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Inside this issue

- *Educational occupational pathways for low achievers*
- *Parental worklessness effects on children*
- *Mothers' and children's alcohol, tobacco and drug use*
- *Family mental health dynamics*
- *Accuracy and significance of long term recall*
- *National Health and Development Study – age 16-26*
- *Supplement: SLLS 2013 Amsterdam conference abstracts*

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CONTENTS

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Longitudinal effects of social background on educational and occupational pathways within early and strong school tracking

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Abstract

Transitions from education to work are subject to person-related factors and institutional opportunity structures. Life course research increasingly focuses on longitudinal effects of social background on educational and occupational pathways within early and strong school tracking. In this context, Switzerland is a paradoxical case because its education system exhibits elements that should both reinforce and weaken social background effects. We draw on data from a PISA 2000 school-leaver cohort. Employing sequence analysis, optimal matching and longitudinal latent class analysis, we find that persistence tendencies are more pronounced in the academic stratum, compared to vocational and precarious strata. Conversely, the education system and labour market allow for a good integration of weak academic performers. Overall, we show that social background and performance determine selection into tracks, after which effects of opportunity structures take over.

Introduction

Transitions from education to work and employment depend on person-related factors and institutional opportunity structures. Opportunity structures entail the interplay between the education system, labour market, employment policies, legal arrangements and socio-cultural norms. They determine the framework for educational and occupational pathways (Blossfeld & Maurice, 2011; Schoon & Silbereisen, 2009). Education systems differ by focus, type and degree. Some are characterised by weak tracking, late selection, high tertiary education quota and an emphasis on general education (e.g. UK, USA and Canada). Others feature early selection and specialization, a strong tradition of apprenticeships

and low tertiary education quota (e.g. Germany, Denmark and Austria). Comparative transition research assumes that characteristics of education systems affect post-compulsory educational and occupational pathways in different ways. For example, Bauer and Riphahn (2006) found that strong tracking at the secondary level I increases the effect of social background on educational and occupational achievement. Gangl (2001) showed that education systems with a focus on vocational training at the secondary level II facilitate labour market entry.

In this regard, the Swiss education system is an interesting case. First, it features early and strong tracking at secondary level I. Second, the Swiss education system is characterized by a low tertiary

quota and dual vocational training (VET), in which learners attend a vocational school for up to two days per week. For the rest of the week they work in a host company. Third, the secondary level II structure facilitates the integration of academically weak young people and provides prospects for a smooth transition into the labour market, as corroborated by a low youth unemployment rate. Hence, Switzerland serves as a paradoxical case study because its education system exhibits elements that should reinforce *and* weaken social background effects.

In this paper, we examine the effects of social background on educational and occupational pathways in Switzerland with a particular focus on tracking and transitions. To achieve this, we first provide an overview of the state of international research and propose a theoretical framework. Given the focus on longitudinal processes in this paper, we draw on life course theories (Baltes, 1987; Elder, 1994; Kohli, 2007; Levy, Ghisletta, Goff, Spini, & Widmer, 2005), which allow a dynamic understanding of the multi-faceted effects of social background. We then describe the post-compulsory pathways of a school-leaver cohort, using sequence analysis and optimal matching and finally test hypotheses employing longitudinal latent class analysis.

State of research and theoretical framework

The influence of social background on educational and occupational pathways has been well-covered in the research literature. In a recent longitudinal multi-cohort study in Sweden, for example, Goodman and colleagues (2010) find that family socio-economic status not only predicts school achievement in elementary school but also attendance of secondary school, as well as entry into tertiary education. Apparently, social background matters at different transitions, and there is evidence for cumulative effects. These findings corroborate earlier research in Sweden (Erikson & Jonsson, 1996) and twelve other countries (Blossfeld & Shavit, 1993). For the UK, Gregg and Macmillan (2010) analyse the effect of familial economic background on the offspring's educational outcome in five cohorts. The authors provide evidence for equalising educational differences across family background for children aged 10, 11 and 16, although it is unclear how these children will fare in terms of labour market returns (McIntosh, 2006). Finnie and Mueller (2009) come

to a similar conclusion, using data from the Canadian Youth in Transition Survey. In this study, the PISA reading ability scores appear to be a strong predictor of academic participation. Using the same data, Bowlby and McMullen (2002) find that the level of parents' education was positively associated with completing high school. Furthermore, dropouts and leavers seem to suffer from stigmatisation and were facing various barriers in obtaining the education they aspired to. For Norway, Andersen and Hansen (2012) show that cultural resources are positively associated with school performance across a variety of educational fields and effects within educational tracks. Based on the Longitudinal Surveys of Australian Youth and Youth in Focus data, Homel and colleagues (2012) find some evidence for an overestimation of commonly used indicators of social background, such as parental education and occupation, on educational success. For example, comparably undesirable educational outcomes of young people from disadvantaged backgrounds seem to result from "the negative experience of schooling" they are more likely to undergo. More recent research aims at disentangling the effects of performance and choice (Bukodi & Goldthorpe, 2013; Jackson, 2013; Schindler & Lörz, 2012), which is especially fruitful in choice-driven education systems, such as England and Sweden (Jackson, Jonsson, & Rudolphi, 2012). This overview shows that personal and social resources affect educational and early occupational pathways in many countries. Most likely, institutional opportunity structures – as the interplay between the education system, labour market, employment policies, legal arrangements and socio-cultural norms – affect how resources are transformed into educational and occupational outcomes.

Germany and Switzerland are examples of countries that feature early selection and specialization, VET and low tertiary education quota. Research from Germany suggests that the effect of social background is mediated by educational pathways. Indirect effects of social background seem to increase at each transition within the education system (Berger & Kahlert, 2005). Direct social background effects, in contrast, diminish over time (Becker, 2010). The influence of social background seems particularly strong for unconventional educational pathways (Konietzka, 2010). For these, the effect of social background is

predominantly indirect, particularly when different educational sequences are strongly linked. It is not clear whether these findings also pertain to Switzerland, which shares many features with the German education system. However, there are many important differences that go unnoticed in the current research debate. German learners work towards a school certificate at secondary level I, which subsequently influences their prospects in the labour market. Consequently, it is an attractive yet risky strategy to stay at school to obtain a higher certificate. In Switzerland, there are no certificates at secondary level I.

At secondary level II, Germany's labour market is characterised by big companies, while in Switzerland, Small and Medium Enterprises (SMEs) predominate. As a result, selection criteria are less standardised in Switzerland. This is considered to be less meritocratic but might also benefit academic weak performers in some instances (Buchholz, Imdorf, Hupka-Brunner, & Blossfeld, 2012). Furthermore, it is common for young people in Germany to enter a VET programme after passing the Abitur (A-levels, Matur etc.), which is rare in Switzerland.

