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Science related careers: aspirations and outcomes in two British cohort studies

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Abstract

Purpose – Understanding the factors and processes facilitating entry into science related occupations is a first step in developing effective interventions aiming to increase a skilled science base. This paper intends to address individual as well as family and school related influences on uptake of science, engineering, technology and health related careers.

Design/methodology/approach – Drawing on data collected for two British birth cohorts: the 1958 National Child Development Study and the 1970 British Cohort Study, a developmental-contextual model of career development is tested, comparing the experiences of over 17,000 men and women during the transition from school to work.

Findings – The findings suggest that there is a persisting gender imbalance both in terms of aspirations and occupational attainment. Interest and attachment to a science related career are formed early in life, often by the end of primary education. School experiences, in particular, are crucial in attracting young people to a career in science.

Research limitations/implications – Much remains to be done to improve intake in science related occupations, especially regarding recognition and access to science related courses at school, and rendering school experiences more relevant and engaging for young people.

Originality/value – Comparing career transitions in two longitudinal cohorts allows the study of careers over time, linking early influences to later outcomes, and enables the identification of stable and changing patterns in antecedents and outcomes.

Keywords Gender, Careers

Paper type Research paper

Science related careers: aspirations and outcomes

With an economy increasingly based on science and technology there is a continuous and increasing need for a well qualified and highly numerate workforce. Robert's review (2002) which investigated the supply of people with the skills for improving productivity and innovation performance in the UK, has identified great concerns regarding the lack of young people with science degrees, and difficulties faced by employers in recruiting highly skilled scientists, engineers, and technicians. Although the aggregate number of students with scientific and technical degrees has risen over the last decade, the number of students taking science related qualification at A-level between 1991 and 2000 has fallen significantly (Roberts, 2002). Another ongoing debate addressed in this paper concerns the under-representation of women in science related courses and occupations (Greenfield *et al.*, 2002). Over the last 20 years research has documented broader and less gender stereotypical career choices among girls (Francis, 2000; Wikeley and Stables, 1999). Yet, although the number of women taking

The analysis and writing of this article were supported by grants from the UK Economic and Social Research Council (ESRC): L326253061 and RES-225-25-2001. A previous version of the paper was presented at the ESRC Social Science Week, held at the University of Cambridge on 16 March 2006. Data from the National Child Development Study and the British Cohort Study are provided by the ESRC Data Archive. Those who carried out the original collection and analysis of the data bear no responsibility for its further analysis and interpretation.

Equal Opportunities International
Vol. 26 No. 2, 2007
pp. 129-143

0261-0159
DOI 10.1108/02610150710732203

up occupations in science, engineering, and technology (SET) appears to be increasing, the number of girls undertaking SET subjects in compulsory and post-compulsory education and training is decreasing, which in turn, has implications for women progressing into SET occupations in the future (IER, 2003).

It has been argued that women are less prepared or socialised into science related careers than men; that boys are encouraged from an early age to explore and work with science related or mechanical toys, while girls do not receive that type of experience (McDade, 1988; McIlwee and Robinson, 1992). It has also been shown that career interests develop relatively early in life, especially regarding science related occupations (Foskett and Hemsley-Brown, 2001). Occupational preferences developed during the formative years, in turn, have also shown to shape the course of future career development and adult occupational attainment (Bandura *et al.*, 2001; Schoon, 2001; Schoon and Parsons, 2002). The study of early influences on career development is therefore of special importance for a better understanding of career trajectories in science related occupations, and will be the focus of this paper.

There are very few investigations studying career development over time, linking experiences during childhood and adolescence to adult outcomes. Still fewer studies have examined career development in a changing socio-historical context, providing evidence regarding persisting patterns of influence. This paper seeks to close this gap in the research literature, and examines the role of family background, of early individual capacities, motivations, and aspirations as well as school experiences in shaping career development in times of social change.

