In the analysis of the PISA data the coefficient for age is invariably small, negative and most often statistically not significant.

Table 1 Effects of father's and mother's education on reading and mathematics scores

	Reading				Mathematics			
	Intercept	Father's education	Mother's education	R Sq.	Intercept	Father's education	Mother's education	R Sq.
Australia	533	22.7***	11.3***	0.09	537	21.2***	11.7***	0.11
Austria	511	17.3***	16.8***	0.10	517	15.0***	18.5***	0.10
Belgium	517	23.6***	27.4***	0.19	530	23.7***	28.0***	0.21
Brazil	396	14.6***	22.8***	0.15	333	20.6***	21.5***	0.15
Canada	536	12.9***	15.3***	0.06	534	11.2***	12.3***	0.05
Czech Republic	497	25.0***	18.5***	0.16	502	24.8***	19.2***	0.16
Denmark	503	20.1***	24.7***	0.17	519	17.8***	18.9***	0.15
Finland	550	13.0***	11.6***	0.06	539	9.6***	13.7***	0.07
France	511	17.4***	23.5***	0.16	523	12.4***	23.5***	0.13
Germany	502	16.8***	29.2***	0.16	503	20.2***	27.0***	0.17
Greece	474	14.1***	20.2***	0.10	446	15.3***	22.3***	0.10
Hungary	482	22.7***	26.2***	0.24	490	22.3***	29.6***	0.25
Iceland	511	10.7***	20.4***	0.09	519	9.4***	15.0***	0.07
Ireland	529	12.2***	14.9***	0.06	505	13.4***	14.5***	0.08
Italy	489	17.4***	13.5***	0.09	459	16.2***	9.7**	0.06
Korea	524	11.7***	8.8***	0.07	545	15.1***	11.6***	0.08
Latvia	463	12.4***	15.4***	0.06	468	12.9***	12.5**	0.05
Luxembourg	450	24.3***	20.2***	0.17	454	19.8***	14.4***	0.12
Mexico	425	20.5***	23.5***	0.22	390	17.3***	22.7***	0.19
Netherlands	539	18.1***	16.8***	0.13	571	16.9***	15.3***	0.11
New Zealand	541	20.6***	16.1***	0.09	549	19.8***	16.7***	0.11
Norway	511	17.9***	14.4***	0.07	504	15.4***	9.7***	0.06
Poland	485	17.2***	17.6***	0.11	477	20.5***	16.3***	0.12
Portugal	474	18.9***	18.1***	0.12	458	17.6***	16.8***	0.12
Russia	464	12.0***	12.4***	0.05	483	11.8***	10.8***	0.04
Spain	496	16.3***	20.2***	0.15	480	18.2***	18.9***	0.13
Sweden	520	13.0***	11.9***	0.05	514	12.7***	11.1***	0.05
Switzerland	499	16.7***	32.2***	0.20	534	15.6***	28.9***	0.18
United Kingdom	533	21.1***	20.4***	0.14	537	21.0***	17.3***	0.14
United States	513	22.8***	17.9***	0.12	502	24.1***	18.7***	0.15
Average		17.5	18.7	0.12		17.1	17.6	0.12

Note: *** $P < 0.001$, ** $0.001 < P < 0.01$, * $0.01 < P < 0.05$, † $0.05 < P < 0.10$

All intercept terms statistically significant, $P < 0.001$

over 5 score points were found in Brazil, France, Germany, Greece, Iceland, and Switzerland. In addition, the effect of mother's education was 3–5 score points greater than the effect of father's education in Belgium, Denmark, Hungary, Latvia, Mexico and Spain. Across these countries the average effect of mother's education was 19 score points compared to 18 for father's education.