These are just a few of the differences between two countries that have a similar educational system. Consequently, we believe that the Swiss case warrants separate analysis. This will provide important information for countries without a VET system, but will also offer others with VET systems the possibility to learn about how specific opportunity structures affect the transfer of social advantages.

Research in Switzerland reveals strong effects of social background on academic performance and participation in education (Bauer & Riphahn, 2006; Becker & Hecken, 2009a, 2009b; Coradi Vellacott, Hollenweger, Nicolet, & Wolter, 2003; Joye, Bergman, & Lambert, 2003). Moreover, tracks with extended intellectual requirements are particularly selective (Zutavern, Brühwiler, & Biedermann, 2002). Familial cultural resources seem to be most important for acquiring reading skills (Coradi Vellacott et al., 2003; Jungbauer-Gans, 2004; Kronig, 2007; Moser, 2004; Neuenschwander & Malti, 2009) and entering post-obligatory education programmes (Hupka-Brunner, Sacchi, & Stalder, 2010). However, most of the cited studies are based on cross-sectional data and focus on special groups. A comprehensive analysis of when and how social

background affects pathways in Switzerland, and to what extent the accumulation and mediation of advantages and disadvantages may be observed has not been conducted to date. This is surprising because, in comparison to other countries, tracking in Switzerland is pronounced and occurs early. In most cantons, the semi-sovereign states within Switzerland, elementary school lasts six years, after which learners are assigned to different tracks at the age of around 12 years (6th grade; ISCED-Level 2; SKBF, 2010). The assignment to different tracks is based on grades, and various assessments, as well as parents' and learner's wishes (Neuenschwander, Gerber, Frank, & Rottermann, 2012).

Only 10 percent of an age cohort is in integrated school types after elementary school, where learners are in the same class regardless of academic performance (BFS, 2007a). After three years, i.e. nine years of compulsory school and an average age of 15 years, learners make the transition from secondary level I to secondary level II (9th grade; ISCED 3). Secondary level II is divided into VET tracks (65 percent of the learners) and general education tracks with demanding intellectual requirements (20 percent, Gymnasium[1] and specialised middle schools; BFS, 2007a). The type of school attended at secondary level I largely determines the type of education selected by learners at secondary level II. This holds especially for higher educational strata. Learners who attended a secondary level I school with basic scholastic performance requirements are unlikely to attend a Gymnasium, just as transitions from Gymnasium to VET tracks are rare in Switzerland.

In Switzerland, VET is highly differentiated and a popular choice. Some training programmes require only basic scholastic performance, while others require competences comparable to academic tracks (Hupka-Brunner et al., 2010; Moser, 2004; Stalder, 2005). Apprentices attend a vocational school up to two days per week, and spend the rest of the week in a host company. Thus, they become part of the workforce at an early stage and are more likely to manage labour market entry more easily. However, some learners postpone vocational training due to a lack of apprenticeship positions, leading to a delayed entry. Changes from one vocational training programme to another are rare and costly. The type of vocational training and the subsequently selected occupation are strongly

linked, because qualifications are required in most cases.

Gymnasium graduates enter university after obtaining a Matur, typically at the age of 18 or 19 (A-levels, high school diploma; cf. Endnote 1). The Matur allows enrolment in any discipline except in medicine. Only 20 percent of a school-leaver cohort obtain this certificate, 90 percent of which enter university (SKBF, 2010). An alternative path to university exists via the federal vocational baccalaureate. A federal vocational diploma allows entry into tertiary education, i.e. universities of applied sciences (Fachhochschule in Germany and Austria), where an academic degree with a focus on professional skills may be obtained. This increases the permeability of the otherwise rigid Swiss education system and diminishes social background effects. Since the mid-1990s, the proportion holding a federal vocational baccalaureate has increased to about 10 percent (BFS, 2007a). However, only 60 percent of holders of a federal vocational baccalaureate enter a university of applied sciences (BFS, 2007b). Accordingly, labour market entry may occur at various stages. Young people in vocational certificate tracks may enter when they are approximately 18 years of age. Those pursuing an academic track enter employment six years after completing compulsory school at the earliest. The vast majority of young people transfer smoothly into the labour market. Youth unemployment rates are low, averaging 7 percent for the 15 to 24 years olds between 2001 and 2011 (own calculations based on ILO, 2011).

In sum, Switzerland exhibits strong and early tracking. The academic track appears highly selective, while VET is open to low- and high-performing learners with a heterogeneous social background. Accordingly, we expect an accumulation of advantages due to cumulative effects of social background and comparably low tertiary education participation. These effects may be observed as persistence tendencies, i.e. a quantifiable propensity of members of a certain stratum to stay in their stratum over time. The propensity is co-determined by personal and social resources as well as opportunity structures. Changes of education or employment are more common in less selective educational programmes. On this education level, tracks are more permeable. Fluctuations between lower strata may be substantial because the Swiss labour market

performs well in integrating people. We thus expect the persistence tendency to be lower for members of less selective strata. In other words, people should be able to move easily between the lower tracks.[2]

Accordingly, we propose the following hypothesis:

1) In early and strong tracking, the persistence tendency is highest in the academic stratum and lower in less selective tracks.

Effects of social background on educational and occupational pathways

Life course theories have been widely employed to study educational pathways. The positions within pathways may be conceived of as strata (Elder, 1975). Based on Elder's work (1994), contemporary life course research focuses on long-term processes (Blossfeld & Maurice, 2011). Life courses are always conceived of as "linked lives," entangled with the life courses of significant others, such as parents, partners and peers (Levy et al., 2005). In this vein, we examine how different strata are linked over time. A strong linkage of strata implies accumulation processes of advantages and disadvantages (Elder, 1994; Merton, 1968). Hence, this strand of theorization is connected to social reproduction (Bourdieu, 2000; Bukodi & Goldthorpe, 2013; Erikson & Goldthorpe, 1992). From this perspective, different social and personal resources affect pathways at different educational and occupational stages. For example, Maaz, Watermann, & Baumert (2007) find evidence that the effects of cultural resources are constrained to the transition from compulsory school to secondary level II. In general, Switzerland seems to exhibit comparably weak effects of cultural resources on educational pathways, compared to Austria and Germany (Maaz et al., 2007). Especially reading skills are considered crucial for successful completion of secondary level II (OECD/PISA, 2001). As they often indicate general learning abilities, they should also affect entire pathways (Heinz, Weymann, & Huinik, 2009; Stalder, Meyer, & Hupka, 2008).

Our research provides evidence for social reproduction and social closure if, for example, young people with an academic background transfer to academic tracks at secondary level II and subsequently transfer to university. Analogously, young people from a socially disadvantaged

background are more likely to be found in precarious educational and occupational situations, such as unemployment.