The study draws on data collected for two British birth cohort studies, following the lives of over 17,000 individuals born 12 years apart in 1958 and 1970 respectively. During the lifetimes of the 1958 and 1970 birth cohorts, British society witnessed considerable changes in almost every aspect of its way of life. While the 1958 cohort grew up during a period of extraordinary economic growth and social transformation described by Hobsbawm (1995) as a "golden age", the 1970 cohort came of age in an era of increasing instability and insecurity – "the crisis decades". The recessions of the 1980s were the most serious since the Second World War, and brought with them increasing levels of unemployment, especially among young people (Hart, 1988). During this same period new technologies brought with them changes in labour market opportunities, and there has been a rapid increase of women entering the labour market (Gallie, 2000).

Although the biggest shift in employment opportunities has been driven by the growth of the service sector, there is a Europe-wide shortage in engineering and technological workers (Rees, 1999). In the UK, the introduction of a National curriculum in the 1980s meant that all young people studied english, maths and science up to the age of 16 – removing many of the gender inequalities in subject take-up (Equal Opportunities Commission, 2001). How have these changes affected interest and entry into SET occupations? Being able to draw on two cohort studies allows us to gain a better understanding of career development in a changing socio-historical context, providing evidence of persisting and changing patterns of influence.

The study adopts a contextual-developmental model of career development (Vondraceck *et al.*, 1986; Super, 1980; Schoon *et al.*, in press; Schoon and Parsons, 2002) linking experiences during childhood and adolescence to later career related outcomes. The model (Figure 1) assumes that adult occupational attainment can be predicted by family social background, school experiences, individual assets, and earlier career choice. The model accounts for socialisation experiences in the family

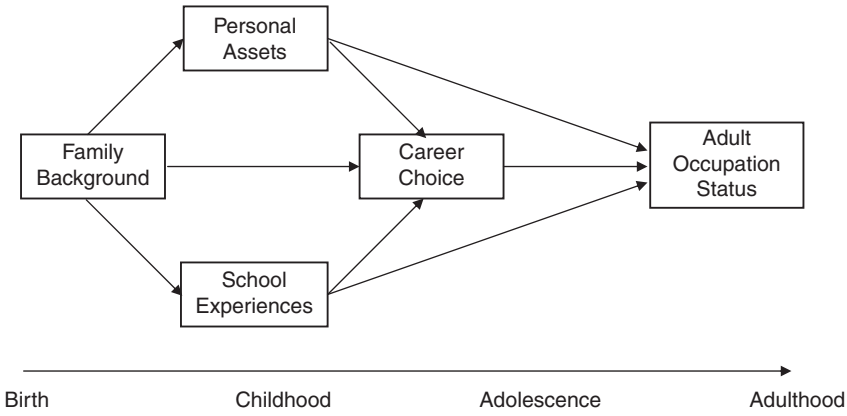

Figure 1.
Contextual-developmental model of career development

and the school environment, as well as for the influence of individual aptitudes and motivation.

Children growing up in families experiencing socio-economic adversity are at a greater risk to show educational underachievement and lack of motivation than their more privileged peers (Duncan and Brooks-Gunn, 1997; Schoon, 2006). There is also evidence to suggest that entry into a professional career, including entry into science related occupations, is more likely for young people from privileged social backgrounds (Farmer, 1997). The major mechanisms through which family socio-economic status translates into differences in educational attainment, motivation, and career choice of young people are parental support for education, and parental hopes and expectations regarding their children's participation in further education (Bandura *et al.*, 2001; Eccles, 1987; Steinberg *et al.*, 1996). Parents from privileged backgrounds have higher expectations for their child, provide greater access to financial resources, offer more educational opportunities, occupational knowledge and role models than less privileged parents (Marshall *et al.*, 1997; Schoon and Parsons, 2002; Vondraceck *et al.*, 1986). Another structural characteristic of increasing interest is maternal employment and its association with school attainment and career choice (Bogenschneider and Steinberg, 1994; Parcel and Menaghan, 1994; Philips and Imhoff, 1997). Maternal employment has, for example, been linked to less stereotypical career choice among girls (Jagacinski, 1987).

Teenage aspirations and subject choice are furthermore shaped by individual characteristics, or personal assets, including interests, motivation, and ability level. Ability in math, in particular, is considered as a "critical filter" for entry into science related fields (Sells, 1980), although there is mixed evidence in support of this hypothesis (Farmer, 1997; Xie and Shauman, 2003). Furthermore, independent of their achievements in maths, girls were found to show lower levels of self-confidence in their abilities and in their aspirations, even when matched with males of equivalent talent or test scores (Eccles, 1987; Subotnik and Arnold, 1994; Wilgenbusch and Merrell, 1999). It has been argued that children's perceived efficacy is the key determinant of their preferred career choice – rather than their actual academic achievement (Bandura *et al.*, 2001).

