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The Editors are most grateful to the Nuffield Foundation for supporting the journal through its development phase.

Editorial

John Bynner
Executive Editor

This Issue of *Longitudinal and Life Course Studies (LLCS)* brings with it important news about longitudinal and life course studies, signalling a new era for the development of the field. There has been massive new investment in new longitudinal research resources, including the US *National Children's Study NCS)* and the French *Étude Longitudinale Française depuis l'Enfance(ELFE), Growing Up in Australia (GUA)*, *Growing up in Ireland (GUI), the German National Education Panel,* which includes a cohort followed from birth, and the new UK 2012 birth cohort study - yet to be named. So despite the economic upheavals of the last two years, and the ongoing recession, recognition of the need for an evidence base founded on long term longitudinal resources to support the policy process, now needs no further justification. Other governments are following suit throughout the world.

Closer to home, but also of much significance to the Journal, is the decision to establish the international *Society for Longitudinal and Life Course Studies (SSLS)* that will be formally ratified at its first annual general meeting and conference at Clare College, Cambridge on September 22nd. The decision in principle to set up the Society was taken at last year's Longview conference at the same venue. An Interim Executive Committee was appointed to agree a draft constitution and make arrangements for the conference and elections for the Executive Committee – see the 'News and Events' section for the results.

The importance of the Society was evident from the 150 people who signed up to become 'Foundation' Members' and elected the Executive Committee. One of the committee's first tasks is to agree the programme for the conference mentioned above, which we see as a major platform for the communication of longitudinal and life course research findings *en route* to publication in *LLCS*. One of the Society's other major tasks in the coming year is to take over responsibility from Longview for *LLCS.* So again the news about the Society is integral to the future of the Journal.

In this Issue of the Journal, three papers are published, each on a different facet of longitudinal and life course research.

The first paper by Michael Wadsworth puts on record the origins of the first major British birth cohort study, the National Survey of Health and Development, which began in 1946. The paper draws out strongly the scientific and policy context that drove the decision to set up the study and shaped its aims, including falling fertility and the social gradient in infant mortality. It also makes the point, which is common to most if not all these early longitudinal research enterprises, that without the energy and enthusiasm of an inspirational Chief Investigator, James Douglas, the study might never have got beyond the stage of the first perinatal mortality survey with which it began. This contrasts with the UK situation today where the government funded Economic and Social Research and Medical Research Councils take for granted that their job is to invest in large scale longitudinal "research resources". The 1946 study was also important in pioneering the whole range of research techniques necessary for longitudinal study, including methods of data collection and maintenance of contact with the survey sample.

The second paper, which was a joint prize-winning entry by Dylan Kneale for last year's Neville Butler Memorial Prize, uses data from the two following birth cohort studies, 1958 and 1970, to examine the interesting question of the effect of parents' educational expectations on the timing of their children (in this case the cohort members) becoming parents. The argument is that early parenthood is set against the opportunity costs of loss of earning capacity and other indicators of achievement in the labour market the educational achievement predicts. In using a two cohort comparison, the paper underlines the important distinction between relative and absolute measures of early parenthood. The former is defined as the first quartile range of the ages of first births for the parents of a given cohort, hence constant over time. The second is defined as the section of the population of cohort members giving birth during their teens, an absolute measure, which through social and cultural shifts has being steadily contracting with time. The paper demonstrates that parental educational expectations for their children, play a significant part in the decisions

involved in especially motherhood, as measured in terms of the first age quartile. These can override those other family factors such as socio-economic status that have been shown in the past to influence early parenting, as measured by absolute age.

The third paper, from the other joint winner of the NBM Prize 2009, Simon Whitworth and Maria Portanti, is again devoted to fertility, this time drawing on the data available through the UK Office of National Statistics 'Longitudinal Study (LS)'. The LS is based on 1% of the census population - over 600,000 individuals each year - linked from one census to the next and augmented between censuses by vital registration data. The focus of analysis reported in their paper is the determinants of childlessness, i.e. what characterises women who remain childless throughout their adult life? They use an appropriate "slice" of the whole longitudinal LS dataset comprising the sub-sample of women born between 1956 and 1960, investigating the relationships between lifelong fertility outcomes and other characteristics. Apart from the structural features of women's lives such as marriage, cohabiting and single status, childlessness can be identified with a distinct group characterised by socio-economic characteristics. The study shows both the potential of the LS dataset for large scale analysis of this kind, but also its limitations in being restricted to census and vital registration data. In this sense it provides a useful way of benchmarking the results of more detailed longitudinal studies - such as the birth cohort study and the household panel study - in relation to such phenomena as childlessness.

Apart from papers, this Issue of the Journal also carries 'News and Events' of interest in the world of longitudinal and life course research to readers. It also includes, for the first time, one of the new developments for the Journal, the periodic publication of "tutorials", reviewing methodology in different areas of longitudinal data analysis. The first tutorial given by Harvey Goldstein and Bianca De Stavola, is devoted to a topic of central importance in longitudinal research, '*repeated measures analysis*, and offers easy access to a goldmine of useful information about the main techniques.

The next LLCS publication will be a Special Issue devoted to "cognitive capital", and what can we learn about the evolving nature of this important theoretical and policy construct by tracing its development through the five British birth cohort studies starting in 1946 and continuing with new studies in 1958, 1970, 1992 and 2000. This thematic approach, based this time on a Nuffield Foundation-funded seminar series, will be a common one in Special Issues over the next two years, of which upwards of eight are in the pipeline. However the Editorial Board's policy will be to ensure there is always space for individual papers and many Issues will continue to be devoted entirely to them.

On 8th February 2010, there was a meeting of the Editorial Committee comprising section editors and associate editors, to consider a number of strategic issues regarding the Journal. Major policy themes arising from the meeting included the commitment to build a world-wide readership and authorship in every way possible. A steady flow of papers is the lifeline of the Journal on which its future success depends. Another decision is to expand the Journal to include easily accessible tutorials on key topics in longitudinal analysis. The first of these, appearing in this Issue, is the tutorial style paper just considered.

Another new venture is special papers, volunteered or commissioned of three kinds:

- Accounts of the longitudinal research landscapes in a particular country
- Descriptions of longitudinal studies of major international significance
- Overviews of longitudinal research on a particular substantive topic

We welcome suggestions for contributions in this area.

Book reviews are also now firmly on the agenda; three are reviewed in this issue of *LLCS* and more are steadily coming in. ***We need volunteers for reviewing***, so if you are interested in receiving a book for review (and keeping it!), please let us know immediately so we can register your name on our reviewers' panel.

Reports on research projects using the major longitudinal research resources frequently appear on the relevant Centre websites. The Journal will regularly list what is newly available – see the News and Events section for the first one. We look forward to receiving details (including the weblinks) of more reports of this kind of likely interest to *LLCS* readers.

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The origins and innovatory nature of the 1946 British national birth cohort study

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Abstract

The first of Britain's six large-scale birth cohort studies began in 1946, within eleven months of the end of the Second World War. Evidence is given in support of the argument that the initial aims of the first study were determined mostly by pre-war policy and scientific concerns with falling fertility and the social gradient in infant mortality. It is also shown that the methods and dynamic of the study were provided by the enthusiasm and expertise of a young demographer, and by a young physician's expertise and war-time experience of data collection and analysis. Their pioneering methods of data collection, their concern with both science and policy, and with biological as well as social questions, and the physician's determination and persistence in swimming against the tide of contemporary scientific opinion, provided a strong basis for the study, which still continues.

Keywords: Longitudinal study; history; epidemiology; social science.

Introduction

Britain has a series of large-scale birth cohort studies of individuals that spans the period from the end of the Second World War until today. The first of these studies began in 1946 (Wadsworth et al 2005). The present paper argues that there are specific links between the design of the first national birth cohort study and the science and the policy concerns of the preceding decade, without which that study might not have evolved.

Between the two World Wars there was concern in Britain about the role of science in society (Bernal 1939; Werskey 1971; Pemberton 2002). Inevitably, however, by the end of that time, science had achieved a role which was defined by the demands of the economic depression, the need for healthy and well-nourished children, mothers, the labour force, and the armed forces (e.g. Boyd-Orr 1937). At the end of that period Bernal (1939) wrote that 'It used to be believed that the results of scientific investigations would lead to continuous progressive improvements in conditions of life; but first the War and then the economic crisis have shown that science can be used as easily for destructive and wasteful purposes, and voices have been raised demanding the cessation of scientific research as the only means of preserving a tolerable civilization' (p.xiii).

When Bernal wrote, British scientific research was concentrated in the munitions industries and the Armed Forces, which were gearing for the coming war (Bernal 1939 p.427). The Medical

Research Council was occupied with the predominant disease problems, and published research reports, for example, on the clinical value of radium (Wood et al 1938; Medical Research Council 1938, 1939a), the care of poliomyelitis (Medical Research Council 1939b), nutrition (Cathcart et al 1940), and pulmonary illness in miners (Medical Research Council 1942). The Government was worried about social inequity and possibilities for social insurance against poverty, income insecurity, ill-health, poor education and unemployment (e.g. Boyd-Orr 1937; Beveridge 1942). In addition there was anxiety and research about why fertility had been falling in Britain and in many other countries since the second half of the nineteenth century (Hogben 1938; Kuczynski 1938). Falling fertility was feared a threat to national economies and influence because of its association with a shrinking work force and an ageing population, and it became part of the arguments for extremist views in politics and eugenics. Anxiety about the changing population structure was so great that a Royal Commission was set up in 1944 to study the problem; it reported in 1949 (Royal Commission on Population 1949).

Despite this range of research, the British scientific civilian research establishment in the inter-war years was small, and compared with the years after the Second World War, there were 'fewer barriers between different fields of scholarship' (Zuckerman 1981). In terms of scale, for example, there were 193 professors and heads of departments associated with all branches of medicine in English, Welsh and Scottish university departments in 1935-36 (Bernal 1939 p.418), as compared with 17,240 at professorial level in the United Kingdom in 1999-2000 (Higher Education Statistics Agency 2001).

Once war seemed inevitable, the relatively small scientific establishment was quickly involved in all its aspects. It is argued in this paper that the development of scientific methods of problem evaluation and solution during the Second World War, profoundly influenced the design and undertaking of the initial data collection in Britain's first national study of maternity, and its continuation as a longitudinal study. It is also argued that contemporary policy and scientific concerns about fertility and infant deaths influenced the establishment, design and working methods of that study, much more than the longitudinal studies extant at that time.

Methods

Four sources of information have been explored in a search for the original ideas which prompted the study. First is the influence of wartime field studies of the physical and psychological effects of air raids. Second are the effects on the new study's design of contemporary policy and scientific concerns with falling fertility and socially-biased infant mortality. Third, the design of the first data collection is outlined, and its links with the first two areas are examined. Finally, the design of the follow-up studies, up to age fifteen years, is described, and influences from the initial study, and from existing longitudinal studies already in progress in 1946 are outlined.

Source material for this paper includes contemporary publications, the Zuckerman archives at the University of East Anglia, the archives of Richard Titmuss and of the Population Investigation Committee (PIC), both at the London School of Economics, Langford's (1988) history of the PIC, and publications from the 1946 national birth cohort study.

Influences of field studies undertaken during the Second World War

In 1931 Dr Solly Zuckerman, director of the University of Oxford's Extramural Unit, inaugurated with others a group that debated 'the question of the general significance of science to society, and the conscious role science might play in social development' (Zuckerman 1978 p.394). Meetings of the small group of young scientists and thinkers who formed the so-called Tots & Quots[i] continued for ten years. They were addressed by leading politicians and political thinkers as well as scientists, including F.A.Lindemann (who became Churchill's Scientific Adviser during the war), Henry Melchett (deputy chair of Imperial Chemical Industries), H.G. Wells (novelist and socialist thinker), Tom Driberg (journalist), J.B.Conant (President of Harvard University), Herbert Morrison (Minister of Supply and later Home Secretary), and Jack Drummond (Chief Adviser to the Ministry of Food) (Zuckerman 1978 pp. 393-404; Crowther JG 1970; Werskey PG. 1971).

When the Second World War started most members of the Tots & Quots became involved in policy and research, and used scientific methods to evaluate the impact and processes of war. For example, they were concerned with 'the physics of explosions…the resistance of structures to various types of shock…and the risk that people in underground shelters might suffer from concussion as a result of shock-waves which passed through the earth when a bomb exploded nearby' (Zuckerman 1978, p113). Members of the club also discussed 'plans for post-war reconstruction' (Zuckerman 1978 p 401).

The involvement of these scientists was not initially widely welcomed. In *Science in war* (1940), which the Tots & Quots published anonymously, they wrote that 'the tradition of civil servants belongs to the age of Victorian Liberalism and is one of laissez faire and of Government non-interference. …What we are calling for, not as an ideal, but as an urgent practical need in a desperate situation, is the effective utilization of scientific method, scientific advice and scientific personnel' (*Science in war* 1940). This tone reflects the prevailing view that scientists had been accorded 'low status…by the nation's political and intellectual elites until 1939' (Werskey 1971). Zuckerman (1978) notes how in his study early in the war 'of the biological effects of explosions…(he) had committed the sin of embarking on researches into unfamiliar problems without the preliminaries of committee discussion, and without taking into account the views of the men who were presumed to know more than I did' (p.121).

Zuckerman's studies were nevertheless welcomed both by new Government Departments set up to manage the war, and by the armed forces (Zuckerman 1978, p.121, pp.324-344). The Ministry of Home Security established a Research and Experiments Department which supported Zuckerman's Oxford Extra-Mural Unit (begun in 1939) as it pressed forward rapidly with experimental studies of injuries associated with blast waves and innovative studies of air-raid casualties. Population samples were selected to represent all those exposed to air-raids in Hull, Birmingham and London in 1940-41, in order to study disruption to production, transport, and morale. Expert statisticians, who advised on sampling and analysis, included Dr Frank Yates from Rothamsted Experimental Station (the national centre for agricultural research renowned for its pioneering and innovative statistical work), and Dr Austen Bradford Hill from the Ministry of Home Security's Research and Experiments Department.

In the air-raid studies, a wide range of data was collected from post-mortem examinations, interviews with survivors, and essays written by children aged 10-16 years especially for the study, and information was gathered on patterns of work absence, police sickness, rail and road passenger traffic, and on patterns of use of libraries, cinemas, baths and wash-houses. About 8,000 interviews were undertaken by psychiatric social workers, psychiatrists and members of the research team, and about 2,000 essays were delivered (Zuckerman archive 56/9-14). Systems were devised for classifying injuries and the processes that led to death (Blake et al 1942), as well as for the classification of information obtained from questionnaires and from essays about material circumstances and morale. Psychiatrists and psychologists gave advice, including Dr Susan Isaacs of Cambridge University and Professor Aubrey Lewis of the Institute of Psychiatry at the University of London.

It is clear that Zuckerman's small team (never more than 25, including administrative staff) had a 'can do' attitude. They worked systematically, and rapidly delivered results that can be found in the papers produced for the Ministry of Home Security (Zukerman archive e.g. 59/10/2 and 57/5).

Influences from policy concerns about fertility and infant mortality

The nature of anxiety about fertility between the two World Wars is evident in some of the influential British work on the topic, including *Twilight of parenthood* (Charles 1934), later reissued as *The menace of under population*, Beveridge's (1925) *The fall of fertility among European races,* and *Parents revolt* (Titmuss & Titmuss 1942).

The perceived problem of falling fertility was associated also with the problem of the risk of death in the first year of life. Infant death rates in the United Kingdom had fallen consistently from 1870 (150 per thousand live births) until a period of little change, between 1920 (62 per thousand) and 1937 (61 per thousand): that followed the introduction of the National Insurance Act (1911). Once the fertility rate began again in 1938 to show a fall it was seen as less of a problem, and in 1940 the president of the Royal College of Physicians wondered 'whether the stinting production and careful saving of infant lives today is really, biologically speaking, as wholesome as the massive production and lavish scrapping of the

last century.' (quoted by Titmuss 1943). However, as Titmuss (1943) noted, 'Despite a considerable fall in the absolute rates, the range of inequality for total infant mortality is as great as, if not greater than, in 1911' (p.57). There was, in addition, concern that falling fertility was in part caused by the high costs of child-bearing and up-bringing (Carr-Saunders 1936).

Anxiety about falling fertility had 'led many authorities to conclude that, with a continuance of the present pattern of differential fertility, a decline in national intelligence is threatened' (Glass 1946). Government concern about fertility led to the appointment of the Royal Commission on Population in 1944. It deliberated for 5 years.[ii] The Population Investigation Committee (PIC) began in 1936 and was, in effect, an energetic independent group, based at the London School of Economics. The PIC's full-time research secretary was Dr DV Glass, a demographer then aged 35 years, who had just published his first book (Glass (1936), a study of measures taken to increase population in a number of European countries (Langford 1988). The PIC aimed to stimulate interest and undertake research in all aspects of population change from fertility to ageing (Langford 1988).[iii] The PIC partly funded[iv]a repeat of the Scottish Mental Survey which, in 1932, had measured intelligence in all children (over 80,000) born in Scotland in 1921; the repeat study took place in 1947 (Scottish Council for Research in Education 1949). The PIC also established a sub-committee in 1943 to plan a study of maternity. Miss W. Burt, a member of the PIC, reported that she had undertaken a pre-war study of maternity by sending questionnaires to all health authorities in England and Wales asking about 'costs of maternity which might have acted as partial deterrents from parenthood' (Population Investigation Committee Archive 1944), but the war had stopped that study. The sub-committee pressed ahead with a design for a national study, and in 1945 received a grant from the Nuffield Foundation for a study of child-bearing 'with particular reference to costs, quality and adequacy of services' (Population Investigation Committee Archive 1945a).

The management and design of the first data collection

Defining the aims

The PIC sub-committee planned a two-stage enquiry into the working of maternity services. The first part of the enquiry was to be 'A short-term enquiry consisting of a factual survey of existing maternity services…and the opinions held as to the value of these services in war-time conditions.' The second part was to be 'A long-term enquiry…on the basis of which recommendations could be made for reconstructing the services after the War' (Population Investigation Committee 1943). The need for information on the mother's expenditure on pregnancy was added. During the following year discussions about the design of the enquiry were held initially with the Royal College of Obstetricians and Gynaecologists (RCOG). As the idea of a new data collection was developed, representatives of the Society of Medical Officers of Health (public health directors at the area level), and the Midwives and the Health Visitors Association (public health nurses) also joined the discussion. It was clear that a combination of concerns about fertility, and infant and maternal mortality, should be accommodated in the study design. The sub-committee recognised that the enquiry would inform plans for the proposed post-war national health care services.

The PIC and the RCOG established a small Joint Committee comprising a Chair, a Secretary, and 11 representatives of the bodies already consulted, to set up and manage the study, together with the study's Director and Research Assistant (Joint Committee 1948). They refined the aims so that the questions the study addressed were (Joint Committee 1948, pp.1-2):

- What was the availability of maternity services to different social classes, in different parts of the country?
- What use was made of these services?
- How effective were the services in educating mothers, and in reducing mortality among mothers and infants?
- What was the extent of need for domestic help during pregnancy and the puerperium?
- What was the nature and extent of expenditure on child-birth?

The timeline of the process of setting up the national study of maternity is shown in figure 1.

Figure 1. Time line of the data collection, management of data, and publication of findings in the first national study of maternity.

July 1943	First meeting of PIC sub-committee set up to plan a maternity study
July 1945	Nuffield Foundation grant notified
October 1945	Dr JWB Douglas appointed as Director
November 1945	Pilot studies begin in Bristol, Kensington and Inverness
February 1946	Concern about questionnaire length
April 21st 1946	Data collection begins (sample attempted all 15,130 births during one week in March 1946)
mid-June 1946	Data collection completed (achieved sample 13,687, 91% of sample attempted)
November 1946	Coding and checking almost complete
Summer 1947	Area studies undertaken
1948	Publication of the first book

It is not clear from the documentary evidence how much preparatory work the Joint Committee had completed before Dr James Douglas, a physician, was appointed as director, but it was enough to convince the Nuffield Foundation to support the project. They gave the greater part of the funding, and the rest was provided by the National Birthday Trust. It is clear, however, that Douglas was actively concerned, once appointed, with how the sample was to be selected, and who would collect the data, and he undertook the pilot studies and at least finalised the questionnaires. Sampling methods considered initially, were either to take representative samples from across the national range of area data on maternal mortality with a target sample of 10,000, or to sample from the Confidential Notifications of Births with a target of 4,000 (Population Investigation Committee 1945b). Douglas (1976) later noted that ideally the sample would have included all births in one year. The sampling base finally agreed on was all births in England, Wales and Scotland during a single week.

The questionnaire began to be developed by members of the Population Investigation Committee sub-committee, and Richard Titmuss was asked to recommend 'questions on the social aspects' (Population Investigation Committee 1945b). Three methods of collecting information were considered. Initially it was debated whether consultant obstetricians could undertake the task (Population Investigation Committee 1944). Later, Douglas and Glass considered interviewing by staff of the Wartime Social Survey, or by health visitors. There was concern that health visitors rarely visited the higher income groups, and that interviewers would not be permitted to handle data from the Confidential Notifications. Midwives and health visitors were agreed to be the best data collectors (Population Investigation Committee 1945b). The questionnaires included instructions about their use, and all area health authorities were sent questionnaires for each birth in the chosen period, to be completed by staff using medical notes and interviews with mothers.

Douglas was in post only one month before piloting began and only seven months before data collection started. Even in February 1946, three months before the first data collection, concerns were still being expressed about the length of time required to complete the questionnaire (Population Investigation Committee 1946a). All local health authorities in England, Wales and Scotland were invited, by letter, to participate, and 424 authorities (92 per cent) agreed; 1.9% of mothers refused to be interviewed, 7.3% could not be traced and 0.3% of forms were not usable (Joint Committee 1948, p.3 and p9). Membership of the Joint Committee included representatives of the health professions that were asked to collect data, and that was intended to encourage participation.

The study's strikingly short developmental period after Douglas's appointment and the rapidity of data collection periods are particularly notable, given that the war in Europe on ended on May 8th, little more than 11 months before the data collection began.

Data coding and checking was undertaken by students at the London School of Economics, and Douglas and his colleagues responded to 'some 3,000' queries from the local health authorities (Population Investigation Committee 1946b). The coded information was transferred to punched cards by the British Tabulation Machine Group who also tabulated the data, on instructions from Douglas and his colleagues.

The first substantial publication came in 1947 (Joint Committee 1947) and was followed in the next year by a book (Joint Committee 1948).

Identification of influences on the design and management of the first data collection

The design and management of the initial study was influenced both by Douglas's work with Zuckerman before becoming director, and by the nature of the Population Investigation Committee and its way of thinking and acting.

Appointment of the study's director

In 1937 Douglas had been appointed as a research student studying animal behaviour under Zuckerman in the Anatomy School at Oxford University, and he had been a member of Zuckerman's Oxford Extra-Mural Unit from 1941 to 1945, working on air-raid casualty studies. Douglas's application for the directorship of the study was supported by Dr Frank Yates, statistical advisor to Douglas and Zuckerman in their air-raid studies (Zuckerman 1978, p135; Blake et al 1942). Dr Richard Schilling of the Industrial Health Research Board also recommended Douglas's appointment (Population Investigation Committee 1945).

Field work design

The influence of the air-raid casualty studies may be detected in the initial sampling; Douglas and Glass were very concerned to select representative samples (Population Investigation Committee 1945). The decision to ask health professionals to collect data follows the method used in the war-time fieldwork.

Data management

The rapid pace of the data collection, the handling of fieldwork queries, the coding and the analysis and writing also reflect the pace and decisiveness of work of the Oxford Extra-Mural Unit and the Population Investigation Committee.

Pace of development work and delivery of findings

The rapid pace of development of the maternity study is similar to the development of the work of Zuckerman's group during the war, cutting across 'official' boundaries and taking decisions without lengthy consultation with experts of all kinds. Arguably that experience strongly influenced Douglas's work style and expectations. Similarly the nature of the Population Investigation Committee as a dynamic and young organisation, eager to tackle problems, and unwilling to await the deliberations of a Royal Commission, was reflected in the pace of the new study's development.

Continuation of the influences on the maternity survey during the first 15 years of follow-up

Soon after data collection for the maternity study was completed Douglas and Glass decided to follow-up that sample, in order to investigate the extent to which those disadvantaged at birth recovered, and the causes of any recovery. Douglas (1964, p12) later noted that 'It had not originally been intended to continue the research beyond the 1946 study. But the potential value of a follow-up study was so evident' (Douglas 1964 p.12).

Because of concerns about funding (Douglas 1976) follow-up was undertaken on a sample of 5,362 members of the birth cohort initially studied. The sample retained geographical representation and was selected from all regions of England, Wales and Scotland, sampling only those whose mother was married, and only singleton births. The sample was stratified by socio-economic circumstances by including all those whose father worked in either a non-manual or an agricultural occupation, and a random one in four of those whose father was employed in a manual occupation. The 672 children born to unmarried mothers were not sampled because most were then adopted at birth and untraceable because there was no access to the Adoption Register. The 180 multiple births were not sampled since they were thought too few for analysis. The sub-sample proved to be reliably representative in the long-term (Wadsworth et al 1992). However the disadvantages of omitting those born out of wedlock (672) and the multiple births (180) were later regularly regretted, and it was sometimes argued that the sample size was too small for the study of less prevalent health conditions.

Location and funding

The influence of the Population Investigation Committee (PIC) initially remained strong. Although Douglas moved the study from the PIC at the London School Economics to the Department of Public Health and Social Medicine at Edinburgh University in 1954, Glass remained on the study's advisory committee throughout the period. Douglas brought the study back to Glass's Department of Demography at the London School of Economics in 1962.