We outlined different transitions in the education system crucial to early employment trajectories. Also, most studies show that the effect of social background at different points in an educational pathway varies, and cumulative effects are likely (e.g. DiPrete & Eirich, 2006; Mare, 1980). Accordingly, we hypothesize:

2) The direct effect of social background on stratum membership is stronger at entry into secondary level II, than during secondary level II and the transition to the labour market or university. The direct effect of social background on stratum membership decreases across transitions.

Data

For this article, we use the Swiss youth panel Transitions from Education to Employment, a nationally representative PISA 2000 follow-up study (TREE, 2011). These data are unique in that they allow the observation of educational and occupational pathways across secondary levels I and II, as well as tertiary education and labour market entry. The PISA sample was drawn from the school-leaver cohort at the end of compulsory schooling in 2000 (9th grade) when the majority of the respondents were around 15 years old. A two-stage, multiple disproportionate, random sampling technique was employed, controlling for language regions and the participating cantons (Renaud, Ramseier, & Zahner, 2000; Sacchi, 2011). The initial sample comprised 6,343 young people from 312 schools. The cohort was surveyed annually from 2001 to 2007. Attrition was addressed using full information maximum likelihood with a robust (MLR) estimator (Raykov, 2005). The data set used for the final model contained 5,117 cases (Appendix 2).

Measures

We recoded all educational or occupational situations into four strata, so as to allow an analytical examination of social background effects on pathways. We did this at every time point. The *academic stratum* comprises Gymnasium and tertiary education. In the *demanding vocational stratum*, we include VET programmes with extended scholastic performance requirements (demanding VET). VET programmes with low to

medium requirements, as well as certified employment, are subsumed into the *vocational and working stratum* (VET or vocational). The *precarious stratum* includes young people not enrolled in secondary level II education (e.g. unemployed, gap year) or working without a certificate. We chose this strategy because it is not possible to meaningfully apply well-established measures such as the Goldthorpe class schema (Goldthorpe, Llewellyn, & Payne, 1987; Goldthorpe, 1996). Transitions are complicated as Figure 1 and 2 depict. While some part of the cohort is already integrated in the labour market, others have not yet found an apprenticeship and yet others are still at university. The covered period of seven years does not allow us to observe destinations in terms of occupations for the majority of the sample.

The analyses of the effects of social background on educational and occupational pathways (hypotheses 1 and 2) require the inclusion of further scales and indices. We use four indicators measured by PISA at the end of compulsory school (Adams & Wu, 2002): Familial economic resources are operationally defined by the family's possessions.[3] Parents' education is measured by the education level of either father or mother (the latter is used when there was no information on the former). Parents' socio-economic status (HISEI) is based on their occupation. Families' cultural resources are proxied by a composite measure that comprises number of books and information on possession of cultural goods (e.g. classic literature, paintings). As reading skills affect entire educational trajectories and indicate general learning abilities (Heinz et al., 2009; Stalder et al., 2008) we describe pathways based on reading skills as measured by PISA (OECD/PISA, 2001). These are also recoded into four strata (refer to Appendix 1a and 1b for all cross-sectional descriptives).[4]

Analytic plan

Our analysis consists of two steps. To describe educational and occupational pathways, we first employ optimal matching and sequence analysis (Abbott & Tsay, 2000; Brzinsky-Fay, Kohler, & Luniak, 2006; Gabadinho, Ritschard, Studer, & Müller, 2010). Optimal matching clusters pathways according to similarity. Similarity relates to the extent to which trajectories are composed of the same educational and occupational states over time. To show the effects of personal resources on the trajectories, we use reading skills as a starting

point. The clustered pathways are visualized to allow for a more intuitive interpretation of the results. Subsequently, sequence analysis helps to establish an understanding of variations of typical pathways in the data set, using entropy as a descriptive measure. Entropy provides a summary of the variation in empirical educational and occupational states over time and further enhances the interpretability of the optimal matching results.

Second, we use Latent Transition Analysis (LTA) to study the patterns of movement between strata and across pathways, conditional on social background (Humphreys & Janson, 2000; Lazarsfeld, 1968; Nylund, 2007; Wiggins, 1973). LTA examines the time-dependency of any given stratum across different thresholds in the education system (Chung, Park, & Lanza, 2005; Lin, Ten Have, & Elliott, 2009; Miglioretti, 2003; Muthen & Muthen, 2000; Reboussin & Ialongo, 2010). Furthermore, it allows estimating the effects of social background on stratum membership across transitions. LTA provides all information necessary to test hypotheses 1 and 2. Our LTA comprises of an autoregressive structural equation model with a latent class analysis as the model of measurement at every time point. The autoregressive elements prevent biased estimates of covariates as they account for preceding strata. Every stratum is conceived of as one of k latent classes. We use $k–1$ dummy variables, each representing one type of stratum membership at every time point (the reference category is the academic stratum). Upward and downward mobility as well as persistence are quantified in the form of probabilities. These probabilities are estimated as first order transition probabilities,

$$P(C_{it} = k \mid C_{i(t-1)} = m) = \frac{exp\ (\alpha_k + \beta_{1k}d_{i1} + \beta_{2k}d_{i2} + \beta_{3k}d_{i3})}{\sum_{l=1}^{4} exp\ (\alpha_l + \beta_{1l}d_{i1} + \beta_{2l}d_{i2} + \beta_{3l}d_{i3})}\ ,$$

with $\alpha_4 = 0$, $\beta_{14} = 0$, $\beta_{24} = 0$ and $\beta_{34} = 0$ for an LTA with four classes (cf. Nylund, 2007).[5]

The dependency of transitions over time may cause biased standard errors. In our case, the comparably large sample size and the use of MLR standard errors (robust to non-normality and dependent observations; calculated with a sandwich estimator) address this potential problem.

Characteristics of post-compulsory educational and occupational pathways

Figure 1 depicts the pathways of the PISA 2000 school-leaver cohort. The first column shows the PISA readings skills. The subsequent columns present various educational and occupational outcomes from 2001 to 2007. The last column presents the certificate obtained by 2007.

The pathways diverge over time, and the variation is highest between 2004 and 2006. During this time, the majority of the cohort enters the labour market or tertiary education. Most pathways end in employment or tertiary education.

Young people with high reading competencies seem to be a homogenous group with regard to their pathways. Most make the transition to the Gymnasium (78% within two years after leaving compulsory schooling). A small proportion enrols in VET with higher scholastic achievement requirements and then enters the labour market, while others enter tertiary education after they obtained a Matur. Only a few with high reading competencies are without educational credentials at secondary level II, one year after completion of compulsory school (6%). Downward mobility or working without occupation-specific credentials is rare.