For mathematics the results were similar. The effect of father's education was stronger than that of mothers by 5 or more score points in Australia, Czech Republic, Italy, Luxembourg, Norway, and the United States and the effect of mother's education was stronger by 5

Table 2 Effects of father's and mother's occupational status on reading and mathematics scores

	Reading				Mathematics			
	Intercept	Father's Occupational Status	Mother's Occupational Status	R Sq.	Intercept	Father's Occupational Status	Mother's Occupational Status	R Sq.
Australia	539	22.5***	16.5***	0.13	541	22.7***	15.7***	0.14
Austria	512	20.8***	15.8***	0.13	518	13.5***	21.4***	0.11
Belgium	525	23.4***	20.7***	0.16	537	22.6***	21.6***	0.17
Brazil	404	20.6***	16.9***	0.13	340	25.9***	24.1***	0.17
Canada	539	19.1***	12.6***	0.09	537	16.1***	10.6***	0.07
Czech Republic	499	20.6***	23.2***	0.17	504	19.5***	23.7***	0.16
Denmark	508	20.4***	13.3***	0.10	524	15.0***	11.9***	0.08
Finland	551	13.8***	10.0***	0.06	541	10.5***	10.9***	0.06
France	517	22.0***	15.3***	0.15	529	17.5***	15.7***	0.11
Germany	501	30.5***	18.9***	0.19	503	27.6***	16.8***	0.17
Greece	484	20.3***	16.9***	0.12	454	20.5***	22.7***	0.12
Hungary	489	23.4***	20.6***	0.20	497	24.3***	22.7***	0.21
Iceland	512	12.5***	12.4***	0.05	520	7.4**	13.1***	0.05
Ireland	534	18.6***	18.8***	0.11	509	16.3***	18.7***	0.10
Italy	502	14.8***	11.3***	0.10	468	10.7***	12.9***	0.07
Korea	526	11.0***	5.4**	0.04	549	15.3***	9.4***	0.05
Latvia	467	13.2***	19.0***	0.08	468	8.5**	16.4***	0.04
Luxembourg	454	25.0***	26.0***	0.18	457	26.6***	12.9***	0.14
Mexico	438	23.4***	19.7***	0.17	402	22.5***	17.3***	0.16
Netherlands	544	18.4***	15.4***	0.13	575	18.2***	11.4***	0.11
New Zealand	540	23.4***	17.5***	0.11	545	19.2***	21.3***	0.12
Norway	515	19.4***	15.2***	0.09	507	18.5***	10.7***	0.08
Poland	490	20.1***	17.3***	0.15	482	20.7***	16.9***	0.14
Portugal	486	24.7***	16.2***	0.18	465	25.1***	13.0***	0.15
Russia	466	18.5***	18.0***	0.11	483	17.2***	14.8***	0.07
Spain	501	18.8***	14.5***	0.11	484	19.3***	15.5***	0.11
Sweden	523	20.9***	12.9***	0.12	518	24.0***	12.7***	0.12
Switzerland	505	29.6***	18.0***	0.11	539	21.3***	19.5***	0.15
United Kingdom	534	25.2***	18.5***	0.19	539	22.5***	15.8***	0.16
United States	524	28.7***	13.5***	0.17	513	29.9***	14.9***	0.15
Average		20.8	16.3	0.13		19.3	16.2	0.12

Note: *** $P < 0.001$, ** $0.001 < P < 0.01$, * $0.01 < P < 0.05$, † $0.05 < P < 0.10$

All intercept terms statistically significant, $P < 0.001$

or more score points in France, Germany, Greece, Hungary, Iceland, Mexico and Switzerland. In these countries the average effect was again slightly larger for mother's education.

The relative impact of mother's education tends to be larger in a number of western European countries: Belgium, Finland (mathematics only), France, Germany, Greece, Iceland and Switzerland. In contrast, in several Anglo-Saxon countries (Australia, New

Zealand and the United States) the effects of father's educational attainment tend to be stronger than mother's or at least comparable. However, there are no clear between-country differences in the relative effects that can be attributed to region, language, economic development or culture.

3.2 Parental Occupation

Table 2 presents the effects for father's and mother's occupation. Across these countries, on average, 13% of the variation in student performance was accounted by parental occupational status, a similar amount to that for parental education. The cross-national pattern was only slightly different: in Australia, Germany, the United Kingdom and the United States more variation in student performance was accounted for by parental occupation than by parental education.

In contrast to the results for parental education, father's occupational status had an appreciably stronger impact (5 score points or more) than mother's occupational status in a larger number of countries. For reading, father's occupational status was clearly stronger in 12 of the 30 countries: Australia, Austria, Canada, Denmark, Germany, Korea, New Zealand, Portugal, Sweden, Switzerland, the United Kingdom and the United States. In contrast, only in Latvia was the effect of mother's occupational status stronger than that of father's by 5 score points or more. Across countries, the average effect of father's occupation was about 3 points higher than that for mother's.