School environment is another powerful shaper of the career development of young people – the type of school attended can compensate for disadvantage caused by an unsupportive family and lack of opportunities, or can prevent gender stereotypes.

An important factor in the school environment is exposure to science, i.e. the number of science related options taken at school (Farmer, 1997), as well as teachers' assessments and perceptions of their students' abilities. Teachers' assessments may reflect biases based on stereotypes, such as the assumption that girls are worse than boys at maths or that less privileged children are less likely to do well at school (Fennema *et al.*, 1990; Li, 1999). On the other hand they may provide a source of information which is not measured by test scores (Plewis, 1997).

Research into specific educational settings has compared the performance of girls and boys in single-sex and co-educational teaching environments, following the assumption that single-sex schooling affects the academic self-concept and sense of efficacy in gender-atypical subjects (Cairns, 1990; Dennison and Coleman, 2000). Evidence regarding the association of single-sex schooling and academic self-esteem, self-concept, and participation in gender-atypical subjects is however mixed, and one has to be aware that in Britain single-sex schools are more likely to select pupils on the basis of their ability than co-educational schools (Arnot *et al.*, 1999).

In sum, career development is shaped by multiple, interlinked factors. Although the school environment and parental social background influence the career decisions and aspirations of their children, they do not determine them, and other factors within the wider social context can have an impact on both aspirations and their realization (Marjoribanks, 2003; Schoon, 2006). To gain a better understanding of how the multiple influences come together in shaping science-related careers among young men and women, we will apply the developmental-contextual model shown in Figure 1, examining the role of family, individual, and school related influences on career outcomes in adulthood.

Method

The study used data collected for the 1958 National Child Development Study (NCDS) and the 1970 British Cohort Study (BCS70), two of Britain's richest research resources for the study of human development. NCDS took as its subjects all persons living in Great Britain who were born between 3 and 9 March 1958. In five follow up studies data were collected on the physical, psycho-social and educational development of the cohort at age 7, 11, 16, 23, 33, and 42 years. The BCS70 has followed children born in the week 5-11 April 1970. Data collection sweeps have taken place when the cohort members were aged 5, 10, 16, 26, and 30 years. An analysis of response bias showed that the achieved sample did not differ from the target sample across a number of critical variables (social class, parental education, and gender), despite a slight under-representation of males, and of the most disadvantaged groups (Plewis *et al.*, 2004; Shepherd, 1993, 1995).

The following analysis is based on cohort members for whom we have data regarding adult occupational status at age 30 (BCS70) and 33 (NCDS), and who participated in the age 16 sweeps from which most of our influencing measures were drawn. The samples comprise 9,519 men and women in NCDS and 8,481 in BCS70. Potential bias due to missing variable information is addressed in the section on estimating the model.

Measures

Family background

Parental social class at birth was assessed using the Registrar General Classification of Social Class (RGSC), which is defined according to current or last job status and

associated education, prestige (Office of Population Censuses and Surveys, 1980) or lifestyle (Marsh, 1986). It is coded on a six-point scale: I professional; II managerial and technical; IIINM skilled non-manual; IIIM skilled manual; IV partly skilled; and V unskilled (Leete and Fox, 1977)[1]. Where the father was absent, the social class (RGSC) of the mother was used in BCS70, and where there was no father at birth of NCDS cohort members, the mother's father's social class was used. Classes IV and V were collapsed because of small class sizes.

Mother's education indicates whether the mother attended school beyond minimum education age or not.

Mother's employment status indicates whether the mother was in paid employment or not when the cohort member was aged 16.

Parental educational aspirations at age 16 differentiate between parents who hoped that their child continues with full-time education after age 18, and those who did not.

Individual assets

Academic attainment in math and reading at ages 10/11: at age 10 cohort members born in 1970 completed a shortened version of the Edinburgh Reading Test (Godfrey, 1977) and a arithmetic-mathematics test especially designed for the BCS70 cohort (Butler *et al.*, 1997). Cohort members born in 1958 completed a reading comprehension test as well as an arithmetic-mathematics test especially designed for use in NCDS (Fogelman, 1976). For more details of the measures see Schoon (2006).