Young people with low, medium-low and medium-high reading skills are less frequently found in academic tracks but enrol predominantly in VET. During secondary level II, episodes outside the education system are rare and primarily observed at the beginning and the end of educational programmes.[6] These gaps follow two main patterns. First, a break occurs between Gymnasium and tertiary education (e.g. gap year overseas, language stay). Second, after VET, breaks appear more frequent and of longer duration. Furthermore, uncertified employment is prevalent when reading skills are low (Figure 1). It is noteworthy that participation in tertiary education following VET with high requirements is rare.

Figure 1. Optimal Matching visualisation of pathways

Reading skills 2000	2001–2007	Certificate
High	Gymnasium	Matur or similar
Medium-high	Demanding VET	Demanding VET
Medium-low	VET	VET
Low	No upper sec. education	Without certificate
	Tertiary education	
Missing	Employed, certified	
	Employed, uncertified	Other status
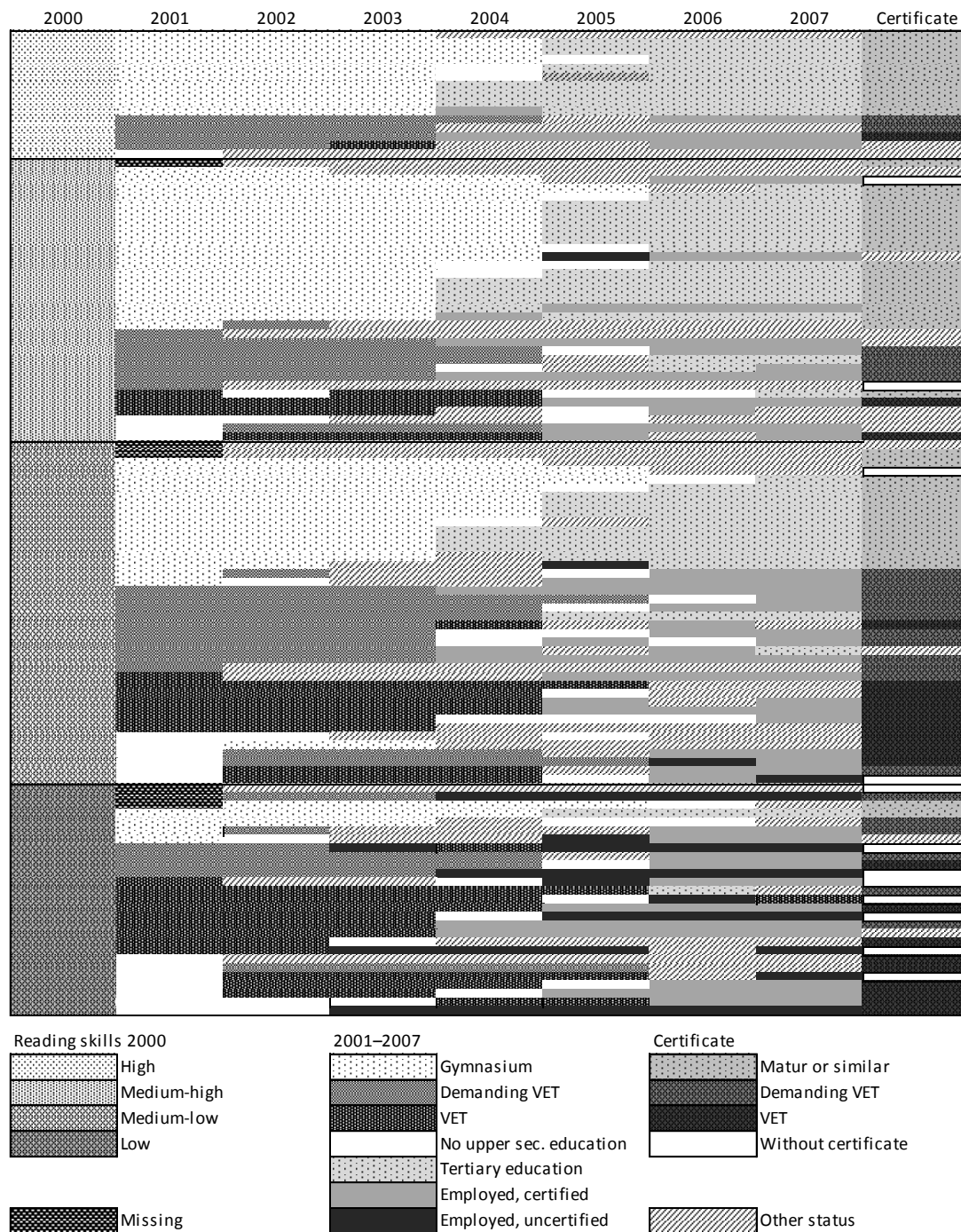
The variety of these patterns is summarized by the entropy index (Figure 2).[7] In our case, entropy is a measure of the plurality of empirical educational and occupational states at a given point in time. The higher the entropy, the more educational and occupational states are empirically observed (cf. Endnote 6). In Figure 2, we present how entropy develops for two select subgroups of our sample. As a benchmark, we provide the aggregated entropy index for all pathways.

Figure 2. Entropy of different types of pathways
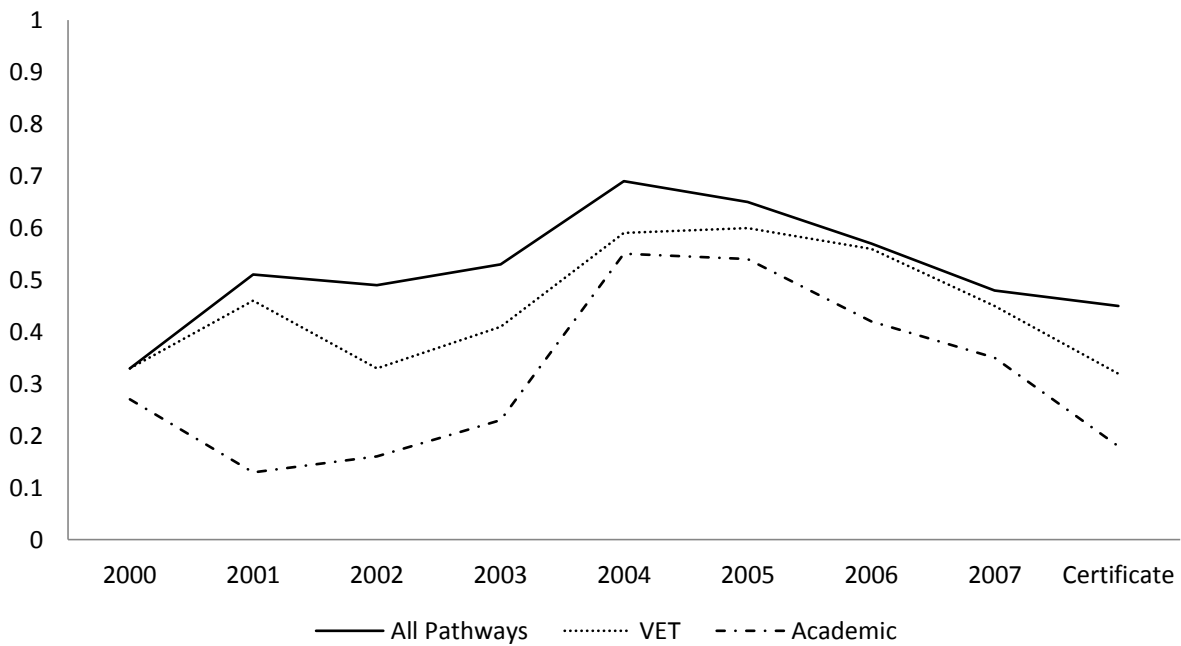
Notes. VET = all persons who entered VET programme within two years after compulsory schooling; Academic = all persons who entered academic track within two years after compulsory schooling.