The results for mathematics were similar but not identical to that for reading. The effect of father's occupational status was substantially stronger (5 score points or more) than mother's in 12 countries: Australia, Canada, Germany, Korea, Luxembourg, Mexico, the Netherlands, Norway, Portugal, Sweden, the United Kingdom and the United States. In contrast, in only 3 countries (Austria, Iceland and Latvia) was the effect of mother's occupational status larger. Across countries, the average effect of father's occupational status was about 2 score points greater.

As for parental education, between-country differences in the relative effects of father's and occupational status could not be easily attributed to readily apparent differences in region, language, economic development or culture.

3.3 Mother's and Father's Socioeconomic Characteristics

For reading the effects of mother's socioeconomic characteristics (occupational status plus education) were comparable with that of father's in most countries (Table 3). The exceptions were Australia, Korea, Sweden and the United States, and to a lesser extent Canada, New Zealand, Norway and the United Kingdom, where the effects of father's socioeconomic characteristics were stronger. Notably, several of these countries are English-speaking. The influence of mother's characteristics was substantially stronger only in Iceland.

For mathematics the findings were again similar. The effects of father's socioeconomic characteristics were substantially stronger (a difference of more than 5 score points) in several countries: Australia, Luxembourg, Mexico, the Netherlands, Norway, Portugal, Sweden, the United Kingdom and the United States. In only two countries (Austria and Iceland) were effects of mother's characteristics substantially stronger. However, for the remaining 19 countries the magnitudes of effects of father's and mother's characteristics

Table 3 Effects of father's and mother's socioeconomic characteristics on reading and mathematics scores

	Reading				Mathematics			
	Intercept	Father's education & Occupation	Mother's education & Occupation	R Sq.	Intercept	Father's education & Occupation	Mother's education & Occupation	R Sq.
Australia	541	25.3***	14.6***	0.13	543	24.3***	14.6***	0.15
Austria	516	18.9***	17.0***	0.12	521	12.4***	23.3***	0.12
Belgium	529	25.4***	24.9***	0.20	540	27.8***	23.6***	0.21
Brazil	404	18.8***	21.4***	0.17	339	24.6***	24.7***	0.20
Canada	540	18.5***	14.8***	0.09	537	15.9***	11.9***	0.08
Czech Republic	500	22.4***	21.8***	0.18	506	22.3***	22.8***	0.17
Denmark	510	22.5***	18.6***	0.16	526	18.0***	15.7***	0.13
Finland	553	13.6***	12.6***	0.07	541	10.0***	14.6***	0.08
France	519	20.3***	19.9***	0.17	532	13.5***	20.9***	0.13
Germany	510	24.5***	24.2***	0.18	510	24.7***	21.1***	0.18
Greece	484	18.1***	19.9***	0.13	453	21.1***	23.6***	0.14
Hungary	489	23.1***	24.0***	0.23	497	23.4***	27.4***	0.24
Iceland	514	11.6***	21.0***	0.10	522	9.6***	16.3***	0.08
Ireland	535	17.9***	19.7***	0.12	509	16.0***	20.4***	0.13
Italy	503	14.8***	12.7***	0.08	469	10.5**	11.5**	0.05
Korea	525	14.0***	8.0**	0.09	548	15.9***	12.5***	0.10
Latvia	468	17.4***	19.2***	0.09	470	16.0***	15.7***	0.07
Luxembourg	457	25.1***	27.7***	0.25	460	25.6***	12.6*	0.17
Mexico	437	22.3***	24.9***	0.25	400	23.4***	21.0***	0.24
Netherlands	546	19.6***	16.6***	0.13	578	19.5***	12.1***	0.10
New Zealand	547	23.5***	18.8***	0.13	553	19.5***	22.6***	0.15
Norway	518	20.8***	16.9***	0.10	510	19.8***	11.9***	0.09
Poland	493	18.9***	20.0***	0.15	484	22.7***	17.8***	0.15
Portugal	487	23.0***	18.2***	0.16	466	22.5***	16.5***	0.16
Russia	467	18.9***	19.3***	0.13	484	17.4***	16.3***	0.08
Spain	503	17.6***	19.5***	0.18	486	20.7***	19.2***	0.17
Sweden	525	20.6***	14.0***	0.11	520	23.2***	14.8***	0.13
Switzerland	508	27.1***	25.3***	0.23	542	19.0***	26.0***	0.19
United Kingdom	539	25.0***	20.4***	0.18	543	23.2***	16.3***	0.16
United States	526	27.1***	14.7***	0.13	515	31.6***	14.8***	0.18
Average		20.6	19.0	0.15		19.8	18.1	0.14