After the study's first data collection, funding continued to be successfully sought from independent sources in Britain and the United States. They included, primarily, the Nuffield Foundation, the Eugenics Society, the Rockefeller Foundation[v], the Ford Foundation, and the Population Council. During the study's first fifteen years, funding was a constant concern and struggle.

The continuing influence of the war-time experience on the follow-up study

Four effects of the continuing influence of Douglas's war-time experience in Zuckerman's unit can be seen. They are (a) the continuing use of health and later also educational professionals to collect data; (b) the concern with children's psychological development, which is close to the air-raid studies' interpretations of children's essays; (c) the continuing statistical advice from Dr Frank Yates who had worked closely with Zuckerman's unit during the war; and (d) the continuation of advice from another war-time colleague, namely Professor Aubrey Lewis who was an expert in mental health and psychological development. Both Yates and Lewis were later to be members of the study's Advisory Committee, full membership of which throughout this period is given in Douglas and Blomfield (1958) and Douglas (1964)).

The continuing influence of the Population Investigation Committee

The Population Investigation Committee's continuing influence (and in particular that of David Glass who chaired the PIC from 1958) after the initial maternity study can be seen in the study's concern for education and intelligence and the relationship between educational opportunity, aspiration and socio-economic circumstances of the family of origin. Glass and Gray (1938) compared undergraduate populations and scholarship awards at Oxford and Cambridge universities from 1913 to 1934 in relation to type of secondary school of origin, and showed a bias in favour of the fee-paying schools. Glass was also greatly concerned with social mobility (Glass 1954); he wrote the Preface to *The home and the school* (Douglas 1964). Douglas wrote about inter-generational social mobility in that book and elsewhere (Douglas 1965).

Potential sources of academic influence on the design of the follow-up studies

Most of the influential longitudinal studies that existed before the 1946 study began were developed in the United States as investigations of mental and physical development. For instance, Terman and colleagues began a follow-up study in Stanford in 1921-22 of the intellectual progress of 1,470 children aged 3 to 19 years, and in 1927-28 fifty eight of their siblings were added to the study (Burks et al 1930).The Berkeley Growth Study, in California, began as a follow-up of 61 infants from birth in 1928, and the Berkeley Guidance Study investigated the effects on the behaviour of 248 children, of parental counselling, beginning when the child was aged 3 months (Jones and Bayley 1941). The Fels study of child growth recruited between 80 and 100 children in Ohio in the periods 1929-33 and 1934-1939 as well as at later dates (Roche 1992). The Oakland (California) Growth Study followed-up the physical and psychological development of 212 children beginning in 1931 when they were aged 8 years (Jones 1939). The Cambridge Somerville (Boston) study included intervention (designed to reduce risk of delinquency) as well as follow-up of 325 children and 325 matched controls (Powers and Witmer 1951), and Glueck and Glueck (1934a, 1934b) began their follow-up studies of 500 delinquents and 500 non-delinquents. Other studies include the observational work of Gesell and Ilg (1943), and others reviewed by Kagan (1964) and Reinert (1979). Although most of these studies went on to have extensive periods of follow-up, there is no evidence that the design of the first British national birth cohort study was influenced by any of these relatively small contemporary follow-up studies.

Two large-scale Scottish investigations which were to become follow-up studies were influential in the design of the data collections in the 1946 national birth cohort. They were the Scottish study of intelligence in 87,498 children born in 1921, that

had begun when they were aged 11 years in 1932 (Scottish Council for Research in Education 1933), and the second study of intelligence in Scottish children born in 1936 (N= 70,805) which began in 1947 (Scottish Council for Research in Education 1949). The director of the 1946 study (Dr J.W.B. Douglas) and Professor D.V. Glass (Secretary of the Population Investigation Committee) were on the advisory board of the second Scottish study and were involved in its planning.

Follow-up data collections

During the pre-school and school years the pace of data collection did not slacken (figure 2). Data collections from the whole sample selected for follow-up (5,362) took place at intervals of 2 years or less while respondents were aged 2 to 15 years, with very little loss of sample members through refusal or failure to trace (Wadsworth et al 1992). Douglas was determined to measure growth and physical and mental development as frequently as possible during these years.

Health data were collected by health visitors at home visits at the first two follow-up contacts, and thereafter, school doctors and nurses undertook medical examinations designed by the study. All references to hospital admissions were followed up with postal questionnaires to each hospital requesting further details.

Educational data was collected from the contact at age 6 years onwards. Each school attended by one or more study children was asked to complete postal questionnaires about its facilities and pattern of attainment, and teachers were asked about the child's attitudes, behaviour and progress, and teachers supervised the study children as they undertook cognitive and attainment tests at ages 8, 11 and 15 years; printed instructions to teachers were provided. In addition parents were asked about their concerns and ambitions for their child's educational progress. A considerable additional effort, in terms of data collection and data management, was required to collect this large amount of information, as well as health data.

Each data collection involved discussion of its design with health and educational representatives on the study's advisory committee, design of the data collection instruments, letters to all health and educational authorities asking for their co-operation in data collecting, mailing out the instruments and instructions to each school, and dealing with queries and re-directing questionnaires for children who had moved. The study team undertook all aspects of the data collections.

Each collection was funded separately, and so each involved new grant applications. Nevertheless the study team remained small, and Douglas usually worked with only 2 or 3 scientific colleagues in his team.

Figure 2. Time line of data collections on the sub-sample of 5,362 during the pre-school and school years

Date of data collection and age of children	Data collectors	Places of data collection
1948 2yrs	Health visitors	Home
1950 4 yrs	Health visitors	Home
1952 6 yrs	Health visitors and school doctors and nurses	Home
1953 7 yrs	Health visitors and school doctors and nurses, and teachers	Home and school
1954 8 yrs	Health visitors, school nurses and teachers	Home and school
1955 9 yrs	Health visitors and school nurses	Home and school
1956 10 yrs	Teachers	School
1957 11 yrs	Health visitors, school doctors and nurses, and teachers	Home and school
1959 13 yrs	Teachers	School
1961 15 yrs	Health visitors, school doctors and nurses, and teachers	Home and school

Data management and analysis

Throughout the first 15 years of the study, coding of information was entirely manual, and coded data were transferred to punched (Hollerith) cards, as in the initial data collection. The original paper questionnaires and test booklets were also stored. Some punching of original data and preparation of sets of cards for analysis was out-sourced.

These years preceded the introduction of computers, and analysis was undertaken using a counter-sorter. This often involved abstracting data from the original cards to make new sets of cards that contained only the information required for the analysis. Since the original coded data about each of the 5,362 sample members was stored on many cards, and several cards of data were usually required for an analysis, this was a cumbersome and time-consuming process. Methods of analysis were greatly constrained by the counter-sorting method of handling punched cards.

Consideration of these difficulties of managing and analysing data is likely to have influenced the decision to follow-up only a sample of the original cohort, rather than all 13,687 births initially studied.

Policy concerns

Throughout its first fifteen years the study continued to be responsive to policy concerns, and expanded its interests to include educational and social as well as health policy. It contributed evidence to Government committees appointed to review primary school education (Plowden Report 1967), and the welfare of children in hospital (Platt Report 1959), and published findings about problems of current policy, including the effectiveness of the health visitor service in maintaining child health during the pre-school period (Douglas and Blomfield 1958). Other policy related publications from this period include studies of the contribution of breast-feeding to infant health (Douglas 1950a), the effects of prematurity on growth (Douglas and Mogford 1953), the psychological effects on children of parental divorce and separation (Rowntree 1955; Douglas and Blomfield 1958), mothers' employment (Douglas and Blomfield 1958) and attendance at nursery school (Douglas and Ross 1964a), the relationship of psychological maladjustment with delinquency (Mulligan et al 1963), the effects of absenteeism on educational attainment (Douglas and Ross 1965), and the prevalence of bed-wetting (Bransby et al 1955)[vi].

Probably the most influential research from the study during this period was concerned with the operation of the education system, as laid down in the 1944 Education Act. The data about educational attainment, school and home circumstances, and parents' interest in the education of their study child, were all used to show the influence, from early life onwards, of family circumstances and parental concerns on attainment. They also showed the socio-economic variation in attainment, in educational opportunity, and in the operation of selection processes for entry to secondary schools at age 11 years (Douglas 1964; Douglas et al 1966; Douglas et al 1968).

Scientific aims

The study's scientific aims during the first fifteen years of follow-up were primarily influenced by contemporary policy concerns in health and education. The aims of the first three follow-up data collections (up to and including age 6 years) were to continue the study of survival, health and illness and physical growth and development, particularly in relation to maturity at birth and to the family's socio-economic circumstances (e.g. Douglas 1950a; Douglas 1950b; Douglas 1951; Douglas and Mogford 1953; Douglas and Blomfield 1958).

From age 7 to 15 years the scientific aims were expanded to also include investigation of cognitive development in relation to health and growth and family circumstances. In addition to studying cognitive function for educational policy purposes, Douglas and his colleagues explored the reasons for poor and deteriorating cognitive performance in relation to intrinsic sources of risk, including personality, prolonged exposure to family insecurity, premature birth, age at physical maturity, short-sightedness, and laterality (Rowntree 1955; Douglas and Ross 1964b; Douglas et al 1965; Douglas, Ross & Simpson 1967; Douglas, Ross & Cooper 1967). Those studies showed the importance of height, prematurity and short-sight in relation to cognitive function as measured by the studies' tests. The conclusions were concerned with the interactions of socio-economic and biological factors, with the interaction of family characteristics and short-sight as an inherited trait, and with the question of whether nutrition and parental social mobility played a part in relation to height.

In health the scientific contribution also made good use of the longitudinal nature of the data, and was concerned with socio-economic differences in growth, illness and survival, the impact of atmospheric pollution from coal burning and the association of physical growth with breast-feeding, and of prematurity with cognitive and physical development (e.g. Douglas 1951; Douglas and Simpson 1964; Douglas 1964; Douglas and Waller 1966). However it is argued that, after the findings of the initial study of maternity, the lines of thought about health during the study's first fifteen years, were less consistently developed compared with those in education and cognitive development.

The study did not develop consistent hypotheses, either about persistent socio-economic differences in risk of illness, or about the development of illness risk. The exceptions to this are three papers about the consequences of prematurity, which show it to be a source of risk for later development of walking and for poor scores on attainment and cognitive function tests at ages 8 and 11 years. These findings were hypothesised to be either the result of birth injury or abnormality or poor concentration and application at school (Douglas 1956a, 1956b; Douglas 1960).

The inconsistency in health findings during these early years of the study is, arguably, attributable to the fact that there was no comparable 'ready market' in the health sciences for the study's scientific concerns. Consistent thinking about health risk in relation to early growth and development had not then been developed in child health. Paediatrics, or child health, was in its infancy and predominantly concerned with care and prevention of disease rather than the processes of development. Even twenty years after the study began, Joseph and MacKeith (1966) noted 'the continuing absence of professorial departments of paediatrics from half the undergraduate medical schools in the country' (p97). Epidemiology was still largely concerned with illness and causes of death, rather than normal development, and the pioneering work of Barker (1991) on the long-term health effects of growth in early life was still almost another three decades in the future. During the whole of the period reviewed here, the study was one of only two large-scale longitudinal studies of health in childhood and adolescence in Britain (the other was the Newcastle Family Study (Spence et al 1954) of a thousand families) and the first follow-up of the 1958 national birth cohort, which took place in 1965, when 1946 cohort members were aged 19 years.

Nevertheless the early health data, in particular the measures of physical development, have, together with the early cognitive data, since been of unique and great value and have been extensively used (see the study's web site at http://www.nshd.mrc.ac.uk).

The study's autonomy

The study's continuing concern with topics regarded by contemporary scientists as outside its range of expertise, attracted rebuke of the kind experienced by Zuckerman for his pioneering work. Burt (1969), for example, in a review of Douglas et al (1968), was critical of the educational aspects of the study, concluding that 'for really trustworthy results, it is desirable that the investigator should be an educational psychologist who is himself a member of the education authority staff, preferably (as in the early days) a member of the inspectorate. Teachers and others will take far more care over reports or replies that are to be examined by such an official.' Burt, himself an educational psychologist, concluded that this sort of research needed 'to be planned, discussed and supervised not by one or two individuals, but by a group of specialists – the psychologist, the senior school medical officer, the senior social worker, the chief inspector, a teachers' representative, and a statistical expert, all working together.' Douglas a physician, Dr Jean Ross his educational psychologist colleague and co-author, and Mr Howard Simpson their statistician co-author, gave a robust response (Douglas et al 1969).

Douglas persisted with his policy of independent thinking and, as exemplified above, this was at times against the grain of convention as he pioneered this new method of large-scale longitudinal data collection. His approach and his management of the study was undertaken in the medical sciences tradition of a Principal Investigator with a small team, supported and guided by an advisory committee representing the scientific and policy areas of the research. Douglas's war-time experience and the influence of the Population Investigation Committee and David Glass, as well as the location of the study at the London School of Economics for eight of the first fifteen years, ensured that the data collections crossed disciplines.

Douglas's independent thinking, in terms of the study's cross-disciplinary interests and frequency and content of data collection, was all the more remarkable in the context of the low level of contemporary scientific interest in longitudinal studies and the opportunities they offered, especially in health, as already described. Although the study was then well regarded for its contribution to educational policy, it was Douglas's innovative collection of longitudinal data on health and growth during these early years of the study, that in the longer term became of great value.

The study's publications

The record of publications during the first twenty five years of the study is considered, because that allows time for publications of work arising from the first fifteen years of data collection. During that time the study published most on education and cognitive development, with a total of 2 books and 33 papers. Douglas's (1964) book *The home and the school,* was reprinted three times and re-issued as a paperback that was reprinted five times. His book with Ross and Simpson (1968), *All our future,* was also re-issued as a paperback: both books were widely used in teacher training. Rather less was published on health (2 books and 30 papers), and on socio-economic (8 papers) and methodological topics (1 paper). Despite these publication achievements, the demands of data collection and fund-raising at intervals of two years or less, together with the time-consuming methods of data handling and analysis, constrained the publication rate.

Discussion

The initial impetus for the first data collection in the British longitudinal study of a national sample of births in 1946 has been shown to lie in the Population Investigation Committee's scientific and policy concerns with fertility and infant mortality.

The origins of the design and methods of the first and the follow-up data collections from ages two to fifteen years have been argued to lie in the war-time experience of its director, Dr James Douglas, who had studied the physical and psychological impact of air-raids on the civilian population, including children as well as adults. Those large-scale studies involved designing data collection instruments and persuading and then teaching health professionals how to use them, collecting great quantities of data in different cities using interviewers, coding and classifying the

information, and reporting the analyses in a short time. Douglas used all these methods during the first fifteen years of the birth cohort study. He designed the study's scientific and policy study agenda, and was the source of energy and originality that began and continued the follow-up the study and maintained its progress.

After the initial data collection Douglas had two difficult decisions to make about the design of the follow-up studies. The first was whether to follow-up the whole sample studied at birth (N=13,687), and the second was how frequently to collect data. Deciding to follow-up only a sample of those originally studied was no doubt influenced by the perceived availability of funding, and by the costs and difficulties of data collection and handling when only punched card facilities were available. The sample of roughly a third of those initially studied, that was consequently selected for follow-up, was seen then (and sometimes since) as too small for the study of some disease and disability outcomes. However the trade-off was that the sample size made it possible to undertake follow-up at intervals of two years or less during the first fifteen years of the study, so that for the first time a remarkably sensitive characterisation of children's growth, cognitive development, health, educational experience and attainment, and home environment was achieved in a national sample. This was the result of Douglas's can-do attitude and autonomy, and the fact that he worked with only a small advisory committee and a small staff, and could make decisions without extensive consultation. Douglas's perception and autonomy achieved a striking and innovative success in establishing a strong data resource for his research, and for what has become a very long-term and productive follow-up study that has maintained the measurement of health as well as ill-health during adulthood (http://www.nshd.mrc.ac.uk). However, it is argued here that Douglas's demanding data collection schedule during the first fifteen years of the study, together with the contemporary methods of data analysis, and the small staff size were not favourable to a high rate of publication.

The study's most consistent work during its first fifteen years of follow-up was in education and cognitive development, more so than in health. This, it is argued, was the result of differences in demand, at that time, for longitudinal findings, and the contemporary concentration of medical scientific interest on disease rather than development.

The collaborative inclination and the more trusting approach to science in British society in the period reviewed here, enabled the study to secure a high response rate, and the co-operation of health and educational professionals in data collections.

As a national study of maternity and neonatal health and survival two years before the establishment of the National Health Service, the 1946 cohort study formed the basis for later comparisons with the situation after ten years of the new Service. The first comparative study was of births in 1958 (Butler and Bonham 1963; Butler and Alberman 1969), and a second was begun after a further twelve years in 1970 (Chamberlain et al 1978). Each of those studies also became a national follow-up study, enabling inter-cohort comparisons of many aspects of socio-economic and family circumstances, education and development, as well as health (Ferri et al 2003).

These British studies are in the long national tradition of empirical research concerned with both policy and science, for which data are collected in the community. The British birth cohort studies have continued and enriched that tradition by their longitudinal nature, their value for inter-cohort comparison, their concern with both health and social topics, with policy as well as science, and their use from the beginning, in 1946, of biomedical and social measures.

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Endnotes

[i] From 'quot homines, tot sententiae' or, idiomatically, 'as many opinions as people'. Members included JZ Young (Biologist), JD Bernal (crystallographer), John MacMurray (philosopher), MM Postan (economist), Roy Harrod (economist), Joseph Needham (biochemist and sinologist), Hyman Levy (mathematician), Lancelot Hogben (zoologist), JBS Haldane (geneticist and evolutionary biologist), Gordon Childe (archaeologist), RHS Crossman (politician), and Hugh Gaitskell (civil servant and politician). Guests at various times included William Penney, John Cockcroft and Allen Lane, whose publishing house produced the society's only formal publication *Science in war* in 1940 (Zuckerman 1978 Pp. 109-112 and 393-404).

[ii] The Report wearily concludes that 'Few Royal Commissions have sat longer or wrestled with more difficult and disputed material. Parts of the subject might be likened to that fabled morass 'Where armies whole have sunk.' Para. 686.

[iii] The Secretary of the PIC, Dr DV Glass, was a member of the Statistics Committee of the Royal Commission, and Prof Alexander Carr-Saunders, also chaired that Committee and the PIC, and was Director of the London School of Economics from 1937-1957.

[iv] Together with the Nuffield Foundation, the Rockefeller Foundation and the Eugenics Society.

[v] From whom Zuckerman had sought social science expertise and advice in 1941 (Zuckerman archive SZ/OEMU/56).

[vi] Bed-wetting was not only a clinical but also a policy concern because it was a cause of rejection for military conscription (Bransby et al 1955).

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Pushy parents make for later grandparents: parents' educational expectations and their children's fertility among two British cohorts

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Abstract

The timing of first birth is often viewed through the opportunity costs of childbearing theory – greater potential in the labour market will lead to postponement of first birth. This paper examines the effect of parental educational expectations in shaping opportunity costs as predictors of early parenthood, using data from two British Birth cohorts born in 1958 and 1970. Rapid inter-cohort changes in labour market and educational patterns could change the importance of educational expectations in determining time to first parenthood. Two definitions of early parenthood are used – one relative, based upon the first quartile of each cohort entering parenthood, and the second equating to teenage parenthood. Parental educational expectations measured at age 16 are used in binary logistic regression models for men and women. Predicted probabilities are presented to emphasise the contrast between educational expectations and socioeconomic measures. Parental educational expectations are found to be strong predictors of early fertility in most models. Expecting any post-compulsory education leads to a decrease in the odds of early parenthood against a battery of controls. Where the expectations of parents are non-significant, those of the teacher are significant. Only in the 1970 cohort teenage fatherhood model were educational expectations of important adults found to be non-significant. Adult, usually parental, high educational expectations reduce the probability of young people becoming early parents, even in the presence of controlling factors that are usually assumed to account for this relationship. This indicates a role for parents in future interventions aimed at lowering levels of early parenthood.

Introduction and Literature Review

Britain's fertility patterns are notable both in the high level of early parenthood (UNICEF 2007) and the socio-economic polarisation in the timing of first birth (Ekert-Jaffe, Joshi et al. 2002; Rendall, Couet et al. 2005). While the majority postpone parenthood, early parenthood remains a norm for a minority (Hadfield, Rudoe et al. 2007). Early parenthood is associated with a range of negative antecedent characteristics and outcomes, evidenced through a large body of research, and became a policy focus for the new millennium (see Social Exclusion Unit 1999). Early parenthood is

strongly linked to a lack of opportunities and is particularly associated with educational disadvantage. This paper examines the additional role that parental educational expectations play in governing who becomes an early parent.

Establishing a greater understanding of the factors that predict entry into parenthood is not only a valuable target in itself, but may help clarify whether young age is responsible for the negative outcomes associated with early parenthood (Furstenberg 2007). This paper explores how parental educational expectations predict entry into early parenthood as opposed to pregnancy, the sole link being that pregnancy is a necessary condition for parenthood. This paper examines who becomes a mother or a father early in two British birth cohorts (1958 and 1970 born) using both a teenage definition of early parenthood as well as a more relative definition of 'early'. This is in response to the relative rarity of occurrences of teenage parenthood, the fact that giving birth in the early and mid-twenties has been shown to carry negative effects (Hobcraft and Kiernan 2001; Robson and Berthoud 2006), and the need to understand patterns of early parenthood in an apolitical and contextually appropriate way for both men and women (Geronimus 2003; Duncan 2007; Furstenberg 2007; Kneale 2009a). Here, parental educational expectations are found to be potent predictors of early parenthood varying by gender, cohort and definition of early.

This paper begins by reviewing some of the literature that hypothesises that opportunity costs of childbearing are a mechanism for governing the timing of parenthood. The data and methodology used to analyse the effect of parental educational expectations are then presented. Finally the potency of parental educational expectations, relative to other predictors of early parenthood, is examined before giving further consideration to the results.

Opportunity Costs, Expectations and the Timing of Parenthood

Explanations for the timing of (early) motherhood are often based upon the theory concerning opportunity cost of childbearing. The theory states that women who face the highest levels of wage penalties and missed chances for career progression through taking time out of the labour market for motherhood (opportunity costs) will delay this process the most (Becker 1991; Joshi 1998; Joshi 2002). Education is a key marker of labour market success, and a lack of education is found to propel young women towards early motherhood (Hobcraft & Kiernan, 2001). Several studies have consistently found the link between higher educational levels and delayed parenthood (for example Kiernan 1997; Rendall and Smallwood 2003; Lappegard and Ronsen 2005; Rendall, Couet et al. 2005; Smith and Ratcliffe 2009). Data from the British birth cohort studies, two of which are used in this paper, suggest that the increasing age at first parenthood of women, is strongly associated with the increase in those attaining tertiary qualifications (Ferri and Smith 2003). For men, explaining the link between low education and early fertility is more challenging, although assortative mating based on educational characteristics is an often-cited mechanism (Hynes, Joyner et al. 2008), thereby indirectly implicating the opportunity cost hypothesis. Education is not the only predictor of labour market success; other factors such as socioeconomic circumstances, family structure and behavioural characteristics are also influential, and in turn influence the timing of fertility. Beyond opportunity cost theory, theories of early parenthood based on social exclusion have also gained prominence whereby the norms and values of socially excluded people become detached from those of the socially included (Burchardt, Le Grande et al. 2002), including family building and fertility norms (for example Kiernan 1997; Arai 2003).

This present paper aims to show that these norms may stretch to the way in which education is perceived, and that only in the presence of both high educational expectations and high educational ability, will the highest chance of avoiding early parenthood be achieved. Therefore, while it is not disputed that the idea of highly qualified and/or advantaged people have more incentive to avoid early parenthood through having higher opportunity costs, this paper explores whether educational ability is the sole component of this calculation.

Calculating the opportunity cost of having children implies a substantial degree of planning (Joshi 1998; Gustafsson 2001). While educational achievement and socio-economic background undoubtedly influence these plans, early motherhood is not a predestined outcome even for those from disadvantaged backgrounds, of which a

substantial group avoid early parenthood. Equally, advantage is not always associated with avoiding early parenthood. Qualitative studies find that family-building expectations and notions of 'successful adulthood' are crucial in determining who enters parenthood early, and success for some young people is not measured through career progression (Arai 2003; Kendall, Afable-Munsuz et al. 2005; Harden, Brunton et al. 2006; Arai 2007). An expectation of starting a family early, which is often incompatible with being a student (Edwards 2002; Joshi 2002), may mean that educational expectations are consequently lowered. Conversely, high educational expectations may increase the perceived opportunity cost of having a child, even if these expectations do not correlate with educational ability. For men, assortative mating based on educational characteristics is expected to be the main mechanism through which educational expectations predict early fatherhood (for example Becker 1991; Qian 1998; Sweeny and Cancian 2004). Men may also not want to be 'burdened' with beginning a family early if they are to attain the high expectations of their parents.

Educational Expectations

The home learning environment has long been linked with children's outcomes. Douglas (1964) found in the first national birth cohort study of children born in 1946 that the most important driver of educational progress was the amount of interest shown by parents in their children's education. Using the same data, Kiernan and Diamond (1983) showed that parental interest in education was also a predictor of the timing of first parenthood. For later cohorts, opportunities for educational achievement changed, with huge growth in the availability of further and higher education (Makepeace, Dolton et al. 2003). Nevertheless, links between parental interest in education and children's educational success (Flouri 2006; Feinstein, Duckworth et al. 2008), and children's subsequent fertility patterns (Kiernan 1997; Russell 2002), remain. This paper examines components of the learning environment that have a closer connection to calculating opportunity costs through focusing on educational expectations; in other words the expectation of leaving education at the minimum age, progressing to further education or progressing to higher education. Parents' expectations, as opposed to those of the child, are the focus, as parents provide the economic and social resources available to children (Morrison Gutman and Akerman 2008), and young adults (Schoeni and Ross 2004) to help realise these expectations.