Academic attainment in maths and English at age 16 was derived from the attained exam scores in these subjects. The examination system was the same for both cohorts, with BCS70 being one of the last cohorts to sit the two-tiered examination structure of O'levels and C.S.E.s. In NCDS exam results were reported by the school, while in BCS70 they were assessed via self report in a follow-up questionnaire. For both cohorts, a simple scoring technique was applied, giving a score of 7 to a grade A O'level and a score of 1 to a grade 5 C.S.E in math and English exams. Zero indicates a fail or no entry for this exam.

Self-rated math ability: at age 16 NCDS cohort members were asked to rate their own aptitude in maths by drawing comparison to "other people their own age", stating whether they were above average, average or below average. BCS70 cohort members were asked whether they "were good at maths?" A compromised dichotomous variable was derived indicating whether the individuals considered themselves above average (NCDS) or good at maths (BCS70).

Educational plans: at age 16 cohort members were asked to indicate at what age they were most likely to leave school, and which of the following they would like to do: continue with full-time study, do a job that involved part-time study, or do a job that required no further study. The answers to these two questions were combined to indicate whether they wanted to pursue further education beyond age 18 or not (Schoon, 2006).

Occupational aspirations

At age 16 cohort members in NCDS were asked "what would you like to be your first full-time job?" and cohort members in BCS70 answered the question "is there an actual job you would like to do?" Answers given by NCDS cohort members were coded at the data entry stage, while the verbatim answers given in BCS70 were coded using CASCOT (Computer Assisted Structured COding Tool) software developed by the Institute of Employment Research at the University of Warwick (Jones, 2004). In both

cohorts we could identify cohort members with science-related occupational aspirations, i.e. those aspiring to a career in the sciences, engineering, technology, or health professions.

School experiences

Teacher rating of general ability: at age 10/11 teachers were asked to rate the cohort members general knowledge on a scale of 1 to 5. A high score represents a child who is exceptionally well informed for his/her age.

Teacher rating of math ability: at age 16, teachers of NCDS cohort members were asked to rate the child's aptitude in maths on a five point scale. In BCS70 teacher assessments of math ability was derived from the level of the class in which the cohort member had been allocated. A high score represents a strong ability in maths (NCDS) or being allocated to the highest class in maths (BCS70).

Number of science subjects entered for examination at age 16 gives indication both of the teachers' assessment of the child's aptitude for, as well as the child's exposure to pure science subjects: i.e. chemistry, physics, biology, as well as mathematics ("general science" not included).

School type indicates whether the cohort member attended a LEA comprehensive, LEA grammar, or independent school at age 16.

School mix differentiated between single sex and mixed schools.

Adult occupational status

Adult occupational status identifies individuals who were either currently employed in a science related occupation, or whose most recent employment had been in such an occupation, if they were currently not in employment. We used the Standard Occupational Classifications (2000) codes to identify SET occupations including natural scientists, engineers, technical occupations, as well as health professionals (DTI, 2006)[2].

Statistical analysis

A number of nested multivariate logistic regression models were run for men and women separately to establish gender differences in the factors and processes influencing career development. The outcome was whether the cohort member was currently employed (most recently employed for those out of the labour market) in an SET related occupation or not. Variables were entered in three blocks, focusing on (1) the effect of experiences in the family environment, (2) individual assets or resources, and (3) school experiences. The hierarchical modelling allows us to identify whether the influence of family background is mediated through individual resources and/or school experiences. Where measurement scales were not equivalent between cohorts, standardised odds ratios are reported. Potential bias due to missing variable information is addressed using multiple imputations (ICE) as implemented in STATA (Royston, 2005). Reported estimates represent the average of five estimates derived from five replications of the data. Standard errors were adjusted according to Rubin's rule (Rubin, 1987).