Note: *** $P < 0.001$, ** $0.001 < P < 0.01$, * $0.01 < P < 0.05$, † $0.05 < P < 0.10$

All intercept terms statistically significant, $P < 0.001$

were comparable. In addition, the average effects across these countries were very similar. So when socioeconomic characteristics are measured by combining education and occupation, there is little difference in the impact of father's and mother's socioeconomic characteristics in most developed countries.

3.4 Individual Effects of Father's and Mother's Occupation and Education

Table 4 presents the effects of the single indicators (father's and mother's occupational status and education) on student achievement in reading and mathematics. In most countries, the effects of father's occupational status are relatively strong. Its effect on reading was the largest or second largest of the four indicators in 21 of the 30 countries. Similarly, mother's education has relatively strong effects in many, especially European, countries: Belgium, Denmark, Finland, France, Germany, Hungary, Iceland, Mexico, Spain and Switzerland. Across these countries the average effect for father's occupational on reading literacy was 13 score points, compared to 10 for mother's occupational status and father's education, and 12 score points for mother's education.

For mathematics there were similar patterns. Father's occupation had clearly the strongest effect in Australia, Brazil, Canada, Luxembourg, the Netherlands, Norway, Portugal, Russia, Sweden and the United States. Mother's education had relatively strong effects in many countries: Austria, Belgium, Denmark, Finland, France, Germany, Hungary, Iceland, Mexico, Spain and Switzerland. Across countries, father's occupational status has the strongest impact followed by mother's education.

3.5 Summary and Conclusions

In many countries, father's occupational status has a greater impact on student achievement than mother's occupational status whereas the converse tends to be true for parental education. When comparing parental socioeconomic characteristics, that is, combining occupational status and education, the influence of fathers and mothers is comparable in most countries. Comparison of the four indicators of socioeconomic background shows that in most countries father's occupational status has a relatively strong, and in many countries the strongest, impact on student achievement. Mother's education is also important in many countries. Father's education and mother's occupation tend to be weaker influences although there is much variation between countries. Differences in the relative effects of father's and mother's socioeconomic characteristics do not correspond to any well-known grouping of countries based on regional, linguistic, economic or cultural similarities. Furthermore, there is little difference in the relative effects of parent's socioeconomic characteristics between student performance in reading literacy and mathematics; so father's characteristics are not more important for mathematics and mother's are not more important for reading.

There are indications that the effect of mothers' characteristics have increased over time. In the Second International Science Study conducted between 1983 and 1988, seven of the eight western countries showed stronger correlations for father's compared to mother's occupational status. In the PISA 2000 data the proportion of countries showing stronger effects for father's occupational status is smaller and the proportion with stronger effects for mother's occupational status is larger. A similar trend is evident for parental education. In earlier international achievement studies the magnitude of the relationship between mother's education and student achievement were either slightly lower or comparable than that for father's education. However, this analysis of the PISA data suggests that in many countries mother's education has a larger impact than father's. Therefore, women's socioeconomic characteristics appear to have become more important influences on their children's educational performance, although the evidence presented here is suggestive rather than conclusive.

Table 4 Effects of father's and mother's occupational status and education on reading and mathematics scores