Educational 'expectations' and 'aspirations' are often used interchangeably in the literature (Flouri and Hawkes 2008). While there may be overlap, with expectations having a significant aspirational component, they do differ (Goldenberg, Gallimore et al. 2001; Lupton and Kintrea 2008). Despite current policy being orientated towards examining aspirations (Cabinet Office 2008; Morrison Gutman and Akerman 2008), here, the focus is on expectations because of their closer alignment to life course planning. Parental expectations may be statements of intent that indicate support for the child in a way not captured by aspirations alone. Additionally, children are more likely to be aware of their parents' expectations; parents' true aspirations for their children may not be known by their children. While educational expectations are likely to reflect current behaviour in part, their collection from parents (generally before young people leave school) in this study means that they also capture a strong predictive component (Schoon 2010). The differing expectations of parents, teachers and children (Schoon forthcoming 2010), suggests that, in addition to reflecting current behaviour, expectations also capture influences on future behaviour.

Educational expectations have been found to be significant predictors of educational attainment and occupational success in several studies, including those using the same data used in this paper (Bond and Saunders 1999; Flouri and Hawkes 2008; Goyette 2008; Reynolds and Woodham Burge 2008). Parental educational expectations may influence educational and occupational attainment through their influence on children's expectations (Flouri and Hawkes 2008). They may also indicate family resilience to external factors (Schoon 2006). Social class and ability are determinants of aspirations and expectations, with lower socio-economic status correlating with lower expectations (Casanova, García-Linares et al. 2005; Feinstein, Duckworth et al. 2008; Goyette 2008), but the potency of expectations may be greater among lower socio-economic groups (Casanova, García-Linares et al. 2005; Schoon 2006).

Gender also plays a role in determining expectations (Schoon 2006; Schoon, Martin et al.

2007; Morrison Gutman and Akerman 2008). Expectations for girls are argued to be more important than those for boys, if girls are to break away from traditional gender role stereotypes (Flouri and Hawkes 2008). But while the links between expectations and educational attainment appear solid, less is known about the links between educational expectations, life course planning and fertility. In the United States, studies that have examined this quantitatively (for example Driscoll, Sugland et al. 2005), have not been able to quantify the effect described in qualitative US and UK studies (Arai 2003; Kendall, Afable-Munsuz et al. 2005; Harden, Brunton et al. 2006). Schoon and colleagues' UK study did find evidence of a link between parenthood and parental educational expectations for both men and women using British birth cohort data (Schoon, Martin et al. 2007). However, that study, using path analysis, was focussed on adult occupational status and not parenthood as the main outcome, and therefore omitted some key controlling factors from models. Furthermore, that study examined parenthood at any point and not only early parenthood, and did not disaggregate the effects of parental educational expectations, treating these instead as binary measures.

While Schoon and colleagues' study gives a basis for looking at parental educational expectations, particularly as predictors of occupational success, this present study shows how parental educational expectations predict early parenthood for men and women in two cohorts using two definitions of 'early' against a battery of controlling factors significant in the literature. It also presents results showing the potency of these expectations relative to the expectations of others and relative to other socioeconomic factors. The methodology allows for a clear indication of the nuances of different levels of educational expectations on early parenthood, and will also explore whether expectations have a greater impact on women and on those from more disadvantaged families. Ferri and Smith (2003) speculate that the impact of career development for women and increased alternatives to family life has grown over time, and that recent rises in age at first parenthood across the British birth cohort studies are unlikely to be solely a product of rising levels of tertiary educated women. Based upon that argument, it might be expected that the influence of educational expectations will have grown over time as female labour market participation has increased; by examining two cohorts, this issue is addressed, and inferences drawn on how the impact has changed over time by gender.

The underlying hypothesis investigated here is that parental educational expectations will independently moderate entry to early parenthood, even after controlling for components that usually form the calculus of opportunity costs. The specific hypotheses are:

a) Parental educational expectations have a greater impact for predicting entry to parenthood for women than men, possibly as indicators for non-traditional gender roles which involve later motherhood.

b) Parental educational expectations have a greater impact on early parenthood than those of other actors, as they provide an indication of the learning environment as well as influencing the cohort member's own expectations.

c) Parental educational expectations will have an increasing effect across the twelve years that separate the two birth cohort studies, because of their increased influence in relation to female children

Data, Measurements and Methodology

Data

This paper uses data from two prospective national British birth cohort studies – the National Child Development Study (NCDS) and the British Birth Cohort Survey (BCS70) that track individuals born within a week in 1958 and 1970 respectively. Over 18,000 have been involved in each study at some point (see Elliott and Shepherd 2006; Power and Elliott 2006; Bynner and Joshi 2007 for more information). Since birth, data collection has occurred at ages 7, 11, 16, 23, 33, 42 and 46 for the NCDS; for the BCS70 at ages 5, 10, 16, 26, 30 and 34 years, with fertility information collected at all post-16 sweeps in both cohorts with the exception of age 26 years in the BCS70. These fertility histories were consolidated and form the basis of the analyses in this paper (see Kneale 2009b for further information). Despite being born twelve years apart, both cohorts have lived through very different contexts relevant to this paper, including

rises in age at first parenthood (Ferri and Smith 2003), growth in further and higher education (Makepeace, Dolton et al. 2003) and increasing educational expectations (Schoon 2010). Both studies originally constituted a British census of births born in these weeks, although through attrition, may not remain wholly representative (see Plewis, Calderwood et al. 2004 for details on attrition over time). There is also concern that the birth histories, and particularly BCS70 histories that were only first collected at age 30 years, may under-represent the number of teenage parents. However, analyses of cohort birth histories compared with official statistics, show that these cohort studies have remained generally representative with respect to first motherhood (Kneale and Joshi 2008).

Measures

Early Parenthood: In addition to a teenage definition, this paper uses a more contextually normative and apolitical definition of 'early' parenthood which distinguishes the first quartile of males and females of each cohort to become parents (derived from Kaplan-Meier Event History models). This definition, referred to as 'early' as opposed to 'teenage' from this point, is a response to the relative rarity of teenage parenthood and the fact that negative effects from early parenthood extends to giving birth in the early-mid twenties (Hobcraft and Kiernan 2001). Table 1 shows the corresponding ages at which the first quartile is reached, with the proportions of teenage parents (under 20 years).

Table 1: Age at which the first quartile of entry into parenthood is reached and proportion of teenage parents by cohort and gender

	Age at first quartile		Proportion of teenage parents	
	♂	♀	♂	♀
NCDS	24.95 years	22.19 years	3.9%	12.8%
BCS70	26.99 years	23.87 years	3.0%	9.8%

This paper examines live births reported by cohort members excluding stillbirths and other fertility outcomes. Those still pregnant or who have fathered a pregnancy not carried to full term are excluded because of problems associated with the accuracy of reports of adverse fertility events (Smith, Adler et al. 1999), as are, inevitably, births which were not reported. This is more likely to be problematic for males for reasons of attrition, because of their potential lack of knowledge of paternity status, and deliberate underreporting of absent children (Rendall, Clarke et al. 1999; Greene and Biddlecom 2000). However, this paper treats these concerns as caveats of the results, as opposed to a proscription from using male fertility histories.

Parental Educational Expectations (Age 16):

These are grouped into four categories – leaving school at the minimum age, leaving school at 18 entering higher education and being uncertain about future educational trajectories. For the BCS70, an additional category is constructed (see Missing Data below). Educational expectations reports were collected from the main respondent, who was the cohort member's mother in over 90% of cases. These analyses implicitly assume that the expectations of both parents are similar, an assumption also made elsewhere in the literature (Schoon 2010).

Controlling Factors

Socio-economic Factors: Socially disadvantaged backgrounds including having a father in a manual social class (Ermisch and Pevalin 2003), living in social housing (Hawkes, Joshi et al. 2004), and living on state benefits (Harden, Brunton et al. 2006) are predictive of early parenthood. The classifications of housing tenure and social class were based on the number of observations in which a cohort member was observed in the particular state, a strategy used in other analyses (Hobcraft and Kiernan 2001; Sigle-Rushton 2005; Hobcraft 2008). Social class was divided into those whose fathers were always in the most advantaged group, were sometimes in the most advantaged group or were never in the most advantaged group (the latter also includes those always without a father). The most advantaged group differs slightly in definition

between cohorts as relying on a non-manual definition of advantaged alone would see a large rise in those being categorised as advantaged. Tenure was classified by experience of social housing, owner occupied housing or private/other housing. The classification strategy for social class and tenure gives a broader indication of childhood environment as well as serving to minimise the effect of missing data, essentially constituting a form of imputation (see Kneale 2009b for more information). Receipt of state benefits indicates those (at age 16) whose family income was obtained wholly or in part from unemployment or sickness benefits.

Educational Measures: Generally, reading and maths ability were tested at all points (through differing tests), with other abilities tested intermittently (see Feinstein, Duckworth et al. 2008 for one outline, pp147-151). For the BCS70, due to a teacher's strike at age 16, a high number of tests were not administered (Goodman and Butler 2005). Additionally, at the time of analysis, maths and reading ability at age 16 were unavailable. Instead, for the BCS70, maths and reading ability at age 10 years were tested. Preliminary analyses also showed that English Vocabulary Picture Test Score (EVPT) from age 5 was also significant (see Golding 1975 for test description). All ability measures were transformed into quartiles, and treated as categorical variables. Other educational measures used, including dislike of school and truancy/school attendance, were collected from cohort members at age 16 and classified as categorical variables, with the exception of attendance from the NCDS, which is modelled continuously as the proportion of lessons missed. Teachers' educational expectations for cohort members (NCDS only) and the cohort members' own educational expectations were also tested. Both were also measured at age 16, and while they correlated with the expectations of the parents, this did not introduce multicollinearity.

Behavioural and Philoprogenitive Measures: Among both cohorts, parents completed a psychometric questionnaire on their child's behaviour based upon Rutter's behavioural score inventory at age 16 (Rutter 1967). Using Principle Components Analysis separately for boys and girls, generally resulted in three main components for both cohorts. Here, the disruptive and aggressive score at age 16 was most significant, and was divided into quartiles and treated as categorical. Philoprogenitive tendencies were measured differently between cohorts. For the NCDS, they were measured as the ideal age at which the cohort member wanted to become a parent, collected at age 16. For the BCS70 they were measured as the importance to a cohort member of having their own family by age 16.

Home Learning Environment and Demographic Measures: Family structure at age 16 and age of the cohort member's mother at birth are significant predictors in the literature and are included in these analyses (Kiernan and Cherlin 1999; Meade, Kershaw et al. 2008). For the NCDS, parenting style at age 16 was included, and comprised an additive score based on a series of statements from the cohort member on how disciplinarian they viewed their parents; a similar score for BCS70 based on cohort member reports on their relationship with their parents was also created. Finally, teachers were asked to rate their perception of how interested the parents of cohort members were, in their children's education. For both cohorts, this represented the mother's interest, although for the BCS70 this was measured at age 10 and for NCDS at age 16 years[i]. Because of the small numbers, parents who were deemed uninterested or 'over-interested' were grouped together as having 'unhealthy' levels of interest.

The inclusion of these variables as controls in models is based upon their significance in early parenthood literature, where for example, Harden (2006) and Imamura (2007) represent recent systematic reviews of the antecedent factors surrounding early pregnancy, while Hobcraft (2008), Kiernan (1997), Hobcraft and Kiernan (2001) and Sigle-Rushton (2005) all represent studies that have used the same data and included several of the controls presented here.

Missing Data

In this paper list-wise deletion alone was not considered suitable because of the effect it had on sample sizes. Other strategies considered including weighting the data and using multiple imputation techniques (see Goldstein 2009 for an example using cohort data). Exploiting observations from previous waves was used to derive social class and housing tenure variables. For variables measured once, or where this was not a suitable strategy, an item non-response category was created and modelled. This was the strategy taken when over 25% of observations were missing, which was generally the case for several

controlling factors in the BCS70 age 16 sweep. Although that sweep recorded a response rate of 70.6% with 11,206 responses recorded (Plewis, Calderwood et al. 2004), it was split into twelve questionnaires and not all parts were completed; those collected in school recorded particularly low response due to a concurrent teachers' strike. Modelling the missing category is a frequently-used strategy to ensure preservation of sample size, and allow comparisons between the missing and baseline groups (for example Mensah and Hobcraft 2008).

Methodology and Model Construction

This study estimates the probability of becoming an early parent (according to the earlier definitions) versus not becoming an early parent after accounting for a number of known predictors. Binary logistic regression models are used and the results presented as odds ratios. An odds ratio above one indicates that the probability of becoming an early parent is greater among a particular group than the baseline group, or in the case of continuous predictors, that the probability of becoming an early parent increases with a one unit increase in the covariate. An odds ratio below one indicates the opposite, while an odds ratio of exactly one indicates no difference between groups. Hosmer-Lemeshow tests were also conducted to assess the overall goodness-of-fit of the models – these test whether the models that have been constructed deviate significantly from the actual observed data – in no case was this found to be the case[ii]. All covariates were tested for multicollinearity – this was not found to be problematic.

A number of the predictors used in these analyses were measured at age 16. Although reverse causality is unlikely, as a cautionary measure, the small number of cohort members who became parents before age 17.5 years were excluded. Models with 'all' early parents and those where the 'clock began ticking' at 17.5 years showed the exact same trends; only those with the restriction are presented here. Consequently, 28 young fathers and 96 young mothers were excluded in the BSC70, and 44 and 187 young fathers and mothers from the NCDS. An alternative approach could have examined measurements from earlier time points, and crucially for this analysis, parental educational expectations measured at 10/11 years for the BCS70 and NCDS respectively. However, that option was not favoured, as other factors that might be regarded as confounding factors, such as philoprogenitive tendencies and the cohort member's own educational expectations, could not be adequately controlled for from this period. Additionally it may be questionable to bring in notions of life course planning at such a young age.

Results

Descriptive Information

Table 2 shows descriptive information for all variables included in the models. Of those who gave a definitive[iii] answer, 46% in NCDS and 62% in BCS70 expected their child to continue in further education. However, this was more likely to be capped at 18 for the BCS70 cohort – higher education (post-18) was a more frequent expectation for the NCDS cohort. In both cohorts more girls than boys were expected to remain in post-compulsory education. However, the gender bias disappeared after this point as similar proportions of girls and boys were expected to enter higher education. Other changes between cohorts include a decrease in reliance on social housing, in line with known trends that include the 'right to buy' scheme (Lupton, Tunstall et al. 2009), and a slight decrease from 13% of the cohort in NCDS to 10% in the BCS70 in family reliance on unemployment and sickness benefits. There was also a growth in fathers in non-manual occupations. Between cohorts, there was also a small drop in the proportion living with both natural parents from 86% to 84%. The overall picture between cohorts is of decreasing housing and income disadvantage which is consistent with other sources (see Ferri, Bynner et al. 2003 for a review of inter-cohort differences in other domains).

Table 2: Descriptive Information for all variables tested in models

	NCDS		BCS70	
Gender	Male	48.4%	Male	47.5%
	Female	51.6%	Female	52.5%
Parent's Educational Expectations Age 16	Leave at Min Age	48.6%	Leave at Min Age	26.9% (31.6%)
	Stay up to 18	19.8%	Stay up to 18	28.5% (33.4%)
	Higher Education	26.1%	Higher Education	15.5% (18.3%)
	Uncertain	5.5%	Uncertain	14.1% (16.6%)
			Missing	15.0%
Teacher's Educational Expectations Age 16	Leave at Min Age	40.4%		
	Stay up to 18	24.1%		
	Higher Education	21.9%	N/A[1]	-
	Uncertain	13.6%		
Maths Score Age10/16	Quartiles Age 16	-	Quartiles Age 10	-
Reading Score Age10/16	Quartiles Age 16	-	Quartiles Age 10	-
EVPT Score Age 5		-	Quartiles Age 5	-
Truancy/Attendance Age 16	Attendance (Mean)	91.3%	Yes, played truant	24.7% (42.1%)
			No, did not play truant	33.6% (57.9%)
			Missing	41.8%
School Dislike Age 16	Strongly dislike school	28.9%	Strongly dislike school	9.4% (16.1%)
	Dislike school somewhat	14.0%	Dislike school somewhat	24.6% (42.1%)
	Do not dislike school	57.1%	Do not dislike school	24.5% (41.8%)
			Missing	41.5%
Mother's Education	Mother Continued in Post-compulsory Ed	Yes: 26.7% No: 73.3%	Mother Continued in Education after 16	Yes: 18.0% No: 82.0%
Cohort Member's Educational Expectations Age 16	Leave at Min Age	60.9%	Leave at Min Age	23.8% (44.1%)
	Stay up to 18	8.0%	Stay up to 18	15.2% (26.3%)
	Higher Education	23.0%	Higher Education	16.9% (29.2%)
	Uncertain	8.0%	Uncertain	2.0% (3.4%)
			Missing	42.2%
Receipt of Unemployment Benefits Age 16	Yes	12.5%	Yes	9.8%
	No	87.5%	No	90.2%
Father's Social Class During Childhood	Always in Non-Manual Class	13.9%	Always in Top 2 Classes	6.2%
	Sometimes	29.5%	Sometimes	35.2%
	Never in Non-Manual Class	56.6%	Never in Top 2 Classes	58.6%
Housing Tenure During Childhood	Always Owner Occupied	40.5%	Always Owner Occupied	57.9%
	Owner Occ. & Social	14.2%	Owner Occ. & Social	21.6%
	Always Social Housing	32.8%	Always Social Housing	15.0%
	Social Housing & Other	5.9%	Social Housing & Other	2.5%
	Other Combination	6.7%	Other Combination	3.0%
Age of Mother at Birth	Mean	27.5	Mean	26.0
Family Structure Age 16	2 Natural Parents	86.6%	2 Natural Parents	83.7%
	Reconstituted Family	5.3%	Reconstituted Family	8.9%
	Lone-parent family	8.1%	Lone-parent family	7.5%
Disruptive/Aggressive Score Age 16	Quartiles Age 16 by gender	-	Quartiles Age 16 by gender	-
Parenting Score Age 16	Index of perceived disciplinarian parents:		Index of Perceived Parenting Relationship	
	Very Disciplinarian	20.3%	Age 16:	7.0% (11.8%)
	Somewhat Disciplinarian	63.4%	Mostly Negative	18.2% (30.6%)
	Not Disciplinarian	16.3%	Some Positive	34.3% (57.6%)
			Mostly Positive	40.4%
			Missing	
Mother's Interest in Education (Age 16 NCDS, Age 10 BCS70)	Healthy Interest	39.1%	Healthy Interest	54.1%
	Some Interest	32.3%	Some Interest	29.3%
	Unhealthy Interest	15.4%	Unhealthy Interest	5.5%
	Can't Say/NA	13.2%	Can't Say/NA	11.1%
Philoprogenitive Tendencies Age 16	Ideal Age to Have a Child:		Importance of Own	
	Under 22 years	14.3%	Children	23.2% (44.2%)
	22 years and above	85.7%	Matter Very Much	20.5% (39.1%)
			Matter Somewhat	8.8% (16.7%)
			Don't Matter	47.5%
			Missing	
Region of Residence Age 16 years	Eastern	9.4%	East	10.6%
	Midlands	9.8%	East Midlands	7.8%
	London & South East	13.3%	London	5.3%
	Northern	7.7%	North East	6.7%
	North Western	12.0%	North West	14.2%
	Southern	7.2%	South East	11.3%
	South Western	6.8%	South West	9.5%
	North Midlands	7.8%	West Midlands	9.0%
	East & West Riding	7.3%	Yorkshire and Humber	8.6%
	Wales	5.2%	Wales	7.2%
	Scotland	13.5%	Scotland & Other	9.5%
N		**5,355**		**5,057**

[1]Teacher's Educational Expectations were collected in the BCS70, although very poor data quality prevented their use.
Figures in Brackets represent valid percentages

Results from Models

Parental educational expectations were significant predictors of entry into most definitions of early parenthood, although less so for NCDS teenage parenthood and for BCS70 teenage fatherhood (tables 3-4). In the NCDS teenage parenthood models, teachers' educational expectations predicted teenage fertility more than those of the parents; for 'early' parenthood, this was not the case and for the BCS70, teacher expectations were not investigated because of poor response rates. In both cohorts, parents' expectation that their child would go into higher education was more protective against entry into parenthood, than expecting a child to stay in education until 18 years, which in turn was more protective than expecting a child to leave at the minimum school leaving age. Indecision was also found to be protective in some instances.

Life course planning was also related to the cohort members' philoprogenitive tendencies and was significant for all definitions of early motherhood and teenage fatherhood in the NCDS cohort. For the NCDS, wanting a child after 21 years reduced the odds of early motherhood by 28% and almost 50% for teenage fatherhood. For the BCS70, attaching a low value on having children in the future reduced the odds of becoming an early mother by 45% and 57% for teenage motherhood.

Gender

The general lack of significance of parental expectations in models of teenage fatherhood could indicate that life course planning may be relatively unimportant. That might be expected if teenage fatherhood models are not capturing forms of 'planned' family formation but rather the characteristics of males having unprotected sex, as has been speculated (Kneale 2009). However, this is refuted somewhat by the fact that teacher educational expectations were significant when modelling NCDS teenage fatherhood. Tests for interactions between gender and parental educational expectations were not significant for either cohort or definition of 'early'. Perhaps parental educational expectations are equally important to men and women in reducing the probability of early parenthood, which would refute the first hypothesis, concerning gender differences.

For NCDS men, (but not women) disciplinarian parenting style was found to be significant, with very disciplinarian parenting associated with higher odds of early fatherhood. For BCS70 women, an index of parenting relationship was a significant predictor of early motherhood, with negative relationships associated with earlier parenthood; there was no such relationship for fatherhood. The difference in measures shows that comparison across cohorts is difficult. In models of data on females, but not in male data, another element of the home learning environment was significant in both cohorts and both definitions of 'early'. Although measured at different time points, having a mother with an 'unhealthy' interest in education approximately doubled the odds of early motherhood relative to having a mother with a 'healthy' interest. This teacher-rated variable reinforces the fact that the home learning environment and parents' involvement in their children's lives moderates transition to early parenthood.

Parental, teacher and cohort member educational expectations

NCDS teenage parenthood models offer strong evidence for the importance of an adult figure in governing time to parenthood, although they do not indicate that this necessarily has to be the parent. In the BCS70 cohort, where teacher expectation is poor quality data, parental expectations are consistent predictors of entry into most forms of early parenthood. No instance was found, in any model, of cohort members' own expectations offsetting the effects of the parents' expectations. For the BCS70 teenage fatherhood model however, there was little evidence that educational expectations of parents or cohort members were significant – in that model, school orientation was a notably significant predictor, which ties in with previous hypotheses of teenage fatherhood models picking up behavioural and not life course or socio-economic adaptations. Therefore, with respect to the second stated hypothesis, the message is mixed and the evidence inconclusive, although the educational expectations of an adult who is significant in the life of the cohort member, are generally significant predictors of early parenthood.

Cohort effects

In those groups in which the effect of parental educational expectations could operate differently,

it could be hypothesised that high parental expectations might be greater among those from higher socio-economic groups. However, no such effect was discovered when testing for interactions between socio-economic variables (tenure, benefits and social class) and parental educational expectations. Direct comparisons between cohorts are hampered by the lack of teacher educational expectations. However, for models of 'early' parenthood, where teacher expectations appeared to play a secondary role in NCDS models, there is remarkable inter-cohort consistency in both the magnitude and direction of the effects of parental educational expectations. Formally testing for cohort effects to investigate the third hypothesis was impossible because of data incompatibility. However, further investigation of parental educational expectations using predicted probabilities (next section) gives weight to the case that these may be of greater influence in the later-born cohort.