Results

Table I shows the descriptive statistics for all variables in the model, after imputation. Focusing on the aspirations expressed at age 16, generally more boys than girls expressed an interest in a SET career, and there has been little change in the overall proportion of boys and girls aspiring to these types of career. Checking the

Descriptive statistics	NCDS Male	NCDS Female	BCS70 Male	BCS70 Female
Parental social class at birth (% in social class IV or V)	19.9	21.1	20.2	20.1
Mother's education (% stayed on at school)	26.6	26.9	37.7	37.7
Mother's employment (% employed when CM age 16)	66.3	66.3	56.6	56.7
Parental aspirations (% wish CM to stay on beyond 18)	34.9	33.8	25.2	25.9
Reading test age 11/10 [mean (SD)]	16.4 (6.3)	16.5 (5.8)	41.3 (12.4)	42.7 (11.6)
Maths test age 11/10 [mean (SD)]	17.7 (10.4)	17.4 (9.8)	46.5 (12.2)	44.9 (11.3)
English exam score age 16 [mean (SD)]	2.7 (2.4)	3.5 (2.4)	3.0 (2.4)	3.6 (2.3)
Maths exam score age 16 [mean (SD)]	2.3 (2.5)	2.0 (2.4)	2.8 (2.6)	2.6 (2.4)
Self-rated maths ability age 16 (% state above average/good at)	21.7	11.4	50.2	34.2
Educational plans age 16 (% plan post 18 education)	18.3	22.4	24.8	29.8
Occupational aspirations age 16 (% aspire to SET/health related occupation)	14.3	6.0	13.8	6.6
No. of science exams entered age 16 [mean (SD)]	1.8 (1.3)	1.5 (1.1)	1.6 (1.3)	1.7 (1.2)
Teacher rating general ability age 10/11 [mean (SD)]	3.0 (0.9)	3.0 (0.8)	3.2 (1.0)	3.1 (0.9)
Teacher rating maths ability age 16 [mean (SD)]	3.0 (1.2)	3.0 (1.1)	2.0 (0.7)	2.1 (0.7)
School type age 16 (% LEA grammar, independent)	10.5, 6.9	12.7, 6.2	3.4, 14.5	4.5, 12.8
School mix age 16 (% in single sex schools)	23.6	26.9	14.2	16.4
Current or most recent occupation age 33/30 (% SET/health prof. occupations)	9.3	2.7	12.0	3.3
N	4,758	4,758	4,041	4,440

Table I. Sample characteristics for men and women in both cohorts (imputed data)

occupational preferences in more detail (results not shown) it seems that there has been a slight increase in interest for pure science and health professions among girls in the later born cohort. Among boys, on the other hand, there has been an increase of interest in technology and a decrease in interest in natural sciences, confirming findings from Robert's (2002) report.

Regarding occupational attainment of cohort members in their early 30s Table I shows the percentage of cohort members who were currently, or most recently employed in a SET occupation. There has been a slight increase of men and women opting for a science career in the later born cohort, yet in both cohorts only about 1 in 10 men and about 1 in 30 women in their early 30s were in a SET occupation. Figure 2 furthermore shows that more men than women had become scientists, engineers, and technologists. In particular, there has been an increase of men entering occupations involving computing and IT. Regarding health professions there are no great gender differences.

In a next step we investigated factors and processes predicting employment in a SET occupation. Table II gives the odd ratios for men and women in both cohorts. Model 1 included predictors related to experiences in the family of origin. In both cohorts parental social class appears to be an important predictor, especially for the later born cohort. Men and women who entered a SET related career are more likely to come from families with a professional rather than a non-skilled background. This effect is strongest for women in the later born cohort. Other significant predictors