Entropy is highest for all pathways combined over time (solid line). Interestingly, young people's pathways in VET and academic tracks differ clearly. Those in VET tracks are subject to more entropy than persons in academic tracks. Young people in VET tracks may enter the labour market with occupation-specific credentials as early as two years after compulsory schooling (year 2003 in Figure 2). The most entropy is observed 2004. People in the VET tracks are entering the labour market, further training programmes or becoming unemployed. Most people in the academic track receive their Matur and will have several options as to how to continue their pathways. As times goes on, more similar educational and occupational states are being observed for all types of pathways. This is reflected in a decrease of entropy.

The impact of social background on pathways and persistence tendencies

Persistence tendencies may be depicted as persistence probabilities. They indicate the probability of staying in the same stratum at a subsequent observation period, controlling for the effect of social and personal resources and higher order transition probabilities (i.e. the probability of making a certain transition to a stratum, given all preceding stratum memberships; Figure 3). High persistence probabilities show social closure of a given stratum. If the persistence probabilities are high for most or all strata, this indicates that there are few changes between strata.

Figure 3. Estimated persistence probabilities based on LTA controlling for several covariates
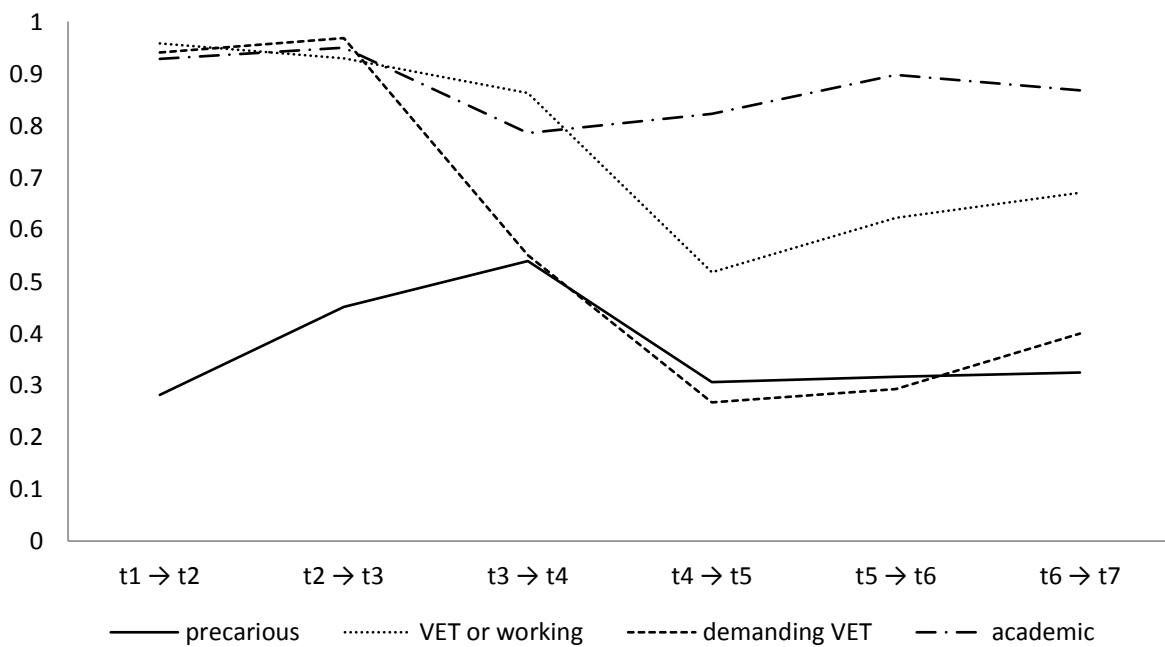
Note. See Appendix 2 for model fit.[8]

The probability of staying in the VET or working, demanding VET and academic strata is high between t_1 and t_3. The precarious stratum is markedly different because its members exhibit only a low probability of staying. In the first year after completion of compulsory school, many young people are not in formal upper secondary educational programmes. All strata display decreasing persistence probabilities from t_3 and t_4. This is where many young people finish their secondary level II education and are faced with several options. The decrease in the probability of staying in the demanding VET stratum is considerable. Often, these young people obtain a vocational baccalaureate and may enter tertiary education or the labour market, where they encounter spells of not being in education, employment or training (NEET). Members of the academic stratum display different mobilities. On average they are the most likely to stay in their stratum over time. In sum, persistence effects predominate, especially for the academic stratum. These findings corroborate hypothesis 1. Once in the academic stratum, drop out is unlikely.

Several predictors account for those findings (Table 1). One year after completion of compulsory school, young people from families with little cultural resources and low HISEI are more likely to be in the precarious stratum (odds ratios[9] are 0.98 and 0.97, respectively; reference category is high stratum). Similarly, having parents with low levels of education is associated with an elevated likelihood to be in the precarious stratum (2.37). Below average math literacy (1.63) and reading literacy (14.82) have a similar effect.