Table 3: Parental Expectations and early parenthood (NCDS cohort: fully adjusted models)

		Early Fatherhood (First 25%)	Teenage Fatherhood	Early Motherhood (First 25%)	Teenage Motherhood
Educational Expectations and Other Educational Factors	**Parental Educational Expectations Age 16** ***(baseline: Leave School at the minimum)***				
	Stay until 18	0.685*	0.502	0.711*	0.794
	Higher Education	0.564**	0.472	0.639*	1.404
	Don't Know/Other	0.798	1.224	0.705	1.180
	Teacher Educational Expectations Age 16 ***(baseline: Leave School at the minimum)***				
	Stay until 18	1.041	0.780	0.760*	0.571*
	Higher Education	0.704	0.188 BS	0.638*	0.345*
	Don't Know/Other	0.943	0.287*	0.945	0.794
	Cohort Member Educational Expectations Age 16 ***(baseline: Leave School at the minimum)***				
	Stay until 18	0.566	1.040	0.785	0.906
	Higher Education	0.636	1.490	0.714	0.718
	Don't Know/Other	1.014	0.616	0.984	1.203
	Maths Ability Age 16 ***(baseline: Lowest Quartile of Ability)***				
	Quartile 2	0.732*	0.287**	0.896	0.818
	Quartile 3	0.751 BS	0.299**	0.719*	0.743
	Highest Quartile	0.524**	0.187**	0.474**	0.318**
	Reading Ability Age 16 ***(baseline: Lowest Quartile of Ability)***				
	Quartile 2	0.928	0.913	0.837	0.866
	Quartile 3	0.989	1.355	0.830	0.697
	Highest Quartile	1.167	3.131*	0.640**	0.822
	Dislike of School ***(baseline: Strongly Dislike School)***				
	Dislike school somewhat	0.766	1.249	0.940	0.796
	Do not dislike school	0.840	1.163	1.081	0.885
	Attendance Age 16	0.999	0.998	0.985**	0.989**
Socioeconomic Factors	**Reports of Father in Non-Manual Social Class during childhood** ***(baseline: All reports in Non-Manual Class)***				
	Some Reports	1.407 BS	0.650	1.571 BS	1.992
	No Reports	1.546	0.831	1.522	2.157
	Tenure Reports During Childhood ***(baseline: All reports of Owner Occupation)***				
	Some Owner Occ.	1.259	1.158	1.406*	1.224
	Only Council	1.605**	1.325	1.669**	1.559*
	Some Council	1.460	1.842	1.344	1.006
	Other	1.158	0.542	1.197	1.530
	Receipt of Unemployment/Sickness Benefits Age 16 ***(baseline: in receipt of benefits)***				
	Not in receipt of benefits	0.979	1.248	0.908	0.967
Home Learning Environment and Philoprogenitive Factors	**Mother's Interest in Child's Education at Age 16** ***(baseline: Healthy Interest)***				
	Some Interest	1.124	1.285	1.147	1.410
	Unhealthy Interest	1.242	0.926	1.602**	1.998**
	Don't Know	1.329	0.973	1.180	1.649 BS
	Parental Disciplinarian Index ***(baseline: very disciplinarian)***				
	Somewhat	0.644**	0.424**	0.725**	0.997
	Not Disciplinarian	0.723*	0.258**	0.823	1.287
	Philoprogenitive Tendencies ***(baseline: want a child under 22 years)***				
	Other response	0.761 BS	0.523*	0.684**	0.610**
	Mother Stayed in Post-compulsory Education ***(baseline: did not stay)***				
	Stayed in Education	1.080	0.633	0.953	0.792
Background Demographic and Behavioural	**Family Structure Age 16** ***(baseline: 2 Natural Parents)***				
	Reconstituted Family	1.304	1.128	1.748**	2.011**
	Lone-parent family	1.010	1.333	1.107	1.314
	Score for Age 16 Behavioural Component: Disruptive and Aggressive Behaviour ***(baseline: Lowest Quartile)***				
	Quartile 2	1.336 BS	1.390	1.044	1.162
	Quartile 3	1.390*	2.725*	1.332 BS	1.093
	Highest Quartile	1.393*	2.326 BS	1.240	1.741**

Table 3 (Continued)

Mother's Age at Cohort Member's Birth	0.996	0.973	0.984*	0.983
Region of Residence Age 16 ***(baseline: Eastern)***				
Midlands	1.157	0.121*	0.861	1.189
London & South East	0.866	0.394	0.887	1.290
Northern	1.144	0.877	1.305	1.263
North Western	1.054	1.239	1.078	1.604
Southern	0.935	0.588	1.495	1.156
South Western	0.978	0.316	1.136	1.687
North Midlands	0.775	1.357	0.659	1.050
East & West Riding	0.959	1.727	1.605 BS	2.158*
Wales	1.644 BS	1.097	1.330	1.486
Scotland	1.164	0.121	1.022	1.168
N	2,288	2,521	2,834	2,834
Pseudo R-squared	0.122	0.200	0.172	0.166

** = p < 0.01 * = p < 0.05 BS = Borderline Significant

Probabilities for Policy

The results presented in tables 3 and 4 highlight the prominence of educational expectations of a close adult as a predictor of early fertility. This contradicts interventions that have aimed to reduce the level of early pregnancy and early parenthood through focussing solely on structural factors (Social Exclusion Unit 1999; Harden, Brunton et al. 2006; Allen, Bonell et al. 2007). Recently, there has been movement towards interventions that focus on personal development and relationships (Allen, Bonell et al. 2007). The results presented in this section broadly support this change through directly contrasting the effect of changing parental educational expectations, with changing an element of material disadvantage on predicted probabilities in hypothetical situations. These can be interpreted as the percentage predicted to become early parents based on the variation in five characteristics (table 5). These show how the effect of changing educational expectations can offset the effects of material hardship. While the results presented in tables 3 and 4 are the main outputs of this analysis of the effects of parental educational expectations, this section is intended to illuminate the contrast between material and parenting factors.

In the BCS70, this simulation shows that changing educational expectations, from leaving at the minimum age upwards to progressing to higher education, had a larger effect on decreasing the predicted probability of becoming an early parent than changing any other element. This included changing educational ability level, which had the largest effect in decreasing the odds of early parenthood in the NCDS cohort. Philoprogenitive tendencies of the cohort member themselves were also tested, but changing these did not have the same impact on these probabilities as changing parents' educational expectations.

Table 4: Parental Expectations and early parenthood (BCS70 cohort: fully adjusted models)

	Binary Logistic Models: Odds Ratios	Early Fatherhood (First 25%)	Teenage Fatherhood	Early Motherhood (First 25%)	Teenage Motherhood
Educational Expectations and Other Educational Factors	**Parental Educational Expectations Age 16** ***(baseline: Leave School at the minimum)***				
	Stay until 18	0.625**	0.426	0.669*	0.517
	Higher Education	0.451**	0.510	0.572**	0.425*
	Don't Know/Other	1.083	0.636	0.671*	0.705*
	Missing	1.222	1.015	0.741 BS	0.707
	Cohort Member Educational Expectations Age 16 ***(baseline: Leave School at the minimum)***				
	Stay until 18	0.774	0.456[1]	0.582**	0.457*
	Higher Education	0.550*		0.477**	0.407 BS
	Don't Know/Other	0.613		0.788	0.288
	Missing	0.676	0.092[1]	1.148	0.455
	Maths Ability Age 10 ***(baseline: Lowest Quartile of Ability)***				
	Quartile 2	0.990	0.594	0.893	1.170
	Quartile 3	1.084	1.376	0.782	0.986
	Highest Quartile	1.236	1.537	0.765	1.189
	Reading Ability Age 10 ***(baseline: Lowest Quartile of Ability)***				
	Quartile 2	0.824	1.004	0.689*	0.700
	Quartile 3	0.797	0.710	0.720*	0.676
	Highest Quartile	0.591**	1.401	0.515**	0.427
	English Picture Vocabulary Test Age 5 ***(baseline: Lowest Quartile of Ability)***				
	Quartile 2	1.132	1.373	0.782 BS	1.175
	Quartile 3	1.022	0.724	1.003	0.746
	Highest Quartile	0.916	0.540	0.711*	0.364**
	Dislike of School ***(baseline: Strongly Dislike School)***				
	Dislike school somewhat	0.808	0.129**	0.754	0.690
	Do not dislike school	0.825	0.130*	0.774	0.744
	Missing	1.285	2.276	1.289	1.065
	Truancy Age 16 ***(baseline: Yes, Played Truant)***				
	No, did not	0.872	0.914	0.817	0.718
	Missing	1.544	0.820	0.915	1.155
Socioeconomic Factors	**Reports of Father in Social Class I and II during childhood** ***(baseline: All reports in Non-Manual Class)***				
	Some Reports	0.805	0.425	1.367	1.161
	No Reports	0.996	0.502	1.701	1.305
	Tenure Reports During Childhood ***(baseline: All reports of Owner Occupation)***				
	Some Owner Occ.	1.120	0.636	1.593**	1.291
	Only Council	1.556**	1.275	2.168**	2.164**
	Some Council	1.471	0.946	1.549	1.717
	Other	1.060	0.708	1.763*	1.263
	Receipt of Unemployment/Sickness Benefits Age 16 ***(baseline: in receipt of benefits)***				
	Not in receipt of benefits	1.006	0.523	0.666*	0.610*
Home Learning Environment and Philoprogenitive Factors	**Mother's Interest in Child's Education at Age 10** ***(baseline: Healthy Interest)***				
	Some Interest	1.208	1.280	1.189	0.924
	Unhealthy Interest	1.300	0.393	2.225**	2.264**
	Don't Know	1.706**	1.015	1.209	1.037
	Index of Perceived Parenting Relationship Age 16 ***(baseline: Mostly Negative)***				
	Some Positive	0.744	0.437	0.549**	0.456*
	Mostly Positive	0.946	0.901	0.650*	0.531*
	Missing	0.693	1.448	0.460*	0.787
	Philoprogenitive Tendencies: Importance of Children in Future Life ***(baseline: Matter Very Much)***				
	Matter Somewhat	1.160	1.920	0.537**	0.879
	Don't Matter	0.801	1.380	0.550**	0.426*
	Missing	0.871	0.958	0.618**	0.818
	Mother Stayed in Post-compulsory Education ***(baseline: did not stay)***				
	Stayed in Education	0.772	0.237 BS	0.855	0.875
Background Demographic and Behavioural Factors	**Age of Mother at Cohort Member's Birth**	0.942**	0.977	0.962**	0.966*
	Score for Age 16 Behavioural Component: Disruptive and Aggressive Behaviour ***(baseline: Lowest Quartile)***				
	Quartile 2	0.896	1.903	1.486*	1.015
	Quartile 3	1.215	2.694*	1.281	1.049
	Highest Quartile	1.274	5.226*	1.674**	2.214
	Missing	0.959	4.572	1.354	1.379
	Family Structure Age 16 ***(baseline: 2 Natural Parents)***				
	Reconstituted Family	1.072	1.684	1.023	0.840
	Lone-parent family	1.190	1.943	0.964	0.813
	Region of Residence Age 16 ***(baseline: East of England)***				
	East Midlands	1.073	1.447	1.610 BS	1.665
	London	0.902	2.539	0.737	0.430
	North East	1.034	1.120	1.126	0.744
	North West	1.066	1.818	1.455	0.920
	South East	1.353	0.682	1.090	0.611
	South West	0.806	2.559	1.753*	1.041
	West Midlands	1.166	1.739	1.382	1.299
	Yorkshire & Humber	1.667	0.946	1.188	0.716
	Wales	1.226	3.018	1.795*	1.854
	Scotland	0.921	0.175	1.045	0.779
	N	2,410	2,410	2,647	2,647
	Pseudo R-squared	0.113	0.229	0.179	0.215

** = p < 0.01 * = p < 0.05 BS = Borderline Significant [1]Because of small sample sizes for teenage fathers, categories were combined to reflect 'post-compulsory education' and 'missing or uncertain'

Table 5: Table of predicted probabilities demonstrating the effect of changing educational expectations in two cohorts in hypothetical situations

NCDS

	Situation 1: 'Destined' to early parenthood	Situation 2: Changing Expectations	Situation 3: Changing Maths Score	Situation 4: Changing Housing Tenure	Situation 5: Changing Social Class Reports	Situation 6: Changing Philoproge-nitive Report
Parental Educational Expectations Age 16	Minimum	**Higher Education**	Minimum	Minimum	Minimum	Minimum
Maths Score (16)	Low	Low	**High**	Low	Low	Low
Tenure Reports During Childhood	Social Housing	Social Housing	Social Housing	**Owner Occupation**	Social Housing	Social Housing
Social Class Reports During Childhood	Lower	Lower	Lower	Lower	**Higher**	Lower
Early Philopro-genitive Tendencies	High	High	High	High	High	**Low**
Predicted Probability: Early Fatherhood	56.3%	33.1%	35.7%	42.1%	42.8%	35.4%
Predicted Probability: Teenage Fatherhood	11.0%	4.7%	2.2%	11.7%	9.5%	5.0%
Predicted Probability: Early Motherhood	54.0%	31.4%	22.9%	38.2%	38.9%	29.1%
Predicted Probability: Teenage Motherhood	29.7%	22.7%	5.3%	14.2%	18.7%	11.4%

Key: Parental Expectations Age 16 (Minimum = Leave at the Minimum Age); Maths Score Age 16 (Low = Lowest Quartile of Ability; High = Highest Quartile); Tenure Reports During Childhood (Social Housing = Always in Social Housing; Owner Occupation = Always in Owner Occupied Housing); Social Class Reports During Childhood (Lower = Always in Manual Social Class; Higher = Always in Non-Manual Social Class); Philoprogenitive Tendencies (High = Under 22; Low = Over 21)

BCS70

	Situation 1: 'Destined' to early parenthood	Situation 2: Changing Expectations	Situation 3: Changing Maths Score	Situation 4: Changing Housing Tenure	Situation 5: Changing Social Class Reports	Situation 6: Changing Philoproge-nitive Report
Parental Educational Expectations Age 16	Minimum	**Higher Education**	Minimum	Minimum	Minimum	Minimum
Reading Score (10)	Low	Low	**High**	Low	Low	Low
Tenure Reports During Childhood	Social Housing	Social Housing	Social Housing	**Owner Occupation**	Social Housing	Social Housing
Social Class Reports During Childhood	Lower	Lower	Lower	Lower	**Higher**	Lower
Early Philopro-genitive Tendencies	High	High	High	High	High	**Low**
Predicted Probability: Early Fatherhood	42.0%	19.6%	28.0%	29.6%	-	36.2%
Predicted Probability: Teenage Fatherhood	4.8%	0.9%	4.8%	3.3%	-	6.7%
Predicted Probability: Early Motherhood	63.0%	38.7%	36.6%	40.2%	-	50.6%
Predicted Probability: Teenage Motherhood	30.2%	9.9%	10.6%	13.3%	-	15.4%

Key: Parental Expectations Age 16 (M = Leave at the Minimum Age); Maths Score Age 16 (Low = Lowest Quartile of Ability; High = Highest Quartile); Tenure Reports During Childhood (Social Housing = Always in Social Housing; Owner Occupation = Always in Owner Occupied Housing); Social Class Reports During Childhood (Lower = Never in Social Class I and II; Higher = Always in Social Class I and II); Philoprogenitive Tendencies (High = High importance place on children; Low = Low importance placed on children); - = No representative cases

Summary and Conclusions

Summary and Limitations

This study investigated the impact of educational expectations as predictors of early parenthood and generally found that these were significant, which supported the underlying hypotheses. Parental educational expectations retain significance, even in the presence of other controlling variables such as educational ability, socio-economic factors, and school and philoprogenitive orientation measures (as displayed in tables 3 and 4), suggesting that these expectations represent more than direct reflections of ability or advantage. Returning to the specific hypotheses:

a) Although the magnitude of the coefficients suggested that higher educational expectations held greater effect in slowing early motherhood than fatherhood, this was not substantiated by testing for interaction effects.

b) Parental expectations were often found to be significant where those of the cohort members were not, although this was not necessarily the case for teachers' expectations. In the NCDS teenage parenthood models, expectations of the teachers were significant and those of the parents were not. In BCS70 models, where information on teachers' expectations of sufficient quality[iv] was not available, the cohort members' expectations were significant, although did not offset the effect of the parents' expectations. Overall, the evidence shows that the expectations of significant adults (be they teacher or parent) were predictive of age at first birth.

c) It is difficult to establish that parental educational expectations would increase in significance over time using these data. Certainly in terms of early motherhood, relative to similar socio-economic factors, the effect of parental educational expectations did increase between cohorts (see Table 5). The evidence from these models, suggests that it is increasingly useful to understand early parenthood as being predicted by disadvantaged home learning environments (having parents with low expectations who offer limited scope for life course planning, plus having poor relationships with parents) just as much as it being a consequence of disadvantaged material backgrounds.

There are limitations to these findings. First is the disparity in measurements between cohorts. A second limitation is the absence of further measurements of life course planning: although much of the theoretical basis for this paper is grounded in the notion of life course planning, but only one aspect of life course planning (education) was available. A measurement of parental family building expectations may have been useful. On the other hand, given that education is thought to account for a substantial amount of the variability in fertility patterns (for example Kiernan 1997; Rendall and Smallwood 2003; Lappegard and Ronsen 2005; Rendall, Couet et al. 2005; Smith and Ratcliffe 2009), and that this paper was looking for an overlap between educational and family-building life course planning, this is not considered a drawback. Similarly, this paper is theoretically grounded in the assumption that these expectations reflect a component of planning and are not solely a reflection of current behaviour. At any rate, their discovery as predictors of early parenthood does contribute to the field, and qualitative research may illuminate this issue further. The absence of other factors including partnership, housing, and employment status is a further limitation as the models do not explicitly recognise that parenthood is symbiotic with other life course events. However, their inclusion would go beyond the intention of the present analysis, which was to examine childhood predictors of early fertility. Furthermore, the concern was to look at all forms of early parenthood (married, unmarried etc) jointly and not to distinguish different circumstances.

A more substantial concern is the two-fold reduction of the sample. Firstly, the effect of missing data reduced the sample size, and is a caveat of the results, as the sample under-represents those from disadvantaged backgrounds (not shown). In addition, since the sample was further restricted, as the measures of early parenthood only began at age 17½ years, there are concerns about establishing causality. This restriction resulted in a small number of early parents being excluded from models, which did not substantively impact on the results. Additionally, while

17½ was chosen as a point at which issues of causality were reduced, they may not necessarily have been completely eliminated, particularly in the context of 'life course planning'. Plans may have been 'set in motion' at the time of questioning, for a small number, so it was not so much the planning, as the implementation of the plan, that was being detected, and this is a further caveat on these results.

Conclusions and Policy Implications

Educational expectations held by adult figures are found to be highly influential over the odds of entering first parenthood early. The evidence in table 5 shows that raising educational expectations can have the same impact as altering an element of disadvantage. Opportunity costs have usually been regarded as the calculation of the minimum impact of wage penalties and missed career opportunities resulting from motherhood. Assortative mating is one likely mechanism by which these costs impact on male fertility patterns. The results in this paper suggest that these calculations are not based on educational ability alone. Parents' or teachers' expectation of a young person's entry to higher education was protective even when educational test score achievements, school orientation, cohort members' expectation and socioeconomic background suggested that this expectation was likely to remain unfulfilled. In other words, parental educational expectations help those usually considered predestined for early parenthood through having low opportunity costs, to postpone.

The results demonstrate that asking about the future and particularly educational expectations, can aid the identification of those who are likely to become early parents. This is a simple but often overlooked concept. Young people have strong ideas about their life course – that overlap somewhat with aspirations – but these are likely to be shaped, changed or reinforced by the adult figures around them. Evidence in this paper suggests that adult expectations are more predictive than those of the children. Raising expectations, even from leaving school at the minimum age to leaving at age 18 reduces the probability of entering early parenthood. These results suggest that more emphasis should be placed on planning and expectations involving young people, their parents and their teachers, and that further research may need to be conducted into the dynamics of these relationships.

For young people for whom formal higher education may not be suitable, greater parental knowledge about vocational education options might increase educational expectations and lead to a decrease in early parenthood. Altering expectations may not be insurmountable. Interventions aimed at raising aspirations show the efficacy of the provision of parenting experts, empowering parents in their children's education through becoming school governors, and providing financial information, advice and guidance on the costs and benefits of higher education through 'money guidance pathfinder' schemes (Cabinet Office 2008). Such actions may also alter parents' interest in their children's education, which was also found to be a significant predictor of early motherhood.

A further implication of the results is the fact that male fertility histories were significantly influenced by educational expectations. While the opportunity cost pathway is usually applied only to women, this paper suggests that males are influenced by factors that are usually included in hypothesised calculations of opportunity costs, and they are influenced by the perception of opportunity costs, adding another dimension to assortative mating theories.

Finally, the findings in this paper could not have been replicated using a different study design because only a longitudinal design could match expectations with adult outcomes. It is probable that fertility is not alone as an adult outcome predicted by life course expectations. Other research has looked at expectations and the relationship with attainment and occupation, but is limited in terms of other dimensions such as family building (Schoon 2006; Schoon, Martin et al. 2007; Flouri and Hawkes 2008). Future research both in terms of prediction and intervention could usefully analyse whether the relationship between expectations and other domains, such as poor housing, or low life satisfaction can be utilised to prevent cycles of disadvantage.

This is one of the first studies to present quantitative evidence of the role of parental educational expectations as predictors of early parenthood, and to examine their role alongside the expectations of other actors in cohort members' lives. The title of this paper referred to 'pushy' parents – in this context, being 'pushy' through having higher expectations was not a negative trait. On the other hand, as has been emphasised, early parenthood itself is not necessarily negative. For many it may well be a desired state. This paper shows that the seeds of this ambition are sowed in part through the educational expectations of parents.

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Endnotes

[i] The father's interest was also measured but was largely insignificant alongside the mother's. Over 50% of responses were missing at age 16 for BCS70 and therefore reports from this age are not used.
[ii] The results of the likelihood ratio tests and Hosmer-Lemeshow tests are not shown.

[iii] Those who responded that they either expected their child to leave at the minimum age, to stay on until 18 or to progress to higher education.

[iv] Over 50% of observations were missing.

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Lifelong childlessness in England and Wales

Evidence from the ONS Longitudinal Study

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Abstract

Previous research on childlessness suggests that childless women differ from those with children mainly in terms of their attitudes and values. In the literature, mixed evidence exists regarding how distinctive childless women are in terms of their socio-economic characteristics. Data from the Office for National Statistics (ONS) Longitudinal Study (LS) is used for the first time to investigate the personal and household characteristics of women born between 1956 and 1960 in relation to their lifelong fertility outcomes. Logistic regression techniques are used to model the probability of lifetime childlessness based on a number of women's and their partners' socio-economic characteristics at various key ages during women's life-course. Single women are the most likely to be childless and married women are least likely to be childless. For those with partners, childless women are more often in "non-traditional" partnership, including cohabitations, and tend more often to have wider age gaps with their partners. In terms of women's own characteristics, the economically active are more likely to be childless and childless women have a slightly higher social and economic status as compared to mothers. Childlessness is often associated with presence of a limiting long term illness and a lack of any siblings in childhood. Using administrative and Census records available in the LS, it is possible to provide robust statistical evidence that childless women appear to be a distinctive group in terms of key socio-economic characteristics. This analysis also shows the potential of the LS to be used more frequently for quantitative research on childlessness alongside other survey data sources.

Keywords: Childlessness, fertility, ONS Longitudinal Study, women, England and Wales, longitudinal research

Background and Literature Review

Since the post second world war baby boom, there has been a dramatic change in childbearing patterns throughout the developed world (Sobotka, 2004). In general, women in most countries have been delaying starting a family, with births to women aged below 30 declining sharply over this period. Women have also been having fewer children on average and increasing numbers of women have been remaining childless. This has resulted in the fertility decline observed in the Western world, where many countries are now experiencing low and very low fertility (e.g. McDonald, 2000, Castles, 2003). Total fertility rates[i] (TFR) dropped sharply between the mid-1960s and mid-1970s and then fell during the 1990s reaching a record low TFR in 2001 of 1.63; since 2001 TFR have shown a steady increase (Jefferies, 2008). UK births data has also shown an increase in the mean age of mothers at first birth. Between 1996 and 2006, mean age of mothers at first birth in England and

Wales rose from 26.7 to 27.6 (ONS, 2007). These trends led Kneale and Joshi (2008) to suggest that "fertility is becoming lower and later among British women" (Kneale and Joshi, 2008).

This paper focuses on childlessness in England and Wales which has been identified as an important driver of the observed fertility decline (Simpson, 2006). For example, using data from ONS Birth Statistics (ONS, 2002), Berrington (2004) showed how the increase in childlessness from 10% of women in 1945 to 19% of women in 1960 was the driving force behind the decline in average completed family size in England and Wales from 2.18 in 1945 to 1.95 in 1960. The literature suggests that childlessness is not a new phenomenon. Hakim (2003) reported that in the past, 20% of women in the UK remained childless due to poverty, poor nutrition and low marriage rates caused by wars and emigration. However, in the post second world war period, childlessness reached an all time low in Britain (Coleman, 1996). Since then, the proportion of women in England and Wales who are childless at the end of their reproductive years (at ages 45 and above) has been increasing, from an estimated 10% of the 1945 cohort to 19% of women born in 1960 (ONS, Birth Statistics, 2008). Importantly, contemporary childlessness has been identified as being different from childlessness in the past, as it is occurring increasingly often amongst healthy females who are living within marriage and cohabitation, and who are sexually active (Coleman, 1996).

There are contrasting predictions of the scale of childlessness in England and Wales for the future. The 2006-based National Population Projections suggested that 19% of those women born in the second half of the 1970s and 1980s in England and Wales will remain childless by the age of 45, and that this will rise to 20% for those women born during the 1990s (Bray, 2008). These estimates of childlessness are similar to those predicted by Hakim (2003) who, using preference theory which theorises that in the contempoary world women have the freedom to choose how they live, estimates that approximately 20% of women will concentrate on their career rather than on their family life, and that a high proportion of this 20% will be childless throughout their lives. Sobotka (2004) predicted higher rates of childlessness, between 23% and 25% among women born in 1975 in England and Wales. Sobotka (2004) used period and cohort fertility data from a range of sources including vital statistics records, census results, expert estimates based on vital statistics, large-scale family surveys and population registers, to make projections of final childlessness in 16 European countries[ii] and the United States. It is suggested that England and Wales has one of the highest levels of projected childlessness, with similar levels to Austria, Finland, West Germany, Italy and Poland (Sobotka, 2004).