	Reading						Mathematics					
	Intercept	Father's occup.	Mother's occup.	Father's educ.	Mother's educ.	R Sq.	Intercept	Father's occup.	Mother's occup.	Father's educ.	Mother's educ.	R Sq.
Australia	540	16.3***	13.0***	13.6***	3.7†	0.14	541	15.9***	12.1***	13.2***	5.0*	0.16
Austria	514	15.0***	10.1***	7.7***	10.7***	0.15	519	7.3**	15.7***	8.0**	12.1***	0.13
Belgium	525	13.4***	14.4***	18.6***	18.2***	0.23	536	12.9***	14.2***	18.5***	19.6***	0.24
Brazil	402	12.8***	6.6**	8.4***	16.3***	0.17	337	16.8***	15.7***	12.7***	11.8**	0.20
Canada	539	15.0***	9.0***	6.4***	9.0***	0.10	537	12.7***	7.2***	5.2***	7.5***	0.08
Czech Republic	500	9.4***	14.1***	16.8***	9.0**	0.19	505	7.5**	14.2***	17.8***	10.6***	0.19
Denmark	508	8.7***	4.0†	16.0***	18.7***	0.17	525	4.2	4.3†	14.9***	15.2***	0.15
Finland	552	7.6***	6.0***	7.9***	8.2***	0.07	541	5.0*	6.3**	5.9**	10.7***	0.08
France	517	14.2***	8.6***	9.4***	15.9***	0.19	530	11.6***	8.9***	5.6*	16.2***	0.14
Germany	506	19.4***	10.6***	7.6**	21.4***	0.20	507	16.6***	6.9*	11.9***	21.5***	0.20
Greece	482	14.8***	11.3***	5.1†	12.2***	0.13	451	14.2***	17.3***	5.7	13.1***	0.13
Hungary	487	11.7***	8.3***	14.2***	18.6***	0.25	495	13.4***	9.2***	12.5***	22.1***	0.26
Iceland	514	6.9***	5.3**	6.7***	17.6***	0.10	521	2.6	8.1***	7.1**	10.9***	0.07
Ireland	534	16.8***	15.6***	2.7	6.9**	0.11	508	12.7***	14.3***	6.7*	8.7***	0.12
Italy	501	8.1**	6.1**	12.1***	5.6**	0.12	467	4.0	8.1*	12.8***	3.6	0.08
Korea	526	4.8***	0.7	10.9***	6.7***	0.07	549	7.1***	4.3	13.4***	7.9**	0.09
Latvia	468	10.2***	15.7***	10.1**	8.5**	0.10	469	6.1†	13.0***	11.1**	7.2†	0.06
Luxembourg	456	16.9***	18.9***	14.8***	11.0***	0.24	458	20.4***	4.0	11.1*	10.1**	0.17
Mexico	430	9.5***	7.3**	14.1***	18.5***	0.23	394	10.3***	5.5	11.7***	17.9***	0.20
Netherlands	544	12.4***	11.6***	11.9***	10.0***	0.16	576	13.1***	6.5*	10.2**	9.9**	0.13
New Zealand	545	13.7***	12.0***	13.4***	10.4***	0.13	551	9.4***	16.0***	12.6***	11.2***	0.14
Norway	516	14.3***	11.7***	11.1***	8.5***	0.11	509	14.2***	7.8**	9.7**	6.3*	0.09
Poland	492	11.3***	10.4***	9.9**	10.2***	0.16	484	10.9**	9.2*	12.0*	10.2**	0.15

Table 4 continued

	Reading						Mathematics					
	Intercept	Father's occup.	Mother's occup.	Father's educ.	Mother's educ.	R Sq.	Intercept	Father's occup.	Mother's occup.	Father's educ.	Mother's educ.	R Sq.
Portugal	485	19.3***	11.2***	5.5*	8.5***	0.19	464	19.1***	7.6**	5.7†	10.0***	0.17
Russia	467	16.2***	15.1***	3.6†	6.9***	0.12	484	15.0***	12.3***	4.6†	5.6*	0.08
Spain	501	9.4***	6.8**	11.1***	15.5***	0.17	484	10.2***	7.9**	12.3***	14.0***	0.16
Sweden	524	18.1***	10.8***	3.6†	6.5***	0.11	519	21.3***	11.5***	3.2	5.7*	0.12
Switzerland	505	21.2***	10.0***	6.9**	24.6***	0.26	540	11.9***	11.8***	9.5***	21.3***	0.22
United Kingdom	537	15.4***	13.0***	13.2***	10.5***	0.19	542	13.2***	11.7***	13.9***	8.1***	0.18
United States	523	19.7***	8.3**	11.8***	12.1***	0.15	511	20.0***	9.0**	15.3***	11.9**	0.18
Average		13.4	10.2	10.2	12.0	0.16		12.0	10.0	10.5	11.5	0.15

Note: *** $P < 0.001$, ** $0.001 < P < 0.01$, * $0.01 < P < 0.05$, † $0.05 < P < 0.10$