Table 1. Odds Ratios based on a Latent Transition Analysis Model

Reference category: academic stratum	t₁: precarious		t₁: VET or working		t₁: demanding VET	
Cultural resources	0.98*	(−2.44)	0.94***	(−8.60)	0.95***	(−6.93)
HISEI	0.97***	(−8.59)	0.97***	(−9.84)	0.98***	(−7.18)
Familial economic resources	1.01	(0.21)	1.13*	(2.21)	1.34***	(5.55)
Math literacy [above the mark]						
at the mark	1.15	(1.34)	0.80*	(−2.23)	1.06	(0.57)
below the mark	1.63**	(3.19)	0.97	(−0.19)	1.11	(0.70)
Parents' education [high]						
medium	1.13	(1.01)	1.06	(0.52)	1.19	(1.77)
low	2.37***	(6.75)	1.63***	(3.93)	1.40**	(2.75)
Reading skills [high]						
low	14.82***	(13.64)	18.03***	(14.70)	2.39***	(3.83)
medium-low	6.15***	(13.68)	8.26***	(16.35)	2.25***	(6.32)
medium-high	2.64***	(8.73)	3.56***	(11.70)	1.90***	(7.06)
	t₂: precarious		t₂: VET or working		t₂: demanding VET	
Cultural resources	0.96*	(−2.41)	0.94***	(−3.94)	0.94***	(−4.57)
HISEI	0.99	(−1.46)	0.99*	(−2.37)	0.99	(−1.85)
Familial economic resources	0.98	(−0.20)	1.20	(1.68)	1.31*	(2.58)
Math literacy [above the mark]						
at the mark	0.91	(−0.41)	1.13	(0.61)	0.84	(−0.86)
below the mark	1.55	(1.44)	1.46	(1.26)	1.28	(0.83)
Parents' education [high]						
medium	1.39	(1.34)	0.95	(−0.23)	1.04	(0.17)
low	1.46	(1.36)	1.28	(0.94)	1.07	(0.28)
Reading skills [high]						
low	11.60***	(6.94)	13.78***	(7.71)	2.57**	(2.62)
medium-low	6.48***	(6.54)	6.61***	(7.05)	2.70***	(3.85)
medium-high	1.82**	(2.61)	2.28***	(4.02)	1.43	(1.91)
	t₃: precarious		t₃: VET or working		t₃: demanding VET	
Cultural resources	0.99	(−0.71)	0.97	(−1.77)	0.99	(−0.55)
HISEI	0.98**	(−2.75)	0.98**	(−2.85)	0.98*	(−2.49)
Familial economic resources	0.88	(−0.89)	0.91	(−0.66)	1.12	(0.79)
Math literacy [above the mark]						
at the mark	2.16**	(3.01)	1.47	(1.45)	1.20	(0.59)
below the mark	2.05*	(2.29)	0.90	(−0.27)	0.81	(−0.55)
Parents' education [high]						
medium	1.27	(0.90)	1.21	(0.67)	1.33	(0.90)
low	1.52	(1.31)	1.20	(0.53)	1.74	(1.46)
Reading skills [high]						
low	8.42***	(5.25)	3.99**	(3.04)	1.15	(0.28)
medium-low	3.65***	(4.21)	2.73**	(3.30)	1.78	(1.64)
medium-high	1.88*	(2.37)	2.16**	(2.89)	1.56	(1.56)
	t₄: precarious		t₄: VET or working		t₄: demanding VET	
Cultural resources	0.98*	(−2.25)	0.97*	(−2.53)	0.98	(−1.67)
HISEI	1.00	(−0.76)	1.00	(−0.26)	1.00	(−0.65)
Familial economic resource	0.84*	(−2.29)	0.91	(−1.10)	1.02	(0.15)
Math literacy [above the mark]						
at the mark	1.25	(1.53)	1.20	(1.14)	1.16	(0.72)
below the mark	1.68*	(2.55)	1.36	(1.42)	1.45	(1.35)
Parents' education [high]						
medium	0.94	(−0.41)	0.90	(−0.66)	1.19	(0.84)
low	1.16	(0.81)	1.19	(0.85)	0.92	(−0.32)

Reading skills [high]						
low	0.98	(−0.05)	0.68	(−1.08)	0.64	(−0.93)
medium-low	0.68*	(−1.97)	0.61*	(−2.34)	0.83	(−0.75)
medium-high	0.56***	(−3.96)	0.56***	(−3.59)	0.62*	(−2.40)
	t_5: precarious		t_5: VET or working		t_5: demanding VET	
Cultural resource	0.99	(−1.22)	1.00	(−0.60)	1.01	(0.62)
HISEI	1.00	(−0.21)	1.00	(−1.39)	1.01	(0.88)
Familial economic resources	0.93	(−1.21)	0.85**	(−3.27)	0.83	(−1.56)
Math literacy [above the mark]						
at the mark	1.16	(1.40)	1.12	(1.26)	1.94**	(3.04)
below the mark	1.30	(1.85)	1.00	(0.01)	1.82*	(2.07)
Parents' education [high]						
medium	1.02	(0.16)	1.22*	(1.97)	1.44	(1.39)
low	0.84	(−1.39)	1.00	(−0.03)	1.04	(0.12)
Reading skills [high]						
low	0.85	(−0.93)	0.75*	(−2.02)	1.21	(0.41)
medium-low	1.13	(0.89)	0.92	(−0.73)	1.55	(1.58)
medium-high	1.06	(0.50)	0.98	(−0.22)	1.26	(0.94)
	t_6: precarious		t_6: VET or working		t_6: demanding VET	
Cultural resources	1.01	(1.05)	1.01	(1.25)	1.01	(0.38)
HISEI	0.99	(−1.41)	0.99**	(−2.68)	1.01	(0.47)
Familial economic resources	1.01	(0.14)	0.96	(−0.76)	0.93	(−0.38)
Math literacy [above the mark]						
at the mark	1.26	(1.82)	1.19	(1.61)	1.54	(1.46)
below the mark	1.38	(1.90)	1.14	(0.86)	0.81	(−0.44)
Parents' education [high]						
medium	1.29	(1.82)	1.36*	(2.51)	1.86	(1.67)
low	1.03	(0.15)	1.18	(1.29)	1.68	(1.22)
Reading skills [high]						
low	0.97	(−0.13)	1.14	(0.78)	1.18	(0.32)
medium-low	1.39*	(2.04)	1.37*	(2.31)	1.70	(1.44)
medium-high	1.24	(1.61)	1.23	(1.83)	0.98	(−0.06)
	t_7: precarious		t_7: VET or working		t_7: demanding VET	
Cultural resources	1.00	(−0.30)	0.98	(−1.90)	0.95	(−1.48)
HISEI	1.00	(−0.42)	0.99*	(−2.14)	1.00	(0.30)
Familial economic resources	0.99	(−0.19)	0.99	(−0.09)	0.76	(−1.19)
Math literacy [above the mark]						
at the mark	1.47**	(2.81)	1.03	(0.25)	0.90	(−0.22)
below the mark	1.17	(0.75)	0.98	(−0.15)	1.14	(0.19)
Parents' education [high]						
medium	0.97	(−0.18)	0.98	(−0.20)	0.59	(−1.09)
low	1.11	(0.57)	1.09	(0.62)	0.25	(−1.89)
Reading skills [high]						
low	1.29	(1.02)	0.90	(−0.60)	0.43	(−0.87)
medium-low	1.18	(0.90)	0.81	(−1.59)	0.43	(−1.50)
medium-high	1.23	(1.31)	0.92	(−0.72)	1.37	(0.67)

*Notes. T-values in brackets; * p < 0.050; ** p < 0.010; *** p < 0.001. n = 5117; comparison to model without covariates: Δ Log-Likelihood = 4669 with Δ df = 210 (adjusted Δ BIC = 8241). Coefficients for autoregressive effects are not displayed.*

In the second year after completion of compulsory school, only objectified cultural resources and reading skills are significant. Effects of enrolment have an effect in the form of persistence probabilities after two years (odds ratios not shown in Table 1; see Figure 2 for a visualisation).