The socio-economic characteristics of contemporary women who remain childless and how they differ from mothers have been the focus of much research. Although delayed childbearing is associated in the literature with higher levels of education, higher ocupational status and greater material resources (Sobotka, 2004), the degree to which childless women are distinctive in terms of their socio-economic characteristics when compared with those with children is less clear. For example in Britain, Kiernan (1989) used data from the nationally representative National Survey of Health and Development, which is a longitudinal study of a sample of a cohort born in 1946, to try to identify the characteristics which distinguished those who were childless from those who were parents. Kiernan's (1989) analysis, based on a sample of 1,924 female respondents aged 36 years old in 1982 indicated that married women who married at a later age and those who were only children were more likely to be childless. However, despite some of the literature suggesting a link between falling fertility and increasing levels of female education (e.g. Hotz et al, 1997) and employment (Becker, 1991), Kiernan found no strong association between childlessness and education, and childlessness and occupation.

Hakim (2003) found even less evidence to suggest that childless females were distinctive from mothers in terms of their socio-economic characteristics. This study used data from the Family and Fertility Surveys (FFS) in 21 European countries[iii] and, for Britain, data from the 1958 National Child Development Study (NCDS) and the 1970 British Cohort Study (BCS). In the British context, this study had a large sample of childless females as the NCDS provided information on 1,143 42-year-old childless women and the BCS provided data on 2,618 30-year-old women. Although this study found that socio-economic differences between the childless and parents were more

pronounced for women than men (who were also included in the study), it concluded that childless women were distinctive from those with children in terms of their attitudes and values rather than their socio-economic characteristics. For example, Hakim (2003) reported that although a high percentage of females employed in higher grades were childless, this was not a distinctive characteristic of childless females because the majority of childless women were still employed in middle and lower grade occupations.

More support for the finding that childless women are distinctive in terms of their attitudes and values can be found elsewhere in the literature. For instance, Berrington (2004) reported that amongst 199 childless women in their thirties, included in the British Household Panel Survey, women who had more egalitarian attitudes about women's paid work outside the home were significantly less likely to intend to start a family. McAllister and Clarke (1998) interviewed a relatively small number of women (34) in the UK, to investigate why they had chosen to be childless. This study found that childless women did not have a negative perception of children or unconventional views on parenthood and that they were not motivated to be childless by career aspiration. Instead, the voluntary childless in this sample were motivated by general quality of life issues (e.g. economic security and good housing) and did not want the disruption and change to their lifestyle that it was perceived parenthood would bring.

As shown in this brief review of the literature, most quantitative research on childlessness in the UK has analysed data collected through traditional cross-sectional and panel surveys such as the General Household Survey (Murphy, 2008), the British Household Panel Survey (Berrington, 2004) and, notably, the Birth Cohort Studies (Hakim, 2003; Simpson, 2006; Kneale and Joshi, 2008). In this paper we use for the first time a linkage study of administrative records, the ONS Longitudinal Study (LS), to revisit the issue of the extent to which childless women are from a distinctive social or economic group relative to women with children in England and Wales. We also use the longitudinal nature of the LS[iv] to investigate the relationship between lifelong fertility outcomes and personal and household characteristics at various points during women's life-course.

It was a particularly appropriate time to use the LS to study childless women, because for the first time the study covered the entire 15-45 childbearing age span for a cohort of women, those born between 1956 and 1960. This feature of the LS enabled us to be confident that the women categorised as childless in our study were lifelong childless and were not merely fertility postponers. This was particularly important as people are increasingly postponing having children rather than avoiding having them altogether (Kneale and Joshi, 2008). Analysis of data covering the entire childbearing age span was important to ensure that premature conclusions were not reached on women's fertility behaviours.

Data and Methods

The ONS Longitudinal Study

The LS is a dataset of linked census and vital events records for one per cent of the population of England and Wales. It includes linked individual records from the 1971, 1981, 1991 and 2001 Censuses, together with routine events registrations such as births, deaths and cancer registrations.

The sample was initiated at the time of the 1971 Census, when all people born on four selected dates in any calendar year were included in the sample. The same four dates were used again to update the sample in 1981, 1991 and 2001. Intercensally, new members are entered by virtue of birth on LS dates or by immigration (if born on LS dates) and exited by death or emigration. The study was designed as a continuous, multi-cohort study, with subsequent samples being drawn at each census, using the same selection criteria, and linked into the study to previous census records and/or a birth or immigration record.

The LS shares some of the limitations of the Census, one of its data sources. For instance, the Census information covers a limited range of topics, it mostly relates to people's circumstances at the time and it is collected only once every ten years. Individual information typically collected at most Censuses includes age, sex, marital status, social class, education, economic activity. To date, Censuses have not included any questions on financial circumstances or behaviours and attitudes that are available in other surveys. As a consequence, in our study it was not possible to distinguish between voluntary and involuntary

childlessness[v] and it was not possible to investigate how different childless women and mothers were in terms of their attitudes and opinions[vi].

Although Census information is only linked into the study every ten years, at any one point in time the LS is largely representative of the England and Wales population as a whole, with events data (births, deaths, immigrations, deaths and cancer registrations) linked into the study on an annual basis.

Over the thirty plus years of the study, data on approximately one million individuals have been collected. This means that the LS has a far larger sample size than any other longitudinal study in England and Wales, thus allowing for robust statistical inference.

Additionally, the LS does not suffer from some of the data quality issues affecting more traditional panel surveys. For example, as it is a linkage study of administrative records, it is not affected by attrition due to non-response or by respondents' memory bias as survey data may be.

The LS also includes Census information for people who are enumerated in the same household as the LS member. This provides the opportunity to investigate the family contexts in which specific fertility behaviours occur. However, the information on people enumerated at the same private address as the LS member is not linked through time, and as such it can only be analysed cross-sectionally.

Definition of childlessness

This research analysed a sample of 12,578 LS female members, all born between the years 1956 and 1960 (included) and continuously resident in England and Wales during their entire childbearing age span, conventionally considered to be between 15 and 45 years old. As only births registered in England and Wales are linked to LS mothers, continuous residence in either of the two countries was required to ensure that fertility outcomes were correctly assigned to each woman. The sample therefore excluded women who entered the country after the age of 15, those who left it before the age of 45, as well as any other woman temporarily absent from England and Wales between these two ages, as indicated by their absence at one of the Censuses. Also, all women who died before 45 years of age were not included in the sample.

The analysis focused on lifelong childlessness. A woman was defined as being childless if she had not had any live or still birth by December 2005, when she was aged between 45 and 50. Childlessness was defined from a biological perspective, although a childless woman may actually have acted as a mother to children that she did not bear herself (e.g. foster and adoptive parents and women looking after their partner's children). Similarly, a biological mother may not have acted as such from a social perspective (e.g. a mother whose child has been adopted by other parents). However, for simplicity of expression, we will from here on refer to the first group as "childless" and to the second as "mothers".

Table 1 compares the percentages of childless women in the LS with ONS published 2005 Birth Statistics for England and Wales[vii] (ONS, Birth Statistics, 2006). Overall, 2,194 LS women from the 1956-1960 cohorts had not given birth by the end of 2005. This was around 17% of the sample and was consistent with national estimates. The LS could therefore be considered to be a reliable and representative sample of childless females in England and Wales as a whole.

Table 1: Childless women in the LS and England & Wales by birth cohort, 2005[viii]

Cohort	Percentage of childless women	
	LS	England and Wales
1956	16.5 (15.0 – 18.0)	16.0
1957	17.0 (15.5 -18.5)	17.0
1958	18.0 (16.5 - 20.0)	18.0

(Table 1 continued)

1959	17.9 (16.4 -19.4)	18.0
1960	17.8 (16.4 – 19.3)	18.0

Note: Figures in brackets represent the 95% confidence intervals for the LS estimates
Source: ONS Longitudinal Study, FM1 Births Statistics, Authors' analysis

Methods

This research used LS data from the 1981, 1991 and 2001 Censuses to investigate the circumstances of women at different key ages and to see how these were associated with their lifelong fertility outcomes. The analysis investigated the extent to which childless women appeared to be distinctive from women with children in terms of several social and economic characteristics. The choice of explanatory variables was informed by the review of both qualitative and quantitative literature related to childlessness (e.g. Hakim, 2005; Parr, 2005; Hakim 2003; McAllister and Clarke 1998), followed by bivariate analysis of association between life-long fertility outcomes and LS socio-economic variables (Portanti and Whitworth, 2009).

The relationship between socio-economic circumstances and fertility behaviours may be quite complex. For example, childbearing may lead some women to leave the labour force, thus showing how parenthood may impact on employment patterns. At the same time however, employment may impact on parenthood. For instance, several empirical studies have found that an increase in women's wage is associated with first birth postponement (de Cooman et al, 1987; Joshi, 2002).

It was beyond the scope of the analysis to disentangle cause-effect relationships between the study variables. Instead, we concentrated on identifying and measuring the association between several socio-economic characteristics and childlessness, without debating the direction of this association.

Various studies have also pointed out how contemporary childlessness is occurring more frequently within marriage and cohabitation (e.g. Coleman 1996; Hakim, 2005). Using information on marital status and cohabitations at the 1981, 1991 and 2001 Censuses, we also estimated that at least 68% of childless women in our sample had been cohabiting for some time with a partner during their childbearing years (see Table 2). We therefore decided to also measure the extent, if any, to which the partners of childless women were distinctive from the partners of those who had become mothers by 2005. This allowed us to measure the association of the partner's characteristics on a woman's fertility outcomes.

Unfortunately in the LS, partners are not linked through time so only cross-sectional analysis was possible. We chose to analyse women in a partnership in 1991, when they were in their early-mid thirties, as this appeared to be a key time point for our cohort lifelong fertility outcomes. Indeed, we estimated that between 94% and 96% of the 1956-60 cohort mothers had their first child by their mid-thirties (authors' calculations based on 2006 ONS data).

In order to identify the key features distinguishing childless women from mothers, logistic regression techniques were used to model the probability of lifetime childlessness based on a number of women's and their partners' individual characteristics. This multivariate analysis allowed the estimation of the level of association of each explanatory variable with childlessness, after adjusting for the effects of other variables.

We first fitted a logistic model on the whole sample of women using women's individual characteristics as independent variables. A second logistic regression model was then separately estimated for the subgroup of women who had a cohabiting partner or spouse when they were in their mid-thirties.

The sample for the first part of the analysis included 12,578 women, of which 2,194 were childless and 10,384 were mothers. The analysis of women with partners included a sub-sample of 9,786 women who were enumerated living with a partner in the 1991 Census. Around 50% of the initial childless group (1,101 women) and 84% of the mother group (8,685 women) had a partner in 1991.

Women's individual characteristics

Socio-economic variables including marital/partnership status, education, economic activity and social class are available in the LS for each Census from 1971. This allowed us to adopt a life-course perspective when investigating the extent to which sample women, who were lifelong childless, differed from the mothers group. We compared the two groups of women not only at the end of their childbearing age, but also throughout their childhood and adulthood.

Three marital status variables were considered, providing information on women's partnership status in their twenties (1981 Marital Status), thirties (1991 Marital Status) and forties (2001 Marital Status). Marital status information however provides only a partial picture of partnerships, as it does not capture consensual unions (cohabitations). As the LS includes information on those individuals enumerated in the same household as the LS member, we could also identify those women cohabiting with a partner, irrespective of their legal marital status. We derived three new "living arrangements" variables, one for each of the aforementioned timepoints, by combining information on marital status and cohabitation. The living arrangement variable allowed us to distinguish between single (never married) women, who were cohabiting with a partner, and those without a cohabiting partner.

Women's ethnicity, economic activity, social class and educational attainment were also included in the analysis. Social class was defined using the Social Class based on Occupation classification (previously known as the Registrar General's Social Class classification). In 1991 and 2001, the Census included a question on health, asking all respondents whether they had any long-term illness, health problem or disability which limited their daily activities or the work that they could do. In the absence of more detailed information, we used this as a proxy for the health status of respondents.

Variables whose values are typically determined either at birth or during a person's childhood are known as early lifecourse variables. These have been shown to have significant predictive power for identifying which women will be childless in later life (Parr 2005). We therefore included in the analysis, two variables related to the household and family context in which women lived during their own childhood. These were the presence of siblings and the Main Economic Support social class in a woman's 1971 household.

Table 2 presents the frequency distribution of some of the variables that have been discussed in this section. The differences between the childless and the mothers group for all the frequencies reported here were statistically different at the 0.05 significance level.

Table 2: Childless women's and mothers' profiles

	% of CHILDLESS women who...	% of MOTHERS who…
Marital status 2001		
were single (never married)	40.2	5.3
were in their first marriage	35.3	59.9
were re-married	8.9	12.8
were divorced	12.6	16.3
Living arrangements		
were in a cohabiting partnership at at least one Census	67.7	95.4
Economic activity		
were economically active (1981)	89.4	67.9
were economically active (1991)	89.2	62.1
were economically active (2001)	84.5	78.5

(Table 2 cont'd)

Social Class 2001		
were in a manual social class	19.7	32.1
were in a non-manual social class	75.3	63.6
Ethnicity 2001		
were of White ethnicity	97.9	97.2
were of Asian ethnicity	0.6	1.2
Limiting long-term illness 2001		
had a limiting long-term illness	17.1	11.7
Siblings 1971		
had no sibling present in their 1971 household	14.9	11.4
Education 2001		
were educated at degree level and above	26.8	19.2
did not have any academic or professional qualification	16.8	21.7
Social Class Main Economic Support (MSE) 1971		
MSE in a Manual Occupation	57.7	63.4
MSE in a non Manual Occupation	37.9	32.3

Base**:** 12.578 women, of which 2,194 childless and 10,384 mothers
Difference between childless women and mothers statistically significant at the 0.05 level for each variable's category.

Partner's variables

The second part of the analysis investigated women living with a partner in 1991. In addition to women's individual variables, we included in the analysis four partner's variables: age, educational attainment, marital status and social class. In particular we treated these variables in relation to the equivalent women's variables. For example, we looked at whether the age gap between partners tended to be wider or narrower among the childless group compared to the mothers group.

Table 3 presents a selection of descriptive statistics for these variables for the childless and the mothers group separately.

Table 3: Couples' profiles, 1991 Census

	% of CHILDLESS women who...	**% of MOTHERS who were…**
Age gap between partners 1991		
whose partner was more than 5 years younger	4.8	2.7
whose partner was between 6 and 10 years older	16.6	12
whose partner was more than 10 years older	10.8	4.3

(Table 3 cont'd)

Living arrangements 1991		
were in their first marriage and whose partner was in a first marriage, too	52.6	73.9
were in their first marriage and whose partner was re-married	12.8	7.4
were single and cohabiting with a single partner	10.9	2.8
were single and cohabiting with a divorced partner	5.7	1.2
Social class 1991		
were in a higher social class than their partner	39.0	34.1
were in the same social class as their partner	30.5	25.2
were in a lower social class than their partner	30.6	40.8
Education 1991		
were more educated than their partner	12.8	8.1

Base: 9,786 women, of which 1,101 childless and 8,675 mothers
Difference between childless women and mothers statistically significant at the 0.05 level for each variable's category.

Results

Women's model

Table 4 presents the result of the logistic regression modelling of childlessness using women's individual characteristics only in the explanatory part of the equation.

Table 4: Logistic regression model for probability of lifetime childlessness, all women

Variable	Beta coefficient	Standard error.	Odds ratio
Living arrangements 1981. Baseline: married (first marriage)			
Single (never married)	0.88***	0.07	2.42
Single (never married) but living with a partner	0.38*	0.16	1.46
Re-married	0.44	0.32	1.55
Divorced, widowed	0.04	0.23	1.04
Living arrangements 1991. Baseline: married (first marriage)			
Single (never married)	1.25***	0.11	3.49
Single (never married) but living with a partner	0.80***	0.12	2.23
Re-married	0.17	0.15	1.19
Divorced, widowed	0.52***	0.11	1.69

Variable	Beta coefficient	Standard error.	Odds ratio
Living arrangements 2001. Baseline: married (first marriage)			
Single (never married)	1.61***	0.12	5.00
Single (never married) but living with a partner	0.60***	0.14	1.81
Re-married	0.26*	0.12	1.30
Divorced, widowed	0.29***	0.09	1.33
Economic activity 1991. Baseline: Economically Inactive			
Unemployed	1.71***	0.16	5.52
Self-employed	1.22***	0.17	3.37
Employed	1.72***	0.10	5.58
Economic Activity 2001. Baseline: Economically Inactive			
Unemployed	0.69***	0.20	1.99
Self-employed	0.40***	0.14	1.49
Employed	0.55***	0.09	1.73
Social Class 1991. Baseline - Unskilled			
I - Professional	1.38***	0.25	3.97
II - Intermediate	1.32***	0.19	3.75
IIIN – Skilled Non Manual	1.15***	0.18	3.16
IIIM – Skilled Manual	1.18***	0.21	3.25
IV – Partly Skilled	0.61***	0.20	1.84
Other	0.76***	0.22	2.13
Ethnicity 2001. Baseline: White			
Mixed	0.06	0.40	1.07
Asian	-0.63	0.41	0.53
Black	-1.81***	0.35	0.16
Chinese	0.37	0.95	1.45
Has a Limiting Long Term Illness 1991	1.46***	0.13	4.31
Has a Limiting Long Term Illness 2001	0.55***	0.09	1.74
Does not have siblings 1971	0.33***	0.08	1.40
Constant	-5.78***	0.22	0.00

* Significant at the 0.05 level
*** Significant at the 0.01 level
Base: 12,578 women, of which 2,194 childless and 10,384 mothers
Source: ONS Longitudinal Study, Authors' analysis

As expected, living arrangements were strongly associated with childlessness. Women who were single, in the sense of never married, were consistently more likely to be lifetime childless, even when cohabiting with a partner. Also women who experienced the dissolution of their marriage were less likely to become mothers, even if re-married. The widows group, which accounted for a maximum of one per cent of the sample at any time point, was combined with the divorced group as they showed similar patterns of childlessness.

Living arrangements at different ages had a different association with lifetime childlessness. Women who were cohabiting with a partner in their early thirties were more likely to be childless than those who were cohabiting at any other age.

Participation in the labour market was also associated with childlessness. The odds of being childless for women who were employed in 1991 were 5.6 times those of women who were economically inactive. Also, women who were self-employed and unemployed at that time were more likely to be childless at the end of their childbearing years. Economic activity status in 2001 presented a similar pattern of association with childlessness, although weaker. The higher coefficients observed in 1991 as compared to 2001 could have been a reflection of mothers returning to work after childbearing and childrearing.

The model also presented a social class gradient, showing how the odds of childlessness for women from higher social classes were up to four times those of women from lower social classes. Social class in 1981 and 2001 were excluded from the model because of multicollinearity issues. The three social class variables were in fact highly correlated as the majority of the women in the sample experienced only limited social class mobility over time.

A relationship between health and childlessness was also confirmed, with childless women relatively more likely to have a limiting long term illness. This association was particularly strong for 1991, when the sample was in their early thirties, the middle of their reproductive time span.

Once social class was taken into account, most of the ethnic differences in fertility outcomes disappeared. Black women were the only ethnic minority to appear significantly less likely to be childless when compared to the White reference group.

The relationship between family background and whether or not a woman was childless, indicated in Table 3, was reduced to some extent after controlling for other variables. Although not having siblings still appeared to increase the likelihood of being childless later in life, the association between family-of-origin's social class and childlessness disappeared.

Women with a partner model

Table 5 presents the result of the logistic regression modelling of childlessness for women who were in a cohabiting partnership in 1991. In this model we included a number of partner's characteristics in addition to the women's individual characteristics identified in Table 4.

Table 5: Logistic regression model for probability of lifetime childlessness, women with a partner in 1991

Variable	Beta coefficient	Standard error	Odds ratio
Partner variables			
Age gap between partners 1991 Baseline: Woman's partner between one year younger and 1 year older			
Woman's partner more than 5 years younger	0.43*	0.19	1.54
Woman's partner between 5 and 2 years younger	0.10	0.12	1.10
Woman's partner between 2 and 5 years older	0.16	0.09	1.17
Woman's partner between 6 and 10 years older	0.52***	0.12	1.69
Woman's partner more than 10 years older	0.86***	0.15	2.35

(Table 5 cont'd)

Living arrangements 1991			
Baseline: LS member and partner in their first marriage			
LS member married (first marriage), partner re-married	0.40***	0.12	1.49
LS member single (never married), partner single (never married)	0.82***	0.17	2.28
LS member single (never married), partner divorced/widower	1.03***	0.20	2.80
LS member remarried, partner married (first marriage)	0.23	0.20	1.26
LS member remarried, partner remarried	0.38	0.20	1.46
LS member divorced/widow, partner single (never married)	0.62*	0.26	1.86
LS member divorced/widow, partner divorced/widower	0.53*	0.23	1.70
Women variables			
Living arrangements 1981			
Baseline: Married (first marriage)			
Single (never married)	0.81***	0.08	2.24
Single (never married) but living with a partner	0.41*	0.19	1.51
Re-married	0.60	0.33	1.81
Divorced, widowed	0.00	0.30	1.00
Living arrangements 2001			
Baseline: Married (first marriage)			
Single (never married)	1.02***	0.28	2.76
Single (never married) but living with a partner	0.55*	0.21	1.73
Re-married	0.05	0.15	1.05
Divorced, widowed	0.16	0.10	1.17
Economic activity 1991			
Baseline: Economically Inactive			
Unemployed	1.25***	0.24	3.50
Self-employed	0.96***	0.20	2.60
Employed	1.57***	0.12	4.82
Economic activity 2001			
Baseline: Economically Inactive			
Unemployed	0.35	0.28	1.42
Self-employed	0.19	0.17	1.20
Employed	0.31***	0.11	1.36

(Table 5 cont'd)

Social Class 1991			
Baseline - Unskilled			

I - Professional	1.63***	0.32	5.08
II - Intermediate	1.43***	0.26	4.17
IIIN – Skilled Non Manual	1.27***	0.25	3.57
IIIM – Skilled Manual	1.22***	0.29	3.39
IV – Partly Skilled	0.70***	0.27	2.02
Other	0.83***	0.31	2.29
Has a Limiting Long Term Illness 1991	1.20***	0.17	3.31
Has a Limiting Long Term Illness 2001	0.56***	0.12	1.75
Does not have siblings 1971	0.20*	0.10	1.22
Constant	-5.72***	0.30	0.00

* Significant at the 0.05 level

*** Significant at the 0.01 level

Base: 9,786 women, of which 1,101 childless and 8,675 mothers

Women in couples who were not in a first marriage were more likely to be childless. The odds were particularly high for those couples where at least one partner was single (never married), with the highest likelihood of childlessness recorded for those single women living with a divorced or widowed partner followed by couples where both partners were single.

Wide age gaps between the women and their partners appeared to be associated with childlessness. Women who had a partner more than five years older than themselves were more likely to be childless. Among women with partners over 10 years older, the odds of being childless were more than twice that for women who had a partner of the same age. A smaller, although still significant, coefficient was also found when women were more than five years older than their partner.

Although the analysis presented in Table 3 suggested childlessness to be related to differentials in educational levels between partners, this result was not confirmed in the multivariate analysis. Similarly, partner's social class did not appear to have a statistically significant association with women's fertility outcomes. These results may be explained by the presence of social class and/or educational differentials in partnership formation and dissolution, but this hypothesis was not explored in our data.

Discussion

The univariate and multivariate logistic regression models showed how the lack of a partner still appears one of the main factors associated with childlessness. Unsurprisingly, women who were single at any Census were the most likely to be lifelong childless while married women were least likely to be lifelong childless. However, our analysis also showed that the majority of women who were lifelong childless still lived with a partner, either being married or cohabiting, at some point in time during the course of the study. We also found that women who were cohabiting at any Census were less likely than their married counterparts to be mothers and that the timing of a cohabitation was associated with a woman's lifelong fertility outcomes.

Women cohabiting in their early-mid thirties appeared more likely to be childless than women cohabiting at any other age. This could be explained by considering that women may have been in different types of cohabitation at different stages of their lives. For example, younger women may have been more likely to be in a pre-marital cohabitation, while post-divorce cohabitations may have been more common among older women. As Casper and Sayer (2000) suggested, cohabitating relationships are not homogenous in terms of their purposes, goals and meanings. We could argue that childbearing is likely to be more central for some types of cohabitations than for others.

Irrespective of their partnership status, women's own socio-economic characteristics were significantly associated with childlessness. For example, women who were economically inactive in their early-mid thirties and/or in their early-mid forties were more likely to be childless at the end of

their childbearing years. This was an expected result, considering that during childbearing and childrearing years, women's participation in the labour market tends to decrease. For example, in 2003, 68% of women with dependent children were in the labour market compared to 76% of those without children (ONS, 2004).

We found strong evidence of association between women's social class, as measured in 1991, and their lifelong fertility outcomes. Our findings confirmed Hakim's (2005) hypothesis that childless women have a slightly higher social and economic status, on average, as compared to the parents group. This was also reflected in the housing characteristics of the two groups. In additional analysis not reported here, we found that in 2001, 20% of childless women owned their accommodation outright compared to only 11.6% of mothers. The latter were also more likely to rent their homes from local authorities and housing associations (Portanti and Whitworth, 2009).

Childlessness also appeared to be more often associated with presence of a limiting long term illness (LLTI), which we used as a proxy for the health status of respondents. This relationship was present both for the 1991 and the 2001 LLTI variables[ix], thus suggesting that on average childless women were in poorer health throughout their adulthood.

Women's ethnicity appeared to have only a very limited association with fertility outcomes. It should be noted however that only 3% of the women in our sample belonged to a "non-white" ethnic group[x]. These small sample sizes limited the power of the the statistical analysis on the relationship between ethnicity and childbearing outcomes.