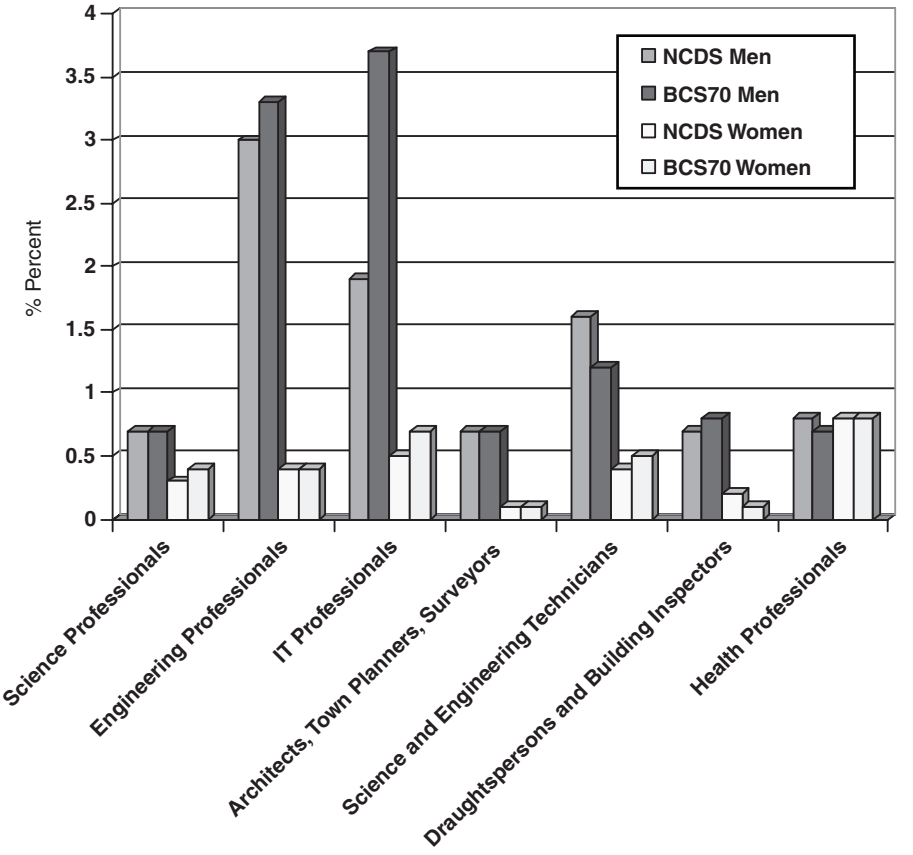

Figure 2.
Percentage of cohort members in a SET occupation in their early 30s[a]

Notes: [a]Most recent occupation if currently out of the labour market

include educational background of the mother, especially for women (among men in NCDS this variable is not significant), as well as parental aspirations for further education, indicating the role of parent-child interactions in shaping career development. This effect however is less strong for BCS70.

In model 2 predictors relating to individual assets of the cohort members were added. Entering the person-based variables into the model renders indicators of family background non-significant, except for maternal education, which continues to play a role for women born in 1970. This finding suggests that the influence of family background is mediated through individual attainment, self conceptions, and aspirations. Occupational aspirations expressed at age 16 in particular are a highly significant predictor for entering a SET related occupation later in life, even after controlling for socio-economic family background factors. Teenagers who aspired to a SET related career are significantly more likely to take up a SET related occupation than teenagers expressing other interests. The odd ratios for women are generally higher, about twice as high as for men, suggesting that for young women in particular, successful entry into SET occupations requires clear formation of their ambitions early on. Other significant predictors of adult occupational attainment include self-rated

Table II. Hierarchical logistic regression predicting SET/health professional occupation at age 33/30 (current or most recent occupation)

	Model 1				Model 2				Model 3			
	NCDS		BCS70		NCDS		BCS70		NCDS		BCS70	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Parental social class: class I versus classes IV+V	2.67*	3.21**	3.31*	5.25*	ns	ns	ns	ns	ns	ns	ns	ns
Mother's education: stayed on at school	ns	2.09**	1.51*	2.28*	ns	ns	ns	1.65***	ns	ns	ns	1.69**
Mother's employment: employed when CM age 16	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Parental aspirations: post 18-education	2.14*	2.48**	1.32***	1.46***	ns	ns	ns	ns	ns	ns	ns	ns
Reading test (age 11/10)					ns	ns	ns	ns	ns	ns	ns	ns
Math test (age 11/10)					ns	1.70**	ns	1.42***	ns	ns	ns	ns
English exam score (age 16)					ns	ns	ns	ns	ns	ns	ns	ns
Math exam score (age 16)					1.34*	ns	1.52*	ns	ns	ns	1.36***	ns
Self-rated math ability (age 16)					1.71*	2.05**	1.70**	2.25**	1.47**	ns	ns	1.85***
Educational plans: post 18-education					ns	2.07**	1.67*	ns	ns	1.75***	1.60**	ns
Occupational aspirations:SET/health prof. aspirations					3.10*	5.49*	4.31*	7.32*	2.66*	3.82*	4.28*	7.36***
Number of science subjects									1.30**	1.41**	ns	1.33**
Teacher rating general ability (age 11/10)									ns	ns	ns	ns
Teacher rating math ability (age 11/10)									1.68*	1.95**	1.85*	1.80**
School type: LEA/LEA grammar/independent									ns	ns	ns	ns
School mix: single-sex/mixed sex									ns	ns	ns	ns