The odds ratios corroborate hypothesis 2 but should not be compared (Allison, 1999; Mood, 2010). As an alternative, we propose to observe the diminishing effect of social background on pathways via the number of significant predictors measuring social background. The effect of social background decreases over time from 3 significant predictors at t_1 to 0 significant predictors at t_7 (cf. Table 1: $t_1 = 3$, $t_2 = 2$, $t_3 = 1$, $t_4 = 2$, $t_5 = 0$, $t_6 = 0$, $t_7 = 0$). This pattern is repeated for the other strata and further supports hypothesis 2.

Cultural resources, parents' socio-economic status and education are crucial for the transition from compulsory school to secondary level II. During secondary level II, only cultural resources and parents' socio-economic status seem to matter. For the transition from secondary level II to the labour market, economic resources also play a role. Wealth decreases the risk of being in the precarious stratum (e.g. NEET).

Discussion and conclusion

In this paper, we analyse educational and occupational pathways of young people in an education system characterised by elements that have been shown in other studies to both reinforce and weaken social background effects. Using Switzerland as a case study, we draw on Elder's work and conceptualized positions within pathways as strata (Elder, 1975, 1994).

We examine how different strata are linked over time and consider institutional opportunity structures and personal action windows. In a first step, we describe pathways in association with competencies for a period of seven years following compulsory school. Subsequently, we analyse the effect of social background on pathways at different times.

The first set of results reveals increasing variations of educational pathways over time. The highest variance of educational and occupational positions is observed after four years. This finding is most likely due to the many ways of how young people use institutional opportunity structures. For example, some enter a VET programme with some

delay, while others follow institutional and societal expectations. The variety of pathways following VET is larger than those following the academic track. This bumpiness in the pathways is mostly due to NEET spells, but also mobility between strata. As proposed in other research (Hupka-Brunner, Samuel, Huber, & Bergman, 2011), delayed entry into the labour market or other non-normative educational and occupational pathways might be stigmatising.

The second set of results supports our hypothesis that persistence tendencies are more pronounced in the academic stratum, compared to the lower strata. Young people with high reading skills are most likely to transform their skills into apposite educational and occupational pathways. The precarious stratum does not seem to be a dead end, at least not for the majority of its incumbents. Also, the findings show a direct effect of social background. This is especially the case at early stages of educational and occupational pathways. Controlling for indirect effects of social background, there are negligible direct effects seven years after completion of compulsory school. Furthermore, different resources seem to affect pathways in particular ways. Cultural and economic resources matter at the beginning of post-compulsory schooling. During the secondary level II, only cultural resources and parents' socio-economic status had an effect. For the transition from secondary level II to the labour market, economic resources also play a role. Wealth decreases the risk of being in the precarious stratum (e.g. NEET). These findings show that a detailed analysis of social background allows for a better and more time-sensitive understanding of social reproduction. Our findings indicate that there are two processes at play. Social background and performance determine selection into tracks. Then persistence tendencies, as observable effects of opportunity structures, take over. Moreover, the cost of the transfer of inter-generational advantage in such education systems, is somewhat offset by the ability to integrate fairly weak academic performers into the labour market via the multiplicity of educational pathways and a strongly structured vocational training.

On a theoretical level, the life course perspective and the broad conceptualisation of social background proves fruitful. This supports a focus on different contexts and how they reward different

resources and how this process contributes to the accumulation or compensation of disadvantages. The Swiss system, as a representative of education systems with VET programmes, offers young people the possibility to attend tertiary education even after an apprenticeship, given a federal vocational baccalaureate. This opportunity seems to depend less on parental backgrounds and more on skills. If skilled, young people from disadvantaged backgrounds seem to be given a second chance. On the other hand, elevated economic resources appear to inoculate against low stratum membership for all observational periods.

As a methodological contribution, we suggest a two-step approach. First, we provide a thorough description of pathways using sequence analysis and optimal matching. The entropy index proves to be especially helpful in our study. Second, an analytical examination of pathways using LTA follows. This approach seems to have advantages over, for example, fixed effects estimation, which typically provides time-averaged estimates. We believe that particularly the study of noisy patterns, which are abundant in life course studies, might benefit from an approach along the lines we are proposing.

Our findings have practical implications. The comparably high permeability of the lower strata is striking and desirable from an educational policy perspective. However, this does not hold for the academic stratum, which is relatively impervious and especially prone to social background influences. This is even more noteworthy in educational contexts, where tertiary education participation is low. Overall, we have shown that a strong and early tracking offers many opportunities for social integration and upward mobility, even though social background and tracking are still the most important factors in explaining young people's educational and occupational pathways.

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Appendix

Appendix 1a. Cross-sectional proportions in percent

Wave	t_0	t_1	t_2	t_3	t_4	t_5	t_6	t_7
Strata in Figure 1								
Reading skills PISA 2000								
High	10.61							
Medium-high	30.04							
Medium-low	34.68							
Low	24.66							
Strata2001-2007 in Figure 1								
Gymnasium		42.50	41.79	39.92	24.06	6.91	1.95	0.58
Demanding VET		19.45	23.40	24.03	14.60	5.49	2.40	1.62
VET		18.47	23.86	23.80	20.36	11.18	6.53	4.43
No upper secondary education		14.85	5.11	2.45	11.38	14.75	12.40	11.28
Tertiary education				1.14	9.89	29.57	40.48	44.19
Employed, certified				0.76	12.95	25.20	27.17	35.09
Employed, uncertified				1.59	2.20	2.35	1.95	2.33
Missing		4.73	5.84	6.30	4.55	4.55	7.13	0.48
Certificate 2007								
Matur or similar								41.16
Demanding VET								29.09
VET								22.92
Without certificate								6.83
Strata in Figure 2 and Table 1								
Precarious		18.46	6.49	5.36	14.80	15.23	11.86	9.65
VET or working		22.59	29.04	28.35	36.17	29.79	27.48	29.71
Demanding VET		19.66	25.05	26.30	15.51	4.49	1.75	1.09
Academic		39.29	39.42	39.99	33.52	50.49	58.91	59.55

Appendix 1b. Cross-sectional proportions in percent and mean and standard deviations (SD) for continuous variables

Wave	t_0	t_1	t_2	t_3	t_4	t_5	t_6	t_7
Math literacy								
Above the mark	65.08							
At the mark	24.66							
Below the mark	10.26							
Parents' education								
High	32.44							
Medium	36.43							
Low	31.13							
Reading skills								
Low	12.77							
Medium-low	20.75							
Medium-high	33.83							
High	32.65							

	Mean	SD
Cultural resources	0.68	6.31
Socio-economic status (HISEI)	2.66	16.30
Familial economic resources	0.03	0.81

Appendix 2. Log Likelihood (LogL), AIC, BIC and sample size adjusted BIC (BIC adj.) for the different models.