Where applicable, lifelong childlessness appeared associated to the characteristics of the partner a woman had when in her mid-thirties, including age and marital status. Childless women were more often in "non-traditional" partnerships, i.e. in non-first marriage relationships. Childless women were particularly more likely than mothers to have been single and cohabiting with a partner who had been married, and had then divorced or become a widower. In some of these relationships, the woman may have acted as a mother to children born in the partner's previous relationship. Childbearing may have played a less central role in these partnerships. However, our analysis could not confirm this hypothesis.

More lifelong childless women than mothers were in a relationship in which there was a wider age gap between partners. This finding confirmed previous qualitative research that suggested that in the childless group, women tend more often to have older partners, sometimes up to 10 years older (McAllister and Clarke, 1998).

Some authors have suggested that childlessness is more common amongst couples who have very similar educational and occupational levels, and thus there is little or no differentiation of roles, interests and activities within their relationship (Hakim, 2003). Therefore, we were expecting to find evidence of a higher presence of educational and/or occupational homogamy within childless women's couples. However, we found no statistically significant evidence to confirm this hypothesis. It should be noted that our analysis of educational homogamy was limited by the little detail on educational qualifications collected at the time of the 1991 Census[xi]. The education variable that we used only made a distinction between three levels of education: individuals with a (higher) degree; individuals with some qualification attained after the age of 18 but lower than a degree; and people without any educational qualification attained after the age of 18.

Finally, childless women appeared not to have had any sibling in their childhood more often than was the case with those with children. This association was also reported by Kiernan (1989). Further quantitative and qualitative research is required to understand how childhood family's composition impacts on family choices later in adulthood.

Conclusions

Lifelong childless is a growing phenomenon in the UK, with a significant proportion of women in the UK remaining childless throughout their lives. This paper has investigated the extent to which women's lifelong childlessness is associated with their own socio-economic characteristics and, where applicable, to the socio-economic characteristics of their partners.

As the LS is a large-scale nationally representative sample of women and their partners resident in England and Wales, we have been able to test some of the hypotheses that have been suggested elsewhere in the literature on a larger sample than had previously been possible. For

example, as partnership rates are lower in the childless group, other studies have been limited by small sample sizes when analysing women's partners (Hakim, 2005). The longitudinal nature of the LS has also allowed us to analyse women's socio-economic characteristics at different points in time, including early lifecourse variables. While previous research has found mixed evidence on this topic, using the LS we have been able to produce robust statistical results showing the extent to which women's childlessness is associated with some of their own and their partners' socio-economic characteristics. This has helped to gain an understanding of how distinctive childless women are in England and Wales in terms of their own and their partners' socio-economic characteristics.

The analysis and results presented here do not explain all variation in fertility outcomes between women. Compared to survey-based datasources, the range of variables available for analysis in the LS is limited to the variables collected at Census and at registration. In particular, our data did not cover intentions, opinions, attitudes and values. These are likely to play an important role in explaining why some women remained childless, as other researchers have suggested (for example, Fisher, 1991; Lisle, 1996; McAllister and Clarke, 1998).

Despite these limitations, this analysis still demonstrates the value of using the LS, alongside other established datasources such as the BCS, in future studies of childlessness. The LS is representative of all birth cohorts, thus allowing for more detailed analysis of changes in fertility behaviours over time. Although our analysis concentrated only on the 1956-60 birth cohort, it can be naturally extended to younger cohorts when the data becomes available in the study. Indeed, it will be interesting to investigate whether the observed socio-economic differentials in childlessness remain similar for more recently born cohorts.

Acknowledgments

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Endnotes

[i] "The Total Fertility Rate (TFR) is the average number of children that a group of women would have if they experienced the age specific fertility rates for a particular year throughout their lives" (Jefferies, 2008, 21)

[ii] These countries were as follows: Austria, England and Wales, France, West Germany, the Netherlands, Finland, Norway, Sweden, Italy, Spain, Czech Republic, Estonia, Hungary, Poland, Romania and Slovak Republic.

[iii] These countries were as follows: Norway, Sweden, Finland, Belgium, France, Germany, Austria, Switzerland, Italy, Portugal, Spain, Latvia, Lithuania, Poland, Hungary, Czech Republic, Slovenia, Bulgaria, Canada, the USA and New Zealand.

[iv] A detailed description of the LS is offered in the next section of the paper.

[v] Involuntary childlessness mainly refers to those individual who experience fertility problems. The United Nations World Fertility Survey reported that between 2 and 3% of women aged 25-50 are infertile (Vaessen 1984).

[vi] It should be noted, however, that the usefulness of fertility intentions as fertility predictors has been questioned (Berrington, 2004).

[vii] England and Wales statistics are derived from ONS published figures of average first births per woman estimated using the true birth order process. See FM1 Birth Statistics, table 10.3 and section 2.9.

[viii] Both LS and England and Wales figures refer to births up to December 2005. Women who have not had any live or stillbirth are classified as childless in the LS, while England and Wales figures take into account only live births. England and Wales figures are rounded whereas figures from the LS are not rounded.

[ix] In 1981, a question on health was not included in the Census.

[x] The sample excluded purposively all immigrants in the UK, unless they immigrated during childhood. See Data and Methods section.

[xi] The 1991 Census only asked respondents to list their qualifications attained after the age of 18. Any qualification attained before that age (e.g. GCSE or A-levels equivalent) would not be listed.

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Statistical modelling of repeated measurement data

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Abstract

This tutorial describes ways of modelling repeated measurements taken on a sample of individuals. It gives a brief historical introduction and then describes how a 2-level formulation provides a flexible and straightforward approach.

Keywords

Growth curves, multilevel model, multivariate analysis of variance, repeated measures models, smoothing models

1. Introduction

The fitting of statistical models to sequential or repeated measurements over time on the same individuals, has a long history. Early interest centred on characterising the growth period of individuals, children and animals, and a discussion can be found in Tanner (1979). These were attempts to fit smoothly varying curves to the growth period, and by the 1930s had spawned a large literature that included complex non-linear models with several parameters that many investigators claimed could be associated with 'biologically meaningful' characteristics (see Goldstein, 1979 for a discussion). These procedures carried out separate fitting for each individual's set of measurements. Subsequent developments generalised these models to consider samples of individuals where terms or 'parameters' are included in order to account for the between-individual variability in growth patterns. In the case of non-linear models the work of Bock (1989) is notable.

The main feature that distinguishes approaches to the fitting of models to repeated measurements is the actual structure of the repeated measures. If observations are planned to occur at the same occasions for all individuals the data are said to be *balanced*. By contrast, if observations occur at irregular time points they are *unbalanced*. The first setting gives rise not only to equal numbers of observations on each individual, but also to a choice of modelling approaches because the data can be viewed as arising either from correlated observations of a single response or 'dependent' variable, or from multivariate outcomes (each outcome associated with one observation time). With unbalanced data only the first approach is generally possible.

In this tutorial we shall give an overview of the more commonly used methods to model repeated measurement data, distinguishing between these two main settings. We shall also touch upon the issue of missing (incomplete) data. We illustrate the various approaches by fitting alternative models to some growth data collected in the `Oxford Boys Study' [Goldstein et al., 1994].

2. Analyses based on balanced data

We set out some basic statistical models for repeated measurement data starting with the balanced case. Our response variable is denoted by $\boldsymbol{Y}$ and the *i*-th response for the *j*-th individual in a sample is denoted by y_{ij}. Suppose that there are *p*

measurement occasions at times t_1, t_2, …, t_p, for each individual *j, j=1, …,N,* and we have complete balanced data. To fix ideas with an example we shall consider the case of 3 occasions, with obvious generalisations, so that the data will look like those in Table 1.

Table 1. Balanced data example with p=3 repeated observations taken at fixed occasion times

Time / Individual	Occasion 1 t_1	Occasion 2 t_2	Occasion 3 t_3
1	y_{11}	y_{21}	y_{31}
2	y_{12}	y_{22}	y_{32}
….	….	….	….
j	y_{1j}	y_{2j}	y_{3j}
….	….	….	….
N	y_{1n}	y_{2n}	y_{3n}

Data missingness, i.e. settings where some of the cells in this table are empty, will be discussed later.

2.1 Multivariate model formulation

Multivariate analysis of variance models for repeated measures, especially those associated with the work of Rao (1965), are summarised in Grizzle and Allen (1969). In brief, a general model is formulated as follows. We write

$$
\begin{aligned}
y_{1j} &= \beta_0 + \beta_1 t_1 + e_{1j} \\
y_{2j} &= \beta_0 + \beta_1 t_2 + e_{2j} \\
y_{3j} &= \beta_0 + \beta_1 t_3 + e_{3j} \\
\begin{pmatrix} e_{1j} \\ e_{2j} \\ e_{3j} \end{pmatrix} &\sim MVN(0, \Omega), \quad \Omega = \begin{pmatrix} \sigma^2_{e1} & & \\ \sigma_{e12} & \sigma^2_{e2} & \\ \sigma_{e13} & \sigma_{e23} & \sigma^2_{e3} \end{pmatrix}
\end{aligned}
\qquad (1)
$$

In other words the three measurements on *y* are assumed to have a multivariate normal (*MVN*) distribution, in this case a 3-variate distribution. Model (1) is therefore simply a multivariate analysis of variance with a single covariate *t* and thus assumes linear growth. Clearly this can be generalised to include higher order polynomial terms and other covariates measured on individuals such as gender or birthweight and even time varying covariates. The innovations introduced in the 1960s involved considering particular structures for Ω. Thus, Rao (1965) considers a structure where each individual has his/her specific coefficients and these coefficients vary across

individuals, with independent residuals having a common variance. This gives the structure

$$\Omega = T\Omega_u T^T + \sigma_e^2 I \qquad (2)$$

where ***I*** is the identity matrix and

$$T = \begin{pmatrix} 1 & t_1 \\ 1 & t_2 \\ 1 & t_3 \end{pmatrix} \qquad \Omega_u = \begin{pmatrix} \sigma^2_{u0} & \\ \sigma_{u01} & \sigma^2_{u1} \end{pmatrix} \qquad (3)$$

This specification of the variance matrix Ω leads to separating two components of variation: the first, $T\Omega_u T^T$ captures how growth trajectories vary across individuals via the definition of Ω_u, and the second captures the within individual 'noise' via the residual variance σ^2_e. Note also that the first component varies quadratically with time. We shall have more to say about this structure when we discuss the multilevel model formulation.

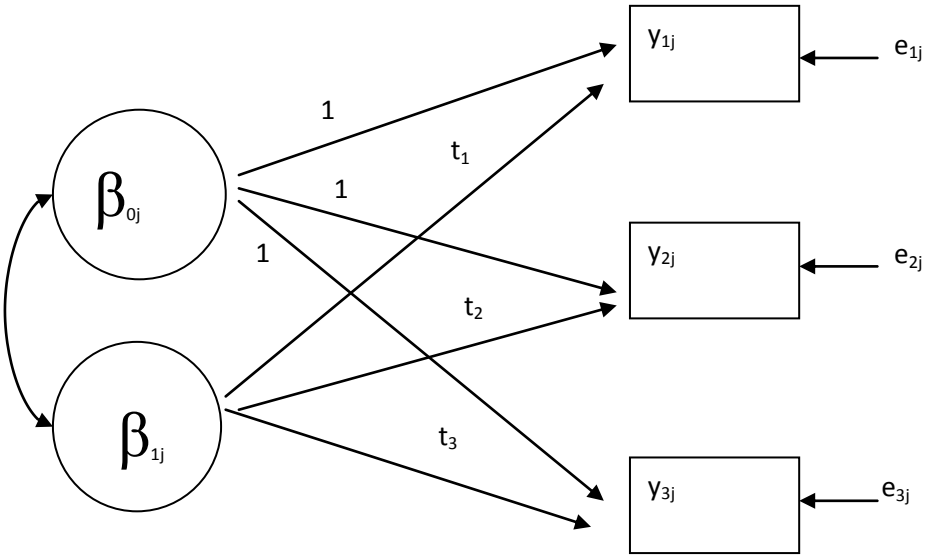
2.2 Latent variables formulation

Model (1) can also be written as

$$\begin{pmatrix} y_{1j} \\ y_{2j} \\ y_{3j} \end{pmatrix} = \begin{pmatrix} 1 & t_1 \\ 1 & t_2 \\ 1 & t_3 \end{pmatrix} \begin{pmatrix} \beta_{1j} \\ \beta_{2j} \end{pmatrix} + \begin{pmatrix} e_{1j} \\ e_{2j} \\ e_{3j} \end{pmatrix} = \mathrm{T}^{\mathrm{T}}\ \beta + \mathrm{e}, \quad \begin{pmatrix} y_{1j} \\ y_{2j} \\ y_{3j} \end{pmatrix} \sim MVN\ (T^T\beta, \Omega\ ), \quad \Omega = T\Omega_u T^T + \Omega_e \qquad (4)$$

We have now introduced the subject specific intercept β_{1j} and slope β_{2j} which are treated as latent variables with known regression coefficients (as defined by the matrix T) and variance covariance matrix Ω_u while the errors e_{ij} have variance covariance matrix Ω_e. A flexibility allowed by this model is that Ω_e is not forced to have identical variances at each occasion, i.e. we can allow $\Omega_e \neq \sigma^2_e \boldsymbol{I}$. The model is often represented using a path diagram as shown in Figure 1, which applies to the example with repeated observations at three fixed times. As usual in this field, latent variables are represented by circles and observed (`manifest') variables by rectangles. Arrows indicate the direction of assumed association. Note that the regression coefficients (in this literature termed `*factor loadings*') are fixed in the matrix T. The covariance between the two latent variables (represented by a double arrow joining the two variables) corresponds to σ_{u01} in the covariance matrix of equation (3).

Figure 1 - **Path analytical representation for the latent variables formulation**



2.3 Analyses based on unbalanced data

As before, denote the *i*-th measurement for the *j*-th individual by y_{ij}. Suppose that there are p_j measurement occasions for the *j*-th individual. To fix ideas with an example we shall consider the case depicted in Table 2. Here individuals are observed at different time points and have different total numbers of observations. Such a data structure could be viewed as a balanced one which is affected by missingness, i.e. where potentially everybody is observed at all listed time points t_{ij}, for all individuals *j*=1, …,*N*. Note, however, that this is still not fully general, since we are assuming a fixed number of discrete time points. In the next section, and in our example, we shall allow the time points (or ages) to occur anywhere.

.Table 2. Unbalanced data example with varying number of observations per individuals pj out of a maximum of 5 possible time points

		Occasion					
Individual	**Variable**	**1**	**2**	**3**	**4**	**5**	**pj**
1	**Time**	t_{11}	t_{21}	-	-	-	-
	Y	y_{11}	y_{21}	-	-	-	**2**
2	**Time**	t_{12}	t_{22}	-	t_{42}	-	-
	Y	y_{12}	y_{22}	-	y_{42}	-	**3**
…	**…**	**…**	**…**	**…**	**…**	**…**	**…**
	…	**…**	**…**	**…**	**…**	**…**	**…**
j	**Time**	t_{1j}	t_{2j}	t_{3j}	-	t_{5j}	
	Y	y_{1j}	y_{2j}	y_{3j}	-	y_{5j}	**4**
…	**…**	**….**	**….**	**….**	**…**		

For such unbalanced designs, assuming that the data are 'missing' at random, modifications to the standard multivariate or latent variable analyses are available (Muthen, 1997)

3. The multilevel model for repeated measures

The seminal paper that introduces the modern approach to fitting repeated measures data is that of Laird and Ware (1982). In essence their model - often referred to as a linear mixed or random coefficient model - can be written, analogously to (1) – (3) as

$$
\begin{aligned}
y_{1j} &= \beta_{0j} + \beta_{1j}t_{1j} + e_{1j} \\
y_{2j} &= \beta_{0j} + \beta_{1j}t_{2j} + e_{2j} \\
y_{3j} &= \beta_{0j} + \beta_{1j}t_{3j} + e_{3j} \\
\beta_{0j} &= \beta_0 + u_{0j} \\
\beta_{1j} &= \beta_1 + u_{1j} \\
\begin{pmatrix} u_{0j} \\ u_{1j} \end{pmatrix} &\sim MVN(0,\Omega_u), \quad \Omega_u = \begin{pmatrix} \sigma^2_{u0} & \\ \sigma_{u01} & \sigma^2_{u1} \end{pmatrix} \\
\begin{pmatrix} e_{1j} \\ e_{2j} \\ e_{3j} \end{pmatrix} &\sim MVN(0,\Omega_e), \quad \Omega_e = \sigma^2_e I = \begin{pmatrix} \sigma^2_e & & \\ 0 & \sigma^2_e & \\ 0 & 0 & \sigma^2_e \end{pmatrix}
\end{aligned}
\qquad (5)
$$

The essential difference between the earlier specification and (5) is that in (5) the time points are allowed to be quite general, that is to differ across individuals so that individuals need not have the same number or spacing of time points. This flexibility is available because (5) is essentially a univariate model where the response is directly modelled as a function of time. It is in fact a 2-level model and thus a special case of a general multilevel model (see Goldstein, 2003). As before extensions include higher order polynomial terms for *t* and other explanatory variables.

3.1 Semi-parametric modelling

Alternative approaches to parametric modelling of repeated measurement data, using the multilevel formulation, involve fitting smoothing or regression splines. Often, the results generally are best presented graphically, although features of the fitted growth curves at chosen ages can be derived numerically. We now show how these can be fitted, concentrating on the regression spline model.

3.2 Smoothing splines

Smoothing splines are non-parametric functions of the outcome variable, *Y*, on time, T, that are selected according to a 'roughness penalty'. As before, let y_{ij} be the *i*-th measurement for the *j*-th individual taken at time t_{ij}. A simple example of a smoothing spline would be a running mean based on a moving window (of size *h*) which is placed symmetrically around each data point, t_{ij}. The estimate of the outcome specific to the point at the centre of the window is then calculated as the mean of the outcome values belonging to that window or as the prediction from a least squares model fitted to those data points.

More general approaches produce predictions based on weighted functions, called *kernels*, across the whole range of data, with points closer to the centre of the kernel given the greatest influence. Changes in the chosen kernel function will lead to changes in the fit to the observed data. However, any improvement in fit may lead to a very jagged shape so that roughness penalties that provide a compromise between fit and smoothness, are used to guide the selection of kernel function. This leads to penalized least squares estimators and automatic selection procedures such as cross-validation [Green and Silverman, 1993], and these procedures can be fitted within the framework of a multilevel or random coefficient model; see for example Wang (1998). In the next section we describe a flexible system that is easily embedded within a multilevel framework.

3.3 Regression splines

The simplest example of a regression spline is a piecewise linear model where simple linear regression models are fitted within consecutive intervals, defined by so-called *knots*, with the lines joining at the knots. More general models include quadratic and cubic splines, with the latter being most commonly used [Pan and Goldstein, 1998]. In such cases the joins can be made 'smooth' in the sense defined below. The main problem with this approach is the selection of the number and location of the knots to be used.

A simple piecewise quadratic version of this model, with a single knot at time t_0, can be written as follows:

$$y_i = \beta_0 + \beta_1 t_i + \beta_2 t_i^2 + \beta_3 (t_i - t_0)_+^2 + e_i$$
$$e_i \sim N(0, \sigma_e^2) \qquad (6)$$
$$(t_i - t_0)_+ = \begin{cases} (t_i - t_0) & t_i \geq t_0 \\ 0 & t_i < t_0 \end{cases}$$

where the term $(t_i\text{-}t_0)_+$ is 'grafted' onto the existing polynomial. In (6) for simplicity we have dropped the suffix *j*. This function has continuous first derivatives and therefore will be smooth at the location of the knot. Thus, at time t_0 the predicted value is $\beta_0 + \beta_1 t_0 + \beta_2 t_0^2$ and the first derivative, the rate of change with time, is $t_1 + 2\beta_2 t_0$.

Thus, at a very small later time $x = t_0 + \Delta$ the predicted value is $\beta_0 + \beta_1 x + \beta_2 x^2 + \beta_3 \Delta^2$, that is a point very slightly perturbed away from the quadratic curve defined at time t_0 .

A direct generalization of this model to a multilevel structure with intercept and slope terms varying across individuals can be written as:

$$
\begin{aligned}
&y_{ij} = \beta_{0j} + \beta_{1j} t_{ij} + \beta_2 t_{ij}^2 + \beta_3 (t_{ij} - t_0)_+^2 + e_{ij} \\
&\beta_{0j} = \beta_0 + u_{0j} \\
&\beta_{1j} = \beta_1 + u_{1j} \\
&\begin{pmatrix} u_{0j} \\ u_{1j} \end{pmatrix} \sim MVN(0, \Omega_u), \quad \Omega_u = \begin{pmatrix} \sigma_{u0}^2 & \\ \sigma_{u01} & \sigma_{u1}^2 \end{pmatrix} \\
&e_{ij} \sim N(0, \sigma_e^2) \\
&(t_{ij} - t_0)_+ = \begin{cases} (t_{ij} - t_0) & t_{ij} \geq t_0 \\ 0 & t_{ij} < t_0 \end{cases}
\end{aligned}
\qquad (7)
$$

This is just a 2-level model with an additional quadratic term smoothly 'grafted' onto the average quadratic relationship at time t_0, and with each individual having a subject-specific intercept β_0 and subject-specific slope for time β_1. For simplicity here the quadratic coefficients β_2 and β_3 are assumed not to vary across individuals, but either or both could be made random.

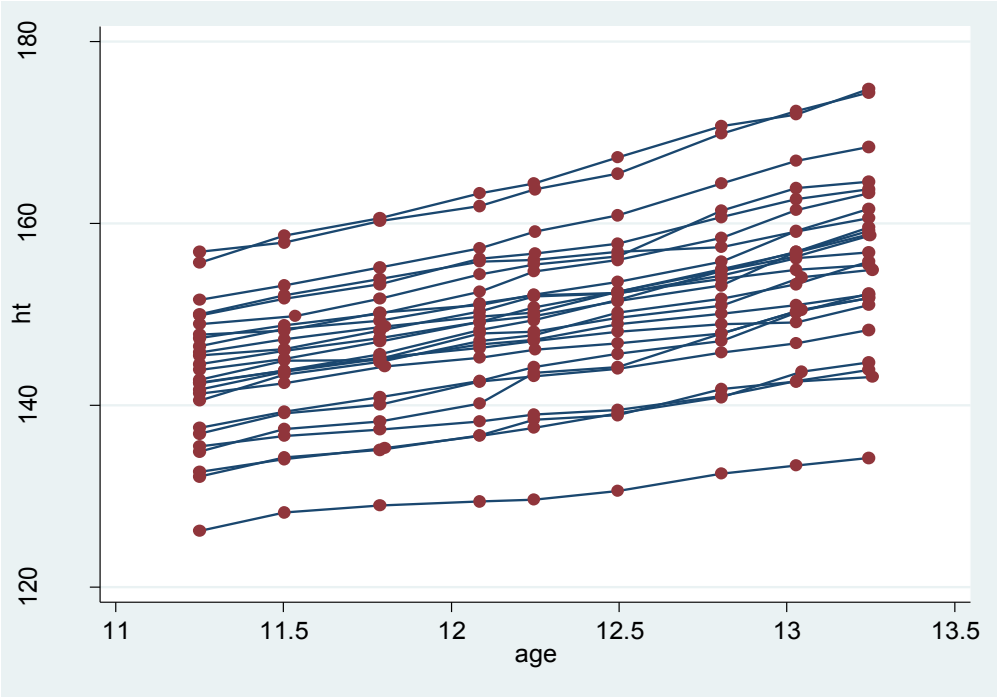
4. Estimation and software

For continuous normal response measurements these models are readily fitted using maximum likelihood (ML). With balanced data, this gives unbiased estimates of β although, especially where there are relatively small numbers of individuals, somewhat biased estimates of the parameters in Ω. In such cases we can use restricted maximum likelihood estimation (REML) which gives unbiased estimates of all the parameters (see for example, Rabe-Hesketh and Skrondal, 2008). REML estimation in its simplest form is the familiar use of the divisor *n-1* for a variance rather than *n* which is the maximum likelihood estimator. Multivariate models can be fitted using SAS, Stata, SPSS and specialised software such as Mplus and MLwiN. All but MPlus allow a general 2-level model to be fitted with both ML and REML estimation.

5. Example: The Oxford boys data

The dataset consists of repeated measures of the height of 26 boys taken on 9 occasions each over a 2 year spell from a residential school in Oxfordshire, England. (Available as an EXCEL spreadsheet through the 'Reading Tools' link on the right of the screen when this paper is viewed). The boys were just over 11 years of age at entry. The age scale in the following models is centred at 12.25 years. Figure 2 shows their observed growth profiles and highlights the regularity of their observed time points, with only a few exceptions. There is clearly a ranking in height at entry that is generally maintained over the full observation period.

Figure 2. Observed growth profiles



The boys seem to increase their rate of growth with time, from around a mean of 6 cm/year between about age 11 and 12 years to nearly 9 cm/years shown in Table 3. The standard deviation of growth also seems to increase with time.

Table 3 – Mean and standard deviation (SD) of the yearly rate of increase (*cm/year*) between successive visits by age interval – Oxford Boys Study

Age interval (years)	*Mean*	*SD*
11 ¼ to 11 ½	6.53	2.53
11 ½ to 11 ¾	5.05	1.91
11 ¾ to 12	6.21	1.28
12 to 12 ¼	6.77	4.50
12 ¼ to 12 ½	5.31	2.75
12 ½ to 12 ¾	7.26	3.58
12 ¾ to 13	8.95	4.01
13 to 13 ¼	7.23	3.22

The repeated observations are effectively balanced, as every boy was observed 9 times, roughly every 3 months. Note the high correlation among these repeated observations as well as its strengthening when they are closest in time.