Notes: $*P < 0.05$, $**P < 0.01$, $***P < 0.001$

math ability, actual math examination results, and educational plans expressed at age 16. Self-rated math ability is significant for both men and especially women in both cohorts, confirming the role of self conceptions in shaping development (Bandura *et al.*, 2001). Among women, actual achievement in math at age 11 (NCDS) and 10 (BCS70) plays an important role, while for men exam scores at age 16 are more relevant. This finding may suggest that the trajectory between school performance and subsequent careers in SET begins earlier for girls than boys. An other interesting finding concerns the role of the teenagers' educational aspirations, which are important for women in NCDS and for men in BCS70. Possibly the shift in the role of educational aspirations could indicate that in the earlier born cohort women needed to be engaged into plans for further education in order to succeed in a SET career, while in the later born cohort, it is men who needed this additional focus.

Model 3 adds predictors related to the school environment. Adding these variables confirms the general importance of early occupational aspirations, the role of maternal education for women born in 1970, and the role of educational plans among women born in 1958 and men born in 1970. It changes however the significance of earlier math achievements and self-rated math ability, suggesting that the influence of family background and individual resources on later occupational attainment, are moderated by experiences in the school context. Young people that were rated by their teacher as having strong mathematical ability are more likely to enter a SET related career than others. Another important predictor was the number of science subjects entered for exams, which is another indicator of the teacher's assessment of the child's ability and the exposure to science experienced at school. The findings suggest that teacher evaluations are significant predictors shaping occupational careers, in addition and above the influences of the family and of individual resources and capacities. School type and school mix, in contrast, played no significant role.

Discussion

The aim of this paper was to assess the role of family, individual, and school influences in shaping occupational careers. Interest and uptake of SET occupations in both cohorts is rather low, although there has been a slight increase among men and women in science related occupations in the later born cohort. There is a persisting gender imbalance, both in terms of aspirations and occupational outcome, and occupational choices remain largely gender-typical. Relatively few young women aspired for SET-related jobs, and only about three percent of women in either cohort settled for a career involving science related or technical jobs. Furthermore, only one in ten men entered a SET-related career, and the slight increase is mainly driven by young men entering IT professions, confirming findings in Robert's review. Our findings roughly are in line with data collected for the 2001 New Earnings Survey Panel Data, which showed that between 1991 and 2001 on average 9 per cent of all employed men and 2 per cent of all employed women were in SET occupations (IER, 2003). Furthermore, using data from the Labour Force Survey 2002/2003 Jones and Elias (2005) showed that men are approximately four times more likely to work in a SET occupation than women, which is also similar to our findings. In comparing findings across surveys one has to take into consideration that the cohort data captures men and women in their early 30s and not of all age groups. Nonetheless, the similarities in findings are striking.

What are the factors and processes facilitating entry into a SET related career? And what can be done to attract more young people to a career in science and technology? In both cohorts, and for both men and women teenage occupational aspirations are an

important predictor for later occupational outcome – suggesting that attachment to a career in science is formed relatively early in life, especially among women. Studies that focus on factors influencing selection into a science career during the college years or even later are not able to account for the fact that interest in science can be manifest already by the end of primary education (see also Foskett *et al.*, 2004).

The association between early aspirations and later career attainment was stronger among women then men, even after controlling for social background factors, school experiences, and individual attainments at age 16. This finding suggests that SET related aspirations expressed at age 16 are stronger predictors for entering a SET occupation among women than among men. It could be the case that men are more likely than women to drift into SET related career without being guided by earlier aspirations for that domain. A science related career might be an option more open and attractive to men, whatever their orientations at school.