Covariates	LogL	AIC	BIC	BIC adj.	N	No. of parameters
None	−27035.62	54491.23	55892.92	55225.60	5853	210
Cultural resources	−26295.14	53052.28	54590.68	53856.63	5766	231
Cultural resources, socio-economic status (HISEI)	−24026.44	48556.88	50215.61	49414.83	5336	252
Cultural resources, socio-economic status (HISEI), familial economic resources	−23981.10	48508.20	50305.10	49437.59	5335	273
Cultural resources, socio-economic status (HISEI), familial economic resources, math literacy	−23923.64	48477.28	50550.62	49549.66	5335	315
Cultural resources, socio-economic status (HISEI), familial economic resources, math literacy, parents' education	−22824.89	46363.78	48698.95	47564.53	5121	357
Cultural resources, socio-economic status (HISEI), familial economic resources, math literacy, parents' education, reading skills	−22366.02	45572.03	48318.97	46984.35	5117	420

Note. The models are not strictly nested due to Full Information Maximum Likelihood estimation. The model with the lowest LogL was selected.

Endnotes

[1] A Gymnasium is a preparatory school for university in Austria, Germany, Switzerland and other countries. The certificate obtained is called Matura (Austria), Abitur (Germany) or Matur(a) (Switzerland).

[2] The most important reason for low persistence tendencies in the vocational track is the permeable structure of tracks on this education level. In other words, people should be able to move easily between the lower tracks. For example, people in the vocational tracks are often affected by gaps and delays.

[3] The indicator "wealth" comprises self-reported information on whether a family has a dishwasher at home and the young person has a room of his or her own, educational software and internet access. Furthermore, the number of mobile phones, televisions, computers, cars and bathrooms is factored into that composite measure. We judge this to be an acceptable proxy for familial economic resources because the information was retrieved from 15-year olds who are usually not well-informed about their parents' assets and accounts. The correlation with other measures of social background is low (.18 < r < .25). Collinearity statistics do not point to any problems of using family economic resources in the same model with the other measures of social background (VIF = 1.09).

[4] PISA reading levels 0 and 1 = low, 2 = medium-low, 3 = medium-high, 4 and 5 = high.

[5] A stepwise approach was developed to generate starting values for first and higher-order transition probabilities between strata, because these models are computationally demanding.

[6] Changes within a stratum and between episodes are not observed. This may hint at short interruptions of education programmes during secondary level II. Most major interruptions in pathways seem to occur at the general thresholds in the education system (1st and 2nd threshold; Schmid, 2009).

[7] We used Gabadinho and colleagues' (2010) TraMiner Package in R and applied the Shannon entropy: $h(p_1, \ldots, p_s) = -\sum_{i=1}^{s} p_i \log(p_i)$, where p_i is the proportion of cases in state *i* at the time point of interest, and *s* is the number of possible states (Gabadinho et al., 2010:67).

[8] The graph in Figure 3 suggests a drop in the absolute level of persistence probabilities between t_3 and t_5. This reflects changes in the marginal distributions during this period. People change strata a lot during this time. Note that changes in the marginal distribution do not tell us much about the patterns of movement between strata. We also argue that the growth of the academic stratum over the last three time points does not reflect or explain persistence.

[9] Odds ratio is a measure of association between a condition and an outcome. It refers to the odds that an outcome will occur, given a particular condition, compared to the odds of an outcome, if the condition does not occur. It is a ratio of two odds.

Parental worklessness and children's early school achievement and progress

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Abstract

In this paper we investigate the relationship between repeated parental worklessness and the academic progress made by children in England in their first full year of primary school. We draw on data from two recent longitudinal birth cohort studies with multiple rounds of data collection in the very early years up to age 5. We use the Avon Longitudinal Study of Parents and Children (ALSPAC) which started collecting data from more than 14,000 children and their families in a geographically defined catchment area in 1991/2, and the Millennium Cohort Study (MCS), which is a sample of 19,000 children and their families born across the UK around the turn of this century. We constructed measures of repeated (persistent) and temporary (intermittent) worklessness and found that both were associated with lower levels of early academic achievement and progress of children. This association cannot be fully explained by a number of other socio-demographic risks factors (including parental education, income, housing conditions and health), indicating independent risk effects. We furthermore could identify beneficial effects of a stimulating early home-learning environment, which were significant even after controlling for previous levels of children's cognitive and behavioural adjustment.

Introduction

Early cognitive development in childhood is a crucially important predictor of later developmental health (Hertzman et al., 2010; Marmot, 2010) and socio-economic outcomes (Hertzman et al., 2010; Marmot, 2010). Moreover, the early years have been identified as a crucial window of opportunity for interventions aiming to improve life chances (Heckman, 2006). However, it is also the case that a child's development and education attainment is strongly linked to their family's socio-economic status, broadly defined (e.g. Blanden, Gregg, & Macmillan, 2007; Feinstein, 2003; Heckman & Masterov, 2007; Gregg & Macmillan, 2009; Jerrim & Vignoles, in press; Schoon et al., 2002; Schoon, Hope, Ross, & Duckworth, 2010). This strong

relationship between family background, educational outcomes and subsequent adult outcomes has prompted much policy concern, particularly in the UK. For example, the recent Field Review on 'Poverty and Life Chances' (Field, 2010) has highlighted the important role of family background and parenting in determining a child's adult outcomes, particularly during the 'foundation years' before age 5. Socio-economic status can be defined in a number of ways, and here we focus on the role of parental worklessness and its influence on early academic achievement and progress.

We add to the literature and policy debate in multiple ways. First, we assess the relative role of worklessness in shaping children's early development across different contexts. Second, we take into account the role of additional socio-economic

risk factors that are associated with worklessness, to control for potential confounding factors. Third, we use longitudinal data to take into account the duration of worklessness. In particular we draw a distinction between repeated (persistent) and temporary (intermittent) parental worklessness