Table 4. Observed correlations between height measured at 9 visits - Oxford Boys Study.

		Age at visit (years)								
		11 ¼	11 ½	11 ¾	12	12 ¼	12 ½	12 ¾	13	13 ¼
Age at visit (years)	11 ¼	1.000								
	11 ½	0.996	1.000							
	11 ¾	0.997	0.999	1.000						
	12	0.992	0.996	0.997	1.000					
	12 ¼	0.987	0.991	0.992	0.996	1.000				
	12 ½	0.983	0.989	0.991	0.995	0.997	1.000			
	12 ¾	0.970	0.974	0.977	0.983	0.991	0.993	1.000		
	13	0.962	0.963	0.968	0.975	0.984	0.988	0.995	1.000	
	13 ¼	0.957	0.959	0.964	0.970	0.979	0.986	0.992	0.998	1.000

We can fit model (1) - or equivalently model (4) – to these data by treating the 9 observations as if they were taken at exactly the same set of 3-monthly intervals (which is nearly correct- see Figure 2). We do this by specifying the (9 x 2) matrix T in equation (4) as a column of 1s and a column where the common observation times measured in years t_i , i=1,..9, are: (-1.0, -0.75, -0.50, -0.25, 0.0, 0.25, 0.50, 0.75, 1)

The model is centred at age 12 ¼ years. This choice of values will lead to the intercept term referring to the mid observation. The results are shown in Table 5 where we fit both a linear model and one that includes a quadratic term in the fixed part of the model that describes average growth. With the first specification we estimate that the random intercept β_0 has mean 149.5 cm and variance 63.2 cm^2 while the linear slope β_1 has mean 6.5 cm/year and variance 2.7 $(cm/year)^2$. The random intercept and random slope have covariance 8.41 and a corresponding correlation of 0.64. Comparisons of log likelihood values indicate that specification 2 with a quadratic term gives a better fit to the data (deviance=21.7 to be judged according to a chi-squared distribution with 1 degree of freedom, p<0.001).

Table 5 – Alternative specifications of model (4) with 2 latent variables β_0 and β_1: as a linear function of age (specification 1) and as a quadratic function of age (specification 2): ML estimation. Estimates and standard errors (SE).

	Specification 1		*Specification 2*	
	Coef	SE	Coef	SE
Latent variable:				
β_0 (intercept)				
Mean	149.50	1.56	149.30	1.56
Variance	63.16	17.53	63.16	17.53
β_1 (linear effect of age (*yrs, centred*))				
Mean	6.54	0.33	6.54	0.33
Variance	2.72	0.78	2.74	0.79
Fixed effect:				
Age^2 (yrs, centred)	-	-	0.53	0.11
$Cov(\beta_0,\beta_1)$	8.41	3.10	8.41	3.10
Residual variance(s) level 1	0.42	0.05	0.38	0.04
-2 Log likelihood	721.28		699.55	

Exactly the same results as those of table 5 can be obtained using a multilevel approach with the actual times of observations replaced by their planned times, ie 11 ¼, 11 ½ , etc., centred around age 12 ¼ years. The first two columns of table 6 report results in the format usually adopted with multilevel models. Here we also compare the results obtained using ML and REML estimation. Because the sample size is relatively small (26 boys measured 9 times) the estimates of the random part of the model do differ somewhat.

We now fit a multilevel model where we use the exact age at the measurement occasions (third set of columns in Table 6). There are some small differences in estimated values from those obtained using the planned ages due to the fact that there is only slight variation from the target ages of measurement.

Table 6 - Alternative specifications for model (5)

	Multilevel growth model with time defined by:					
	Planned age at visit				Observed age at visit	
	ML		REML		REML	
	Coef	SE	Coef	SE	Coef	SE
Fixed part						
Intercept	149.52	1.56	149.52	1.59	149.37	1.59
Age (yrs, centred)	6.54	0.33	6.54	0.34	6.53	0.34
Random part						
$\sigma^2_{Intercept}$	63.15	17.53	65.68	1.59	65.30	18.49
σ^2_{Age}	2.72	0.79	2.84	0.84	2.83	0.83
$\sigma_{Intercept-Age}$	8.41	3.10	8.75	3.29	8.71	3.27
Residual variance	0.42	0.05	0.42	0.05	0.44	0.05
-2 Log likelihood	721.28		719.40		724.08	

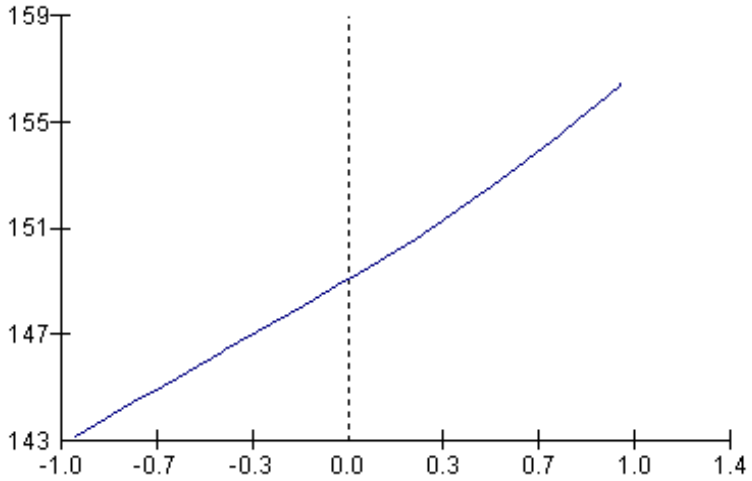
As before, adding a quadratic term to the last model we fitted, we find that it is significant (see first set of columns in Table 7).

We can compare the model with a quadratic term with one obtained using a multilevel quadratic regression spline with a single knot at the centred age of zero (i.e. age 12 ¼ on the original scale), which is an example of model (7). We fit two specifications of this model: the first has both the standard quadratic term in age and the additional term identifying the local departure from the quadratic function after the knot at 0. The second removes the original quadratic term as it was found not to be significant. Figure 3 shows the predicted average growth curve for this final model. The quadratic component only comes in at the mean age of 12 ¼ years: before that the growth is effectively linear. This illustrates the flexibility that we can introduce within the class of models that are based upon polynomials.

Table 7- Alternative specifications of model (5) and model (7) – time defined as the observed age at visit (in years, centred) and REML estimation

	Multilevel model		**Regression spline model**			
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Fixed part						
Intercept	149.06	1.56	149.06	1.59	149.06	1.59
Age (yrs, centred)	6.52	0.33	5.93	0.42	5.89	0.35
Age^2 (yrs, centred)	0.74	0.10	0.05	0.31	-	
$(Age)_+^{\zeta}$	-	-	1.40	0.59	1.49	0.19
Random part						
$\sigma^2_{Intercept}$	62.81	17.43	65.32	18.49	65.32	18.49
σ^2_{Age}	2.74	0.78	2.85	0.83	2.85	0.83
$\sigma_{Intercept-Age}$	8.38	3.09	8.72	3.28	8.72	3.28
Residual variance	0.44	0.05	0.33	0.04	0.33	0.03
-2 Log likelihood	780.20		674.74		674.26	

Figure 3. Predicted average growth curve for quadratic regression spline model with linear growth before 12 ¼ years.



6. Checking assumptions

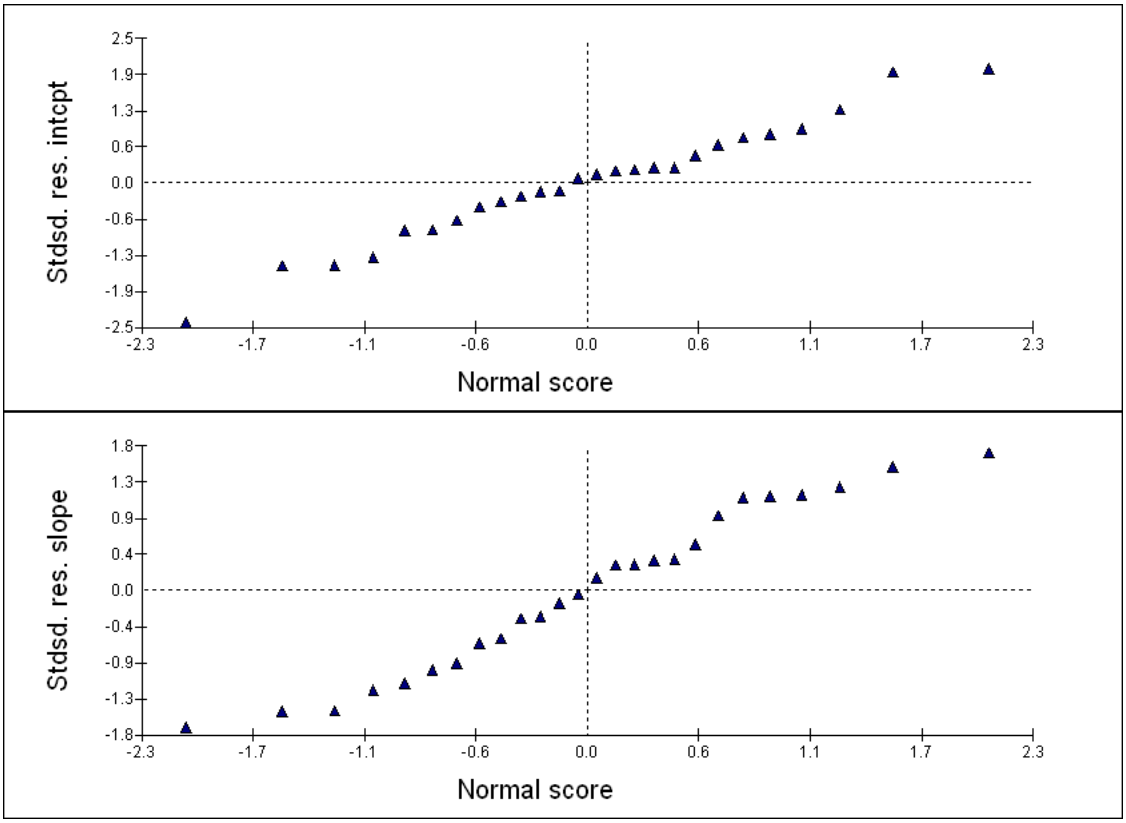
Several diagnostic procedures are available for multilevel models to check the various assumptions made, especially that of normality (See Goldstein, 2003 Chapter 2 for more details). To illustrate, Figure 4 shows normal quantile plots for the level 2 (individual) and level 1 (occasion) estimated standardised residuals. If the assumption of normality for the random effects (residuals) is correct these plots should be approximately linear. At level 2 there is some evidence of departure from normality for the slope estimates, but little evidence at level 1. In particular there are no estimates that appear to be real outliers.

In fact, we can go on and allow the coefficient of the grafted quadratic term to vary randomly over individuals and this does improve the fit. We omit the details but it produces more linear plots at level 2 as shown in Figure 5.

A further assumption that we have made is that the residuals, especially those at level 1 are independent. In some cases, for example when measurements are taken very close together, this may not be the case and we may need to fit, say, a model with autocorrelated level 1 residuals. For a discussion of this case with an example see Goldstein et al., (1994).

Figure 4. Standardised residuals for model in column 3 in Table 7.

Level 2



Level 1

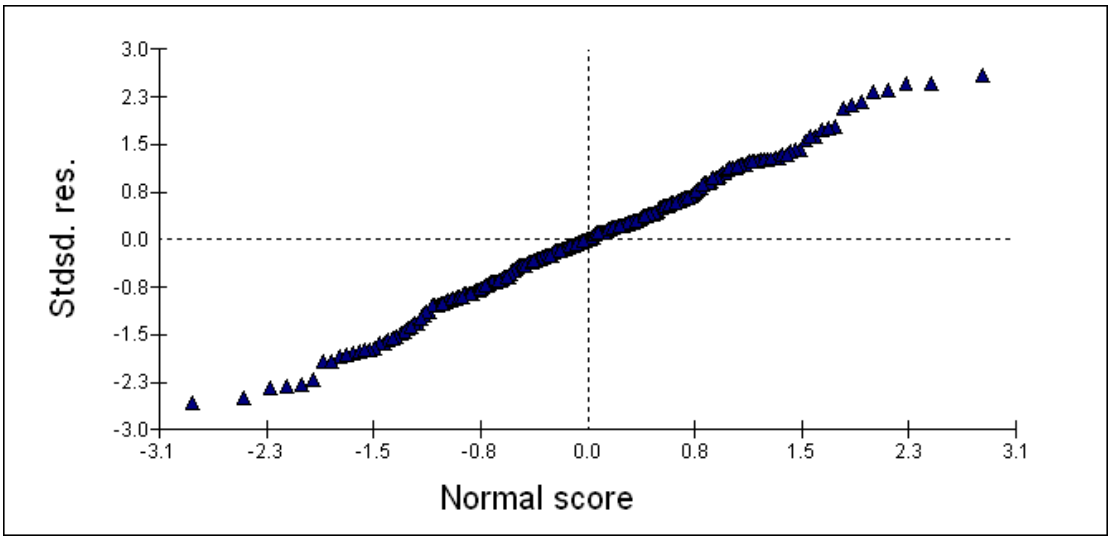
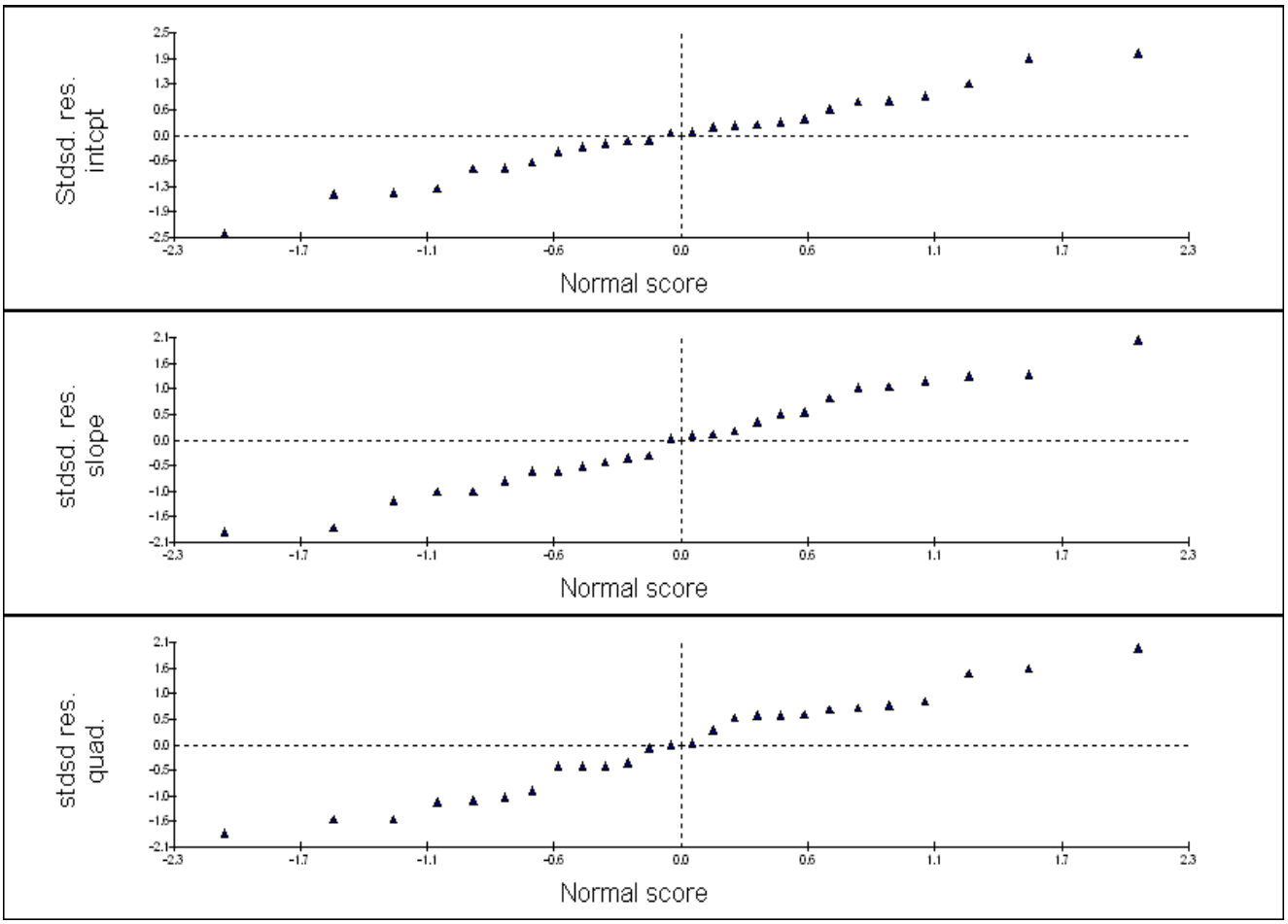


Figure 5. Standardised residuals at level 2 for model in column 3 in Table 7 with additional random effect for grafted quadratic.



7. Conclusions

In this tutorial we have described the fitting of models to repeated measures data using a multilevel model formulation that allows considerable flexibility and is easily generalisable. Our basic model can be extended to incorporate more complex data structures such as further levels of nesting, for example of individuals within schools or neighbourhoods or clinics, and to cross classifications where individuals are simultaneously classified, for example by where they live and where they are educated. We can also add further predictors such as an individuals' gender or ethnic background.

The use of regression splines further extends the usefulness of these models by allowing different degrees of polynomial to define the prediction curve over different time periods.

We have provided some historical background. Prior to the mid 1980s almost all the published analyses used multivariate approaches and these can still sometimes be found in contemporary literature, but are effectively best viewed as special cases of the more general approach using multilevel models. Thus, in the special case where there is a fixed number of discrete occasions the 2-level model becomes equivalent to the multivariate model. It is, however, more general and more flexible, especially since it easily allows further levels of nesting structure. With the ready availability of multilevel software, it can be recommended as the approach of choice for most purposes.

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BOOK REVIEWS

The Craft of Life Course Research

Glen H. Elder, Jr. & Janet Z. Giele (Eds) 2009
New York & London: Guilford Press
372pp
ISBN 978-1-60623-321-4

Elder and Giele have assembled 13 chapters that convey both the excitement and the manifold challenges of life course research. Researchers who have guided exemplary, long-term research programs demonstrate how basic principles of life course analysis are investigated, how questions are reframed in temporal perspective, and how multiple data sources can be used to address them. Moreover, the book provides an invaluable introduction to key life course archives in the United States and Europe, many of which are now publicly available.

Unlike standard methods texts, which typically feature research methods or statistical techniques with only brief substantive examples, this reader illuminates the actual work of the life course researcher from the specification of research questions to data analysis and interpretation. The selections illustrate the issues, dilemmas, and decisions that are usually not part of published journal articles, or even books. They point to the ways in which questions must be formulated when temporal, life course processes are of central interest; how data, often collected for very different purposes, may be recast to answer such questions, and the special challenges of longitudinal data analysis. Its revelation of the many considerations and decisions that generally take place "behind the scenes," often prior to the initiation of a systematic investigation, make this book invaluable for students.

Elder and Giele overview the historical development of the life course paradigm and summarize Elder's basic principles of life course analysis (e.g. historical time and place, social embeddedness, agency, etc.). This first chapter provides a solid introduction for the student who is new to life course studies. The remainder of the book is divided into three sections that roughly parallel the chronology of empirical research.

Hauser begins the first section, on *Methods of Data Collection*, with an informative historical account of the Wisconsin Longitudinal Study, which has followed a 1939 birth cohort from adolescence through the early 70's. He summarizes its early contributions to the understanding of intergenerational mobility and its subsequent extensions to many other questions of interest to life course researchers, most notably, the linkages between life trajectories and health in the latter phases of life. Hauser illuminates the rationales for key design decisions involving additions to the data archive - to include friends and siblings of the cohort as well as DNA. This chapter convincingly demonstrates the value of the Wisconsin data as a resource to examine a multitude of life course questions.

Hogan and Spearin demonstrate the potential of life records by featuring Kertzer and Hogan's fascinating study of the life paths of residents of an Italian town from1861-1921, drawing on census, tax, baptismal, marriage, and migration records. While carefully noting the limitations of life records (e.g. incompleteness, matching difficulties, etc.) and sensitizing the researcher to ethical dilemmas (e.g. involving privacy, confidentiality, and informed consent), the authors provide excellent reasons to add life records to the life course researcher's toolbox, which may usefully supplement self-reports in survey panel studies.

Burton, Purvin, and Garrett-Peters draw on the Three-City Study of abuse of low-income mothers to illustrate the power of longitudinal ethnography in a multi-method research program. The authors show how the ethnographers stimulated discourses on abuse which emerged naturally in the context of interactions and ongoing discussions. The prevalence (64% were sexually or physically abused in childhood, adulthood, or both) and traumatic character of abusive experiences necessitated procedures to address "vicarious trauma" experienced by the researchers, as well as the safety of fieldworkers and participants.

Elder and Taylor show how to "breathe new life" into longitudinal archives, by recasting data to extend their relevance well beyond the goals of the original researchers and by supplementing earlier data

collection efforts with other records and contemporary follow-ups. They provide several examples, including the Terman study of gifted children, recast to describe life course trajectories of health; Glueck's study of juvenile delinquency (by Laub and Sampson), to reveal life course patterns of desistance from criminality; and the National Long-Term Care Survey, to understand linkages between earlier chronic conditions and later disability.

Part II, *Measuring Life Course Dynamics*, leads off with George's exceedingly thoughtful exposition of the study of cumulative life course processes, featuring hierarchical linear models and latent class analyses. Her careful distinction between person level differences and within person changes, and how these can be separated analytically, will be fully comprehensible to students with only rudimentary statistical backgrounds. Using the Glueck data on delinquent and Boston males (a cohort born between 1925-32 that was followed to age 32 by the original investigators and at age 70 by Sampson and Laub), Doherty, Laub and Sampson provide further illustration of the power of group-based trajectories in understanding patterns of criminality across the life course. They identify six offending trajectories, five incarceration trajectories, and the relations between them.

Almeida's and Wong's chapter on life transitions and daily stressor exposure illustrates the use of daily diaries from the longitudinal National Study of Daily Experiences (with two waves of data from a nationally representative general population survey—the Midlife in the United States, or MIDUS study of adults-- spanning a 10 year period), as well as the stressors distinguishing different age cohorts (early and late Baby Boomers). Their research links daily stress processes to basic principles of life course analysis—historical time and place, interdependent lives, human agency, and timing.

Part III, *Investigating Explanatory Factors*, begins with the perennial question of nature vs. nurture. Shanahan and Boardman examine how the combination of genetic makeup and social experience influences behavioral trajectories through the life course. For example, boys with a "risky" gene and low social capital (as measured by parental SES and school involvement) are especially unlikely to pursue their educations beyond high school (30% do so); those who have the more salutary genetic makeup and high social capital are the most likely (75%) This chapter constitutes a rousing "call to arms" to social scientists to join with geneticists in the study of person-environment interactions: how genetic makeup conditions the effects of cumulative environmental exposures on life course trajectories, or, conversely, how the cumulative history of experience, conditions phenotypic expression of genetically determined potentials. Their presentation of strategies for studying gene-environment interplay will be exceedingly useful to those who wish to join them in this innovative research.

Giele tackles the perennial question of why some members of disadvantaged groups transcend the stereotypes associated with their ascriptive statuses, achieving success despite the odds. She shows how the life story method can address this question through careful selection of cases, collection of retrospective data, attentiveness to attributes of the cases, and comparative analysis (inspired by Ragin's methods). Her study of 48 college-educated African American and White women indicates distinctive aspects of identity, choice of marital partners, work motivation, and adaptation to change that promoted their success and differed by race.

Moen's and Hernandez's shift of focus to relational data is especially welcome given the field's heavy reliance on individual-level data. Their comprehensive review of existing research on relational dynamics over time, shows how new questions can be addressed by taking a relational perspective. By constructing truly relational, couple-level measures, the researcher can explore the demographic determinants of relational trajectories, as well as the strategic adaptations that couples make over time (e.g. work and family decision-making). Also of great interest in relational studies are cross-over effects, how each member of a pair influences the other.

In the concluding chapter, Blossfeld discusses the pronounced advantages of longitudinal data over cross-sectional data for causal comparative analysis (in elucidating age, period, and cohort effects; national life event timetables; and contextual processes at multiple levels). The kinds of questions amenable to longitudinal cross-national study are illustrated by his comparative studies involving 9 to

5 countries. He addresses the problem of generality (e.g. in mobility and family formation patterns), and underscores the importance of variation in institutional structures (e.g. education, work, school-to-work regimes, welfare policy, and family). His concluding discussion of young people's responses to the uncertainties posed by globalization is particularly insightful.

This collection should be on the shelf of all social scientists who study life course processes. The chapters' clarity, accessibility and unique contributions, and the superb balance of quantitative and qualitative approaches, make this collection a highly useful supplement for graduate and advanced undergraduate courses on the life course, as well as courses on methodology and data analysis.

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The Life Course Reader: Individuals and Societies Across Time

Walter R. Heinz, Johannes Huinink & Ansgar Weymann (Eds) 2009
Frankfurt: Campus Verlag,
591pp
ISBN 978-3-593-38805-2.

The purpose of this collection is 'to present the life course as a field of innovative interdisciplinary research on the interrelationships between social structure, institutions and biographies across time.' It brings together 24 contributions from different sources: mainly from Germany and the US, but also from other European countries. Almost all the papers have been previously published in journals or books, but they are tied together by a series of excellent introductions to the different sections. The volume combines discussion of theoretical considerations of life course research and its different concepts with some empirical applications. It amply fulfils its function as a reader, i.e. as a volume which gives a good sense of the scope of the field and how research in it is conducted. Working through this set of papers would give anyone a good grasp of the key issues involved, and the challenges facing those of us who grapple with life course research.