Family background appears to influence entry into a science related occupation only indirectly; its effect is mediated through personal resources, especially math performance, self-rated math ability, and individual aspirations. In developing their self-concepts and orientations for the future young people are influenced by encouragement from parents and their teachers. Maternal education in particular continues to play a vital role in shaping career development, especially among women born in 1970, confirming previous findings (Berryman, 1983; Ware and Lee, 1988). There is also evidence to suggest that parental aspirations for their child's education play an important role in encouraging career development, over and above family social background (Ware and Lee, 1988; Xie and Shauman, 2003). Maternal employment, on the other hand, shows no significant effect.

Among the school experiences, teacher assessments of pupils' math ability, as well as the number of science related subjects entered for examination (except for young men in BCS70 for whom math attainment at age 16 is more important) are vital in encouraging young people to pursue a career in sciences. These effects are manifest after controlling for social background and personal assets. The findings imply a vital role for teachers to recognize and encourage science and math related aptitudes in their pupils, and the provision of science courses at school. Similarly, Robert's review has indicated that the experience of all children at school is crucial to their subsequent education and training, as well as to their careers. Significant problems to be addressed in primary and secondary schools include shortage of science and math teachers, poor practical environments, need for lab space, and the ability of the courses to inspire and attract pupils. Making school experience more relevant and engaging for young people, and encouraging participation and uptake of science subjects might be a crucial step forward in increasing interest in a SET related career. School type or single-sex schooling, on the other hand, was not significant, suggesting the need for further research into the role of school environment on occupational attainment.

In interpreting the findings some limitations of the study should be noted. The study offers a cross-cohort comparison of two large-scale follow-ups of individuals born 12 years apart. As with all research using cohort studies, this work is constrained by having to make the best use of the available data. Great care was taken to assess relevant variables in as similar a way as possible, although it was not always possible to obtain exactly the same measures in both cohorts. To account for missing data both in terms of unit and item non-response we have used multiple imputations as a best effort technique, but bias in the model estimates might still be present. The study is based on individuals born in 1958 and 1970, and there have been many changes in the

school environment and labour market perspectives encountered by later born cohorts. Nonetheless, our findings mirror more recent employment statistics, and the study enables us to establish persisting and changing influences on career development, and to capture the influence of multiple factors over time.

The findings indicate that occupational choices and transitions are not simply individualized choices, but are socially embedded and remain circumscribed by gender, social background, and the wider socio-historical context. There are persisting gender differences in occupational choice and career development, yet gender cannot be seen in isolation from other facets of identity, such as social origin or social change. The study has indicated the role of contextual factors in determining career choice and development, calling for improved opportunity structures and support systems. Explanations for the continuing trend of relatively few young men and women aspiring to and entering a SET-related career involve both home and school environment, especially interactions with the teacher.

Experiences during primary and secondary schools are the first stages in the screening and filtering process. The educational careers of girls and boys, especially their attainment and placement in math, may reinforce stereotyped views and self-concepts. Views about own abilities and career orientations appear to be already established by age 16 and may affect participation in post-compulsory education and attachment to a SET-related career path. For women, in particular, early occupational orientations play an important role in influencing their attachment to a SET career, and more can be done to facilitate their career progression. This might include investment in resources for schools and teachers to develop and encourage pupils' interest in math and science, as well as measures for flexible working conditions and arrangements for child care.

During the early years, parents and teachers play a vital role in encouraging and supporting academic self-concepts and engagement in education and training. As most career guidance is provided within the school environment, school children should be made aware of current and developing patterns of job availability and skill shortage by their teachers and career guidance officers. Furthermore, global competitiveness as well as current threats to our environment and climate call out for technological solutions. Explaining the way in which their subject and career choices can influence their future career prospects and earning power (Francis, 2002), as well as their ability to influence the well-being of future generations, might raise awareness and interest. Guidance should be given even before subject choices are finalized and a commitment to a career has been made. There might also be case for a broader education about trends in the labour market and technological challenges to be faced by society.

Notes

1. The occupational categories used in the US census and other European countries are similarly based on the skills and status of different occupations (Krieger *et al.*, 1997).
2. SET occupations were identified using the SOC 2000 Minor Groups: 211; 212; 213; 221; 243; 311; 312.

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