All intercept terms statistically significant, $P < 0.001$

Appendix

Table A1 Effects of father's and mother's occupational status on reading and mathematics scores (list-wise deletion of missing values for mother's occupation)

	Reading				Mathematics			
	Intercept	Father's occupational status	Mother's occupational status	R Sq.	Intercept	Father's occupational status	Mother's occupational status	R Sq.
Australia	539	22.2***	16.6***	0.11	541	21.7***	16.0***	0.13
Austria	512	18.4***	16.8***	0.11	518	11.5***	22.2***	0.11
Belgium	525	20.3***	22.1***	0.14	537	20.4***	22.6***	0.15
Brazil	404	19.5***	17.3***	0.14	340	23.5***	25.2***	0.18
Canada	539	18.6***	12.8***	0.08	537	16.1***	10.6***	0.07
Czech Republic	499	20.0***	23.4***	0.16	504	19.4***	23.7***	0.15
Denmark	508	20.2***	13.4***	0.09	524	14.9***	11.9***	0.07
Finland	551	13.3***	10.2***	0.05	541	10.2***	11.0***	0.05
France	517	19.4***	16.4***	0.13	529	13.7***	17.2***	0.10
Germany	501	27.4***	20.1***	0.15	503	24.8***	17.8***	0.14
Greece	484	20.1***	17.0***	0.12	453	22.8***	21.5***	0.14
Hungary	489	22.8***	20.8***	0.17	497	25.0***	22.4***	0.19
Iceland	512	12.4***	12.4***	0.05	520	7.7***	13.0***	0.04
Ireland	534	17.4***	19.1***	0.11	509	15.2***	19.0***	0.11
Italy	503	10.7***	13.4***	0.06	469	6.4*	15.0***	0.05
Korea	526	12.9***	4.5*	0.05	550	16.2***	9.0**	0.07
Latvia	467	14.3***	18.7***	0.07	468	9.9**	16.0***	0.04
Luxembourg	454	23.2***	27.0***	0.20	457	24.2***	14.1***	0.15
Mexico	438	21.1***	20.9***	0.19	402	21.9***	17.6***	0.18
Netherlands	544	16.3***	16.1***	0.10	575	15.6***	12.2***	0.08
New Zealand	540	22.2***	17.8***	0.10	545	17.8***	21.7***	0.12
Norway	515	19.3***	15.3***	0.08	507	18.4***	10.7***	0.07
Poland	490	19.2***	17.8***	0.12	482	21.0***	16.8***	0.12
Portugal	486	23.0***	17.1***	0.15	465	23.5***	13.9***	0.14
Russia	466	18.4***	18.1***	0.11	483	17.0***	14.9***	0.07
Spain	501	16.2***	15.8***	0.12	484	17.3***	16.5***	0.12
Sweden	523	20.6***	13.0***	0.10	518	23.3***	12.9***	0.12
Switzerland	505	28.9***	18.3***	0.17	539	20.1***	20.0***	0.13
United Kingdom	534	24.9***	18.6***	0.14	540	22.0***	16.0***	0.13
United States	524	26.7***	14.0***	0.12	513	28.2***	15.3***	0.15
Average		19.7	16.8	0.12		18.3	16.6	0.11

Note: *** $P < 0.001$, ** $0.001 < P < 0.01$, * $0.01 < P < 0.05$, † $0.05 < P < 0.10$

All intercept terms statistically significant, $P < 0.001$

Table A2 Effects of father's and mother's occupational status and education on reading and mathematics scores (list wise deletion of missing values for mother's occupation)