As the volume repeatedly argues, this is an inherently multi-dimensional field. The number of factors, levels, contexts, institutions and interdependences which should, ideally, be brought into the picture is almost overwhelming. Successive authors make their case for a specific approach, often with overlapping but not identical frameworks. No single study, or even programme of study, could possibly encompass the full range of dimensions; but the volume provides substantial backing to the argument that the patterns of individual lives can only be grasped at all by approaches which take account of at least several of the dimensions. Although the theoretical discussions are at times heavy going, the effect overall is a strong counterblast to those narrow and often desiccated analyses which abstract human behaviour from its spatial and above all temporal context. There are several trenchant critiques of over-rationalised approaches to how people lead their lives, and a welcome rejection of fixed stages in favour of a dynamic approach to transitions and trajectories.

One of the valuable features of the collection is the perspective it gives on how the field has itself evolved over time. It opens with a 1964 piece by Leonard Cain which looks back further to Mannheim's career stage theory. Amongst other things, this highlights the relevance of legal and religious factors in defining the life course – factors which remain relevant today, though in a different light. Many of the pieces are classics from the 1980s and the 1990s; naturally there have been significant changes in important contextual features such as the labour market, but the contributions both remind us of issues which continue to shape the debate, and challenge us to update the debate as we read them. There are a number of recurrent tensions which appear consistently, for example between standardisation and de-standardisation of the life course: in what senses does the individual have more choice and control over their own trajectories and sequences than before, and how has the influence of institutional context changed in relation to this? This and other issues take different forms as the context changes.

Some striking cultural differences emerge. Most evident is the emphasis placed, often self-consciously, by many of the German contributors on the power of the labour market as a structuring factor, in respect of individual life courses generally, but also as a factor which heavily differentiates male from female patterns. Of course this differentiation occurs in every society, but the way employment interacts with the welfare state to shape gender differentiation over the life course is particularly strong in Germany.

There are few definitive answers given here to how human life courses are determined or shaped, even within a single culture. Instead we find a whole panoply of concepts and analyses. But the universal thread running through is the need to combine different approaches. As several contributors observe, life course studies depend on, but also complement, longitudinal research. They build in biographical and institutional elements, so that the powerful insights of cohort studies can be contextualised and nuanced. The field is replete with metaphors and images, and these too are necessary for us to get a better grasp of this protean subject. Gunnhild Hagestad uses the photographic imagery of 'depth of field' to argue for a long view, in portraying individual lives, linked lives and chains of interconnected relationships. This surely is the way forward: to seek combinations of methodology and focus.

We might have benefitted from a few more immediately contemporary contributions to bring the debate right up to date. These might have addressed, for example, the huge implications of the ageing of most western societies and the way this changes the shape of individual life courses and intergenerational relations - touched upon in a couple of papers, but deserving of fuller treatment. But this is a collection of papers which have individually stood the test of time, and which together provide a solid platform for life course researchers at any level.

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Children of the 21st Century: The first five years

Kirsten Hansen, Heather Joshi and Shirley Dex (Eds)
2010
Bristol: Policy Press
320pp
ISBN: 978-1-84742-475-4

The British birth cohort studies stretching back to 1946 started as perinatal mortality surveys of a single week's births in 1946, 1958 and 1970 with subsequent follow-up. The Millennium Cohort Study (MCS) 30 years later was conceived in longitudinal and comparative terms from the beginning, maintaining a degree of continuity with the earlier studies while making good limitations in design and measurement scope for contemporary scientific and policy purposes. *Children of the 21st Century* reports findings for the first three waves of the study: wave 1 at 9 months, wave 2 at age 3 and wave 3 at age 5.

Innovations in the study's design included replacement of all births in a single week by a multi-stage clustered sample comprising 400 electoral wards, within which all babies born over a given period of one year to 18 months were selected for the sample. Other features were disproportionate stratification of the sampled wards to ensure adequate representation of the ethnic minority and disadvantaged groups and boosting the samples in Scotland, Wales and Northern Ireland to double their naturally-occurring size. Respondents included mothers, fathers and by age 2 the infants themselves. Innovations in developmental measurement included cognitive, behavioural and physical development and assessment of the physical and social environment of the family, including parent relations and attitudes. Administrative data from health and education sources was also linked to the record.

The value of this expanded measurement regime is fully manifested in the excellent compendium of findings on contemporary UK child development that the book's 16 chapters present[i]. The repeated measures offer a degree of statistical control on the estimated relationships between child circumstances and child outcomes, enabling authors to home in on the core relationship of interest, and suggest how other confounding and mediating factors play a part in the developmental processes involved.

Not surprisingly in view of the design strategy, the chapters focus on the *diversity* in circumstances and experience that young children of each gender increasingly encounter in the early stages of growing up. Such a contextual emphasis extends to ethnicity, where eight major ethnic groups had sufficient numbers for analysis. 14 policy related topics are examined (chapter numbers in brackets): child poverty (2) ; ethnicity , community and social capital (3); parental relationships and parenting(4) ; partnership trajectories, parent and child well-being (5); employment trajectories and ethnic diversity(6); neighbourhoods and residential mobility (7); child care in the pre-school years(8); intergenerational inequality in early years assessment (9); ethnic inequalities in child outcomes (10; school choice (11); teacher assessments in the first year of school (12); childhood overweight and obesity(13); resilience in children's development (14); parental and child health(15).

*Disadvantage s*haping child outcomes is a prominent theme throughout. The staggeringly high proportion of families in the disadvantaged category, approximating 30%, has remained stable over the first five years of the children's lives, though not necessarily for the same individuals on each occasion. The distribution has also remained relatively stable across cohorts. In chapter after chapter strong relationships between child circumstances and a cognitive or behavioural outcome reduce, often substantially, when socio-economic status is taken into account.

Another striking feature of child circumstances is the increasing *complexity* of contemporary family forms and family life. Compared with earlier cohorts, the proportion of children growing up in single parent and cohabiting family situations has rocketed, with two-fifths of children at age 5 living with unmarried parents. Capturing these features of development through the idea of family and parent *trajectories* with foundations shifting over time is where the longitudinal design is seen to its best advantage. Such concepts as family economy and resilience to disadvantage and hardship illuminate further the dynamics of the life course in early childhood.

Intergenerational transfer is another important aspect. The book presents strong evidence of cycles of disadvantage and advantage mediated through the mechanism of family interaction processes. If anything, breaking loose from these cycles has actually reduced over the thirty years since the 1970 cohort study. We see inequalities established from the time of birth that increase through the early years, then stabilise at around five, powerfully predicting life chances later on. On the other hand, while outcome prevalence has shifted dramatically on many child indicators, of which overweight and obesity are striking examples, the processes linking circumstance to outcomes, do not appear to be changing in direction or intensity, nor are they immutable. As the chapter concludes, there is much fluidity in child development on which the agency of parents, child care providers, social service and health professionals, and the children themselves can work.

One small criticism of the book is that perhaps more could have been made explicitly of the life course perspective early on, as a means of unifying more clearly the complementary findings reported on the fourteen topics covered. The multi-level structure of the sample, embracing local neighbourhood ecology also merits further exploitation in the examination of neighbourhood ecology effects. In the meantime the authors are to be congratulated on their achievement in producing such a rounded and impressive account of early childhood in the first five years of the 21st century.

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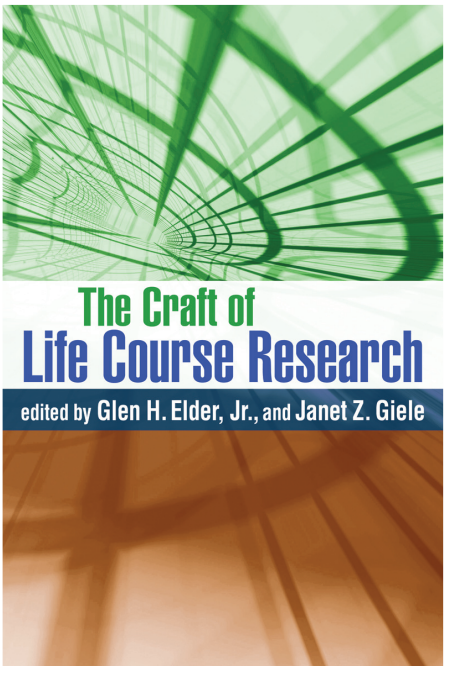
[i] Authors: (1, 16) Heather, Joshi, Kirsten Hansen, Shirley .Dex; (2) Jonathan Bradshaw, John Homes; (3) Alice. Sullivan; (4) Elizabeth .Jones; (5) Kathleen Kiernan, Fiona. Mensah; (6)Shirley Dex and Kelley. Ward; (7) Sosthenes. Ketende, John J Macdonald, Heather .Joshi; (8) Fiona. Roberts, Sandra Mathers, Heather .Joshi, Kathy Sylva, Elizabeth. Jones; (9 Jo Blanden and Stephen Machin; (10) Lorraine Dearden and Luke Siebeta; (11) Kirstine Hansen, Anna Vignoles; (12) Kirstine Hansen; (13) Lucy Jane Griffiths, Summer Sherbourne Hawkins, Tim Cole, Catherine Law; (14) Ingrid Schoon, Helen Cheng, Elizabeth Jones; (15) Yvonne Kelly, Melanie Bartley

Full technical details and associated technical reports on the MCS including data access are available on the MCS website:
www.cls.ioe.ac.uk/text.asp?section=000100020001



This book brings together prominent investigators to provide a comprehensive guide to doing life course research, including an "inside view" of how they designed and carried out influential longitudinal studies. Using vivid examples, the contributors trace the connections between early and later experience and reveal how researchers and graduate students can discover these links in their own research. Well-organized chapters describe the best and newest ways to:

- Use surveys, life records, ethnography, and data archives to collect different types of data over years or even decades.
- Apply innovative statistical methods to measure dynamic processes that result in improvement, decline, or reversibility in economic fortunes, stress, health, and criminality.
- Explore the micro- and macro-level explanatory factors that shape individual trajectories, including genetic and environmental interactions, personal life history, interpersonal ties, and sociocultural institutions.

The Craft of Life Course Research

Edited by **Glen H. Elder, Jr.,** Howard W. Odum Distinguished Professor of Sociology and Research Professor of Psychology, University of North Carolina, Chapel Hill & **Janet Z. Giele,** Heller School for Social Policy and Management, Brandeis University

"This book illuminates the utility of diverse methodologies, from behavioral genetic analysis to cross-national and historical comparison. It is unique in its scope, including qualitative (life story, ethnography, diary) and quantitative (hierarchical growth, latent class, and group-based trajectory models) approaches. Students will learn how to formulate research questions, locate data sources, and increase the potential of existing data through recasting and supplementation. Ideal for methods courses and substantive courses on aging in social context." **- Jeylan T. Mortimer, Life Course Center, Department of Sociology, University of Minnesota**

"This is a most important book in which the quality of the contributors and editors shines through the pages; a major contribution to the life course literature." **- John M. Bynner, Emeritus Professor and former Director, Centre for Longitudinal Studies, Institute of Education, University of London, United Kingdom**

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60-day examination copy available

NEWS & EVENTS

News

Society for Longitudinal and Life Course Studies (SLLS)

At the Longview October 2009 conference in Clare College, Cambridge, it was agreed to establish a learned society, the international Society for Longitudinal and Life Course Studies (SLLS). An Interim Committee was established to develop a constitution for the Society, make arrangements for the election of the first Executive Committee and plan the Society's first conference and first Annual General Meeting, where the Society will be formally established.

The election took place in March and attracted great interest, with two candidates each for the President and Secretary of the Society and one for Treasurer, and twenty five nominations for the six Ordinary Member places on the Committee. Details of candidates are available on the Society website: www.longstudies.longviewuk.com

The results of the election were:

President: **Heather Joshi,** *Institute of Education, UK*

Secretary: **Elizabeth Webb,** *Imperial College London, UK*

Treasurer: **Tom Jupp,** *Institute of Education, UK*

Ordinary Members: **Elizabeth Cooksey**, Ohio State University, USA; **Amanda Sacker**, University of Essex, UK; **David Blane**, Imperial College London, UK; **Ingrid Schoon**, Institute of Education, UK; **Walter Heinz**, University of Bremen, Germany; **Paul Boyle**, University of St. Andrews, UK.

The first meeting of the Executive Committee will take place on 13th May 2010.

Annual SLLS Conference

With the support of EUCCONET, The European Network for New Birth Cohort Studies, the Society's first conference will be held in Clare College Cambridge, with up to 150 participants expected. The conference will take place in the Gillespie Conference Centre, running from the evening of 22nd to 24th September. A programme is being constructed comprising keynote speeches, individual papers and symposia and posters. There will also be opportunities for member convened meetings and official meetings such as the Society's first AGM and a meeting of the EUCCONET Executive Committee. The second Call for Papers took place on 5th April with the closing date for submissions of 21st May 2010. A form for the electronic submission of abstracts is available at http://www.longstudies.longviewuk.com

The conference promises to be a historic event for the Society and for the field of life course and longitudinal research so make sure you apply in good time, with or without a proposal.

EUCCONET

The **European Child Cohort Network** is now up and running. It is a Research Networking Programme, financed by the European Science Foundation, for five years until 2013, with a secretariat based at INED (National Demographic Institute), Paris. The Millennium Cohort Study and the French child cohort study (ELFE) are founder members. The aim is to create a specific forum for the longitudinal study of children so as to exchange best practices on the management and organisation of longitudinal studies, but also on the analysis of collected data and their impact. The Network already gathers scientists involved in major national child and birth cohort studies in Europe, including Norway, Denmark, Netherlands and Germany. British cohorts include ALSPAC (based in Bristol), Born in Bradford (BiB) and Growing Up in Scotland (GUS) as well as the Millennium Cohort. The Network's intention is to expand to anyone who can share or use knowledge on these subjects, within and beyond Europe. This includes the readers of the CLS Newsletter 'Kohort' www.cls.ioe.ac.uk/kohort.asp The synergy thus created allows for further collaborations between the various teams.

The network is calling for Proposals, to fund the organisation of Scientific Meetings and Exchange Visits. The Scientific Meetings could be workshops or conferences, and exchange visits between research teams could last from one day to six months. The activities could be at any time over its five year duration to 2013, but the applications can be made as soon as possible. Details of how to apply are given below.

The first workshop considered the topic of consent in child cohort studies, and heard the cautionary tale of the political and ethical obstacles which led to the cancelling of the SESAM child

cohort study in Switzerland. The Steering Committee of the Programme has defined specific themes to be treated within the frame of Science Meetings in 2010. For each theme an Interest Group was created so that all people interested can participate and give their opinion on the organisation and the content of the event. Previous workshops this year were held on the Role of Fathers in Cohort Studies (Vienna, February 2010) and on data management in cohort studies (Bristol, March 2010).

Exchange visits between research teams can be quite flexibly defined, and can last between one day and six months. One example of such a visit has been by the survey managers of the Millennium Cohort to the Growing Up in Ireland team in Dublin, to share best practice in interviewing children. All applications will be evaluated by the Steering Committee.

The EUCCONET website is the portal of access to all the information concerning the network and its activities:
http://eucconet.site.ined.fr/

To register your interest for an Interest Group or to propose other thematic workshop, follow: http://eucconet.site.ined.fr/fr/about_us/activities/science_meetings/

To have more information on the travel grants and submit an application, follow: http://eucconet.site.ined.fr/fr/about_us/activities/travel_grants/

The website's Forum, on which readers might like to register, offers the opportunity to discuss any subjects related to longitudinal studies and to meet new partners!
http://eucconet.forumotion.com/

Understanding Society

Funded by the Economic and Social Research Council (ESRC), *Understanding Society*, the UK Household Longitudinal survey, is a major new research study designed to enhance our understanding of life in the UK and how it is changing. The largest study of its type in the world, *Understanding Society* is a hugely important resource because of its longitudinal design following the same sample of people across many years. The study has a target sample of 40,000 households and attempts to interview all household members aged 10 and over annually.

Fieldwork for waves 1 and 2 of the main survey is being carried by the National Centre for Social Research (NatCen). Wave 1 went into the field in January 2009. Wave 2 began in January 2010. The large sample size means that fieldwork for each wave is spread over a two year period. However each individual is interviewed at one year intervals giving an overlapping pattern of waves. The current data collection assumptions are that waves 1, 2 and 3 will be collected face-to-face, wave 4 will be collected by a mixture of modes, including at least face-to-face and telephone, and possibly web interviews

The content of the questionnaires has been designed to cover a broad range of topics in order to permit analysis of the relationship between outcomes, behaviours, preferences, the environments within which participants are located and the endowments and constraints which affect their life chances.

What is unique and special about *Understanding Society* is that it involves the collection of data on all members of sampled households and their interactions within the household. This has major advantages for important research areas such as consumption and income, where within-household sharing of resources is important, or demographic change, where the household itself is often the object of study. Observing multiple generations and all siblings allows examination of long-term transmission processes and isolates the effects of commonly shared family background characteristics.

The study consists of four distinct samples:

1. an Innovation Panel of around 1500 households (2400 adults), with fieldwork occurring 12 months before the other samples and used primarily for testing new questions and ways of asking questions as well as innovation in questionnaire design and incentive experiments. Wave 2 of the Innovation Panel trialled mixed-mode interviewing (face to face and telephone). Experiments for Wave 3 went into the field in April 2010.
2. a new random sample representative of the whole UK population large enough for the investigation of sub-populations
3. an ethnic minority boost facilitating minority group research

4. the incorporation of the existing BHPS sample for which 18 waves of data have already been collected to provide opportunities for early analysis of long durations.

The target of 40,000 households across the study's samples gives an opportunity to explore issues for which other longitudinal surveys are too small to support effective research. It will permit analysis of small subgroups, such as teenage parents or disabled people, and analysis at regional and sub-regional levels, allowing examination of the effects of geographical variation in policy, for example differences between the countries of the UK. A large sample size also allows high-resolution analysis of events in time, for example focussing on single-year age cohorts.

Understanding Society will make an important contribution to understanding some of the most pressing challenges facing UK society and similar societies around the world. For example, it will allow us to developing a better understanding of:

- The impact of personal characteristics and attitudes on future outcomes. These include cognitive abilities, personal plans and expectations.
- The formation of individual health-related behaviours (diet, tobacco and alcohol consumption, exercise) and impact on economic behaviour; and outcomes.
- The causes and long-term consequences of disadvantaging conditions such as unemployment, teenage pregnancy, ill-health, mental illness, truancy, drug taking and criminality.

It is expected that the first data from Understanding Society will be made available through the ESRC's Economic and Social Data Service for researchers to undertake their own analyses during 2010. The questionnaires are available at http://www.understandingsociety.org.uk/design/materials/questionnaires.aspx

Life Course Changes

On 31st March, **Heather Joshi** ended her term of office as Director of the Centre for Longitudinal Studies (CLS) at the Institute of Education. She is succeeded as CLS Director by her colleague Jane Elliot - formally director of the 1958 and 1970 birth cohort studies. Heather will continue as Director of the Millennium Cohort Study.

On the same day, **John Bynner** retired from his post as Director of Longview. He is succeeded by Tom Schuller, former research director of the (UK) National institute for Adult and Continuing Education and formerly Head of the OECD Centre for Educational Research and Innovation (CERI). John will continue as Executive Editor of *Longitudinal and Life Course Studies* and Longview Trustee, and will be a co-opted member of the SLLS Executive Committee.

Congratulations to **Heather Laurie** who was recently appointed Director of the Institute for Economic and Social Research (ISER) at the University of Essex, the home of the UK Longitudinal Household Study, *Understanding Society.* Heather was a founder member of the team that 20 years ago established the British Household Panel study (BHPS) and replaces Stephen Jenkins who has directed ISER for the last three years.

Neville Butler Memorial Prize 2010

The second of the annual Neville Butler Memorial Prize competitions took place this year, aimed at early career longitudinal researchers, who were invited to submit a paper reporting some post-doctoral longitudinal research they had done and plans for its dissemination. £5,000 is awarded to the winner, together with support for developing the paper for publication in *LLCS,* and UK Economic and Social Research Council (ESRC)-supported training in research communication and dissemination skills. This year there were joint winners: Dr Mayada Elsabbagh from the Centre for Brain and Cognitive Development, Birkbeck College, London and Dr Luna Munoz, from the School of Psychology, University of Central Lancashire. The award ceremony took place on 10th March 2010 in the Houses of Parliament as part of the ESRC Festival of Social Sciences. The prize is sponsored by ESRC and managed by Longview.

Neville Butler Memorial Lecture

This year's lecturer was Professor Sir Michael Rutter, who gave an excellent lecture attended by 150 people on 31st March, 2010 in the London Institute of Education on the 'The Power and Potential of Longitudinal Research'. Apart from reviewing the scientific gains and pitfalls in

undertaking longitudinal research, the lecture ranged across a range of longitudinal studies that Professor Rutter had been engaged in, from children growing up in Romanian and English orphanages to biogenetic studies of autism. The lecture is sponsored by the Longview-administered Neville Butler Memorial Fund with support from the Neville Butler Estate, and is organised jointly with the Centre for Longitudinal Studies.

Research Reports

The 'Digital Divide' and its relation to basic skills and employment. John Bynner, Steve Reder, Samantha Parsons and Clare Strawn, 2010

This report supplies the findings from a comparative longitudinal research project using data from matched samples of early 30s poor educational achievers in the UK National Child Development Study (London and South East England) and the Longitudinal Study of Adult Learners in Portland Oregon. From fitting the same Structural Equation Model to the data in both countries, conclusions are drawn about the direction of effects and their relative strengths, including the somewhat counter-intuitive finding that employment in both countries appears to be a stronger driver of basic skills enhancement than basic skills enhancement is a driver of improved chances of employment (Full details are available on the National Research and Development Centre for Adult Literacy and Numeracy website http://www.nrdc.org.uk/publications_list.asp

Events 2010

Modern demographic methods in epidemiology - Training course, **1-3 June,** St Andrews University, Edinburgh. http://www.lscs.ac.uk/news.htm

ESHMS - (European Society of Health and Medical Sociology) 13th Annual Congress, Ghent, Belgium, **26th-28th August**. Theme: 'Health and Well-Being in Radically Changing Societies'.
http://www.eshms.org/Eshmsnews-2010-10-10%20Ghent%20Belgium.htm

ALSPAC - (Avon Longitudinal Survey of Parents and Children) Workshop. 'Longitudinal Data Analysis: Multilevel modelling and Structural Equation Modelling Approaches'. **20-21 September**. Bristol University, UK
http://www.bristol.ac.uk/alspac-social-sciences/workshops/longitudinaldataanalysis.html

SLLS - (Society for Longitudinal and Life Course Studies) Inaugural Conference and General Meeting, Clare College, Cambridge, UK**, 22-24 September.** Abstracts by 21 May**.**
http://www.longstudies.longviewuk.com/pages/conference.shtml

CELSE 2010 - (Conference of Epidemiological Longitudinal Studies in Europe) Paphos, Cyprus, **13th-15th October** . Abstracts by 13 May.
http://www.celse.eu/

LHRS Meeting - (Life History Research Society) **14th- 17th October**, Montreal, Canada
http://crdh.concordia.ca/LifeHistory/

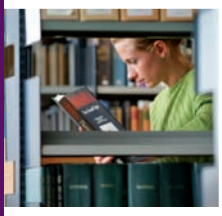
Events 2011

SRCD - (Society for Research in Child Development) Biennial Meeting March 31st – April 2nd, Montreal, Canada. http://www.srcd.org
Volunteer Reviewer website http://www.srcd.org/submissions2011/volunteers.

University of Essex

Four Professorships

Institute for Social and Economic Research
University of Essex



The Institute for Social and Economic Research (ISER) is an internationally recognised interdisciplinary research institute; a multidisciplinary centre of quantitative social science research; and a producer of household panel data of the highest quality.

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ISER runs one of the largest longitudinal household panel studies in the world and carries out research on behalf of a wide range of organisations including research councils, government departments and leading charitable foundations.

We are looking for experienced, talented and highly motivated academics who will build on our current success and have the vision to take ISER into the future. The successful candidates will develop new and innovative strands of research within our wide-ranging research agenda and provide research leadership to an outstanding team.

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To obtain further information please visit our website: http://jobs.essex.ac.uk

The closing date for applications is 23 May 2010

The posts

We are making four key appointments, at least two of which will be in Economics with other candidates coming from a range of disciplinary backgrounds relevant to our research portfolio. The key areas of coverage for these posts are:

- Economic and social policy
- Family life, changing patterns of family formation and dissolution, and demographic change
- Health
- Analysis methods for longitudinal data

Two postholders will take over the Directorships of the main ESRC funded centres within ISER. In the case of the Research Centre on Micro-social Change (MiSoC) this will be within six months of appointment. For the UK Longitudinal Studies Centre (ULSC) the transition will be longer term. These are high profile positions offering the right candidates considerable scope for shaping the future social science research agenda within the UK.

These appointments represent a significant investment in the future of ISER and will enhance our capacity to produce world class research and continue to attract large scale funding.

The people

The post-holders will provide leadership within our vibrant interdisciplinary research environment.

We seek individuals with a distinguished publication record; excellent and sustained performance in winning external research funding; and experience of providing the intellectual direction for research in a major area within ISER's research portfolio.

With a substantial established professional reputation related to your main area of academic interest, you must also have the ability to work collaboratively in a multidisciplinary environment.