	Reading						Mathematics					
	Intercept	Father's Occup.	Mother's Occup.	Father's Educ.	Mother's Educ.	R Sq.	Intercept	Father's Occup.	Mother's Occup.	Father's Educ.	Mother's Educ.	R Sq.
Australia	540	15.9***	13.1***	13.8***	3.6	0.13	542	15.1***	12.7***	13.5***	3.9	0.15
Austria	515	14.1***	12.4***	6.6**	6.8**	0.12	520	6.7*	17.3***	7.3*	9.5***	0.12
Belgium	525	12.0***	15.3***	18.0***	17.5***	0.19	537	12.5***	15.2***	19.2***	16.5***	0.20
Brazil	402	13.3***	7.3**	7.3**	15.7***	0.17	338	17.3***	17.9***	10.4**	9.5*	0.20
Canada	539	14.6***	8.9***	6.2***	9.6***	0.09	537	13.0***	7.0***	4.6***	8.2***	0.08
Czech Republic	500	10.1***	14.9***	14.9***	8.6**	0.18	505	8.3***	14.9***	16.7***	9.6**	0.17
Denmark	509	9.4***	4.4*	16.0***	17.3***	0.16	525	4.8†	4.7†	14.8***	13.8***	0.13
Finland	552	6.8***	6.4***	8.3***	7.9***	0.07	541	4.8*	6.5**	5.9*	10.5***	0.08
France	517	12.8***	9.6***	10.2***	14.3***	0.17	530	9.2***	10.4***	5.1*	15.3***	0.13
Germany	506	18.0***	11.3***	8.9***	19.9***	0.18	507	15.1***	8.7**	12.7***	17.6***	0.17
Greece	482	15.4***	12.3***	4.9	9.8***	0.13	451	17.7***	16.7***	5.2	11.0**	0.15
Hungary	487	12.0***	8.1***	13.7***	19.1***	0.22	495	14.4***	8.6***	12.2***	22.5***	0.24
Iceland	514	6.8***	5.1*	6.3**	18.2***	0.10	521	2.8	7.4***	7.4**	12.2***	0.08
Ireland	534	15.8***	15.5***	2.3	8.1***	0.12	508	12.0***	14.5***	5.6*	9.4***	0.13
Italy	502	4.9*	9.0***	11.3***	3.8	0.07	469	1.2	12.8***	10.6**	−1.1	0.05
Korea	526	6.8***	−0.8	10.2***	8.7***	0.09	549	9.7***	3.7	10.3**	9.5**	0.10
Latvia	468	11.2***	15.5***	10.9***	8.0*	0.09	469	7.0*	12.5***	13.4***	6.7	0.07
Luxembourg	456	17.0***	20.1***	11.3*	12.1***	0.25	458	19.9***	5.6	6.3	12.1**	0.17
Mexico	430	8.5***	7.2*	15.0***	18.6***	0.25	394	9.7**	4.5	15.2***	17.1***	0.24
Netherlands	544	10.9***	12.7***	12.1***	7.8**	0.13	576	11.7***	7.8**	11.0***	6.9†	0.10
New Zealand	545	12.9***	12.1***	13.9***	10.7***	0.12	551	8.6**	16.1***	13.2***	11.4**	0.15
Norway	517	15.1***	11.9***	9.2**	8.3***	0.10	509	14.3***	7.8**	9.4**	6.4*	0.09

Table A2 continued

	Reading						Mathematics					
	Intercept	Father's Occup.	Mother's Occup.	Father's Educ.	Mother's Educ.	R Sq.	Intercept	Father's Occup.	Mother's Occup.	Father's Educ.	Mother's Educ.	R Sq.
Poland	492	10.1***	9.7***	10.1**	12.2***	0.15	484	9.9*	7.9*	14.5**	11.4**	0.15
Portugal	485	16.8***	12.0***	7.5**	7.9**	0.16	465	16.9***	8.4**	6.0	10.5***	0.16
Russia	467	15.8***	15.3***	4.2*	6.3***	0.12	484	14.2***	12.7***	5.5*	4.8†	0.07
Spain	501	7.5**	8.2***	11.6***	14.2***	0.17	484	8.2**	8.6**	14.3***	13.0***	0.16
Sweden	524	18.2***	11.0***	3.3	5.7**	0.10	519	21.0***	11.9***	2.7	5.1†	0.12
Switzerland	506	21.2***	10.8***	7.6**	22.2***	0.23	540	11.4***	12.5***	11.0***	18.7***	0.19
United Kingdom	537	15.1***	12.4***	14.0***	11.8***	0.17	542	13.0***	11.8***	14.6***	7.4***	0.16
United States	524	19.6***	9.0***	11.2***	10.1**	0.13	512	20.6***	9.4**	15.5***	9.7*	0.18
Average		13.0	10.7	10.0	11.5	0.15		11.7	10.6	10.5	10.6	0.14

Note: *** $P < 0.001$, ** $0.001 < P < 0.01$, * $0.01 < P < 0.05$, † $0.05 < P < 0.10$

All intercept terms statistically significant, $P < 0.001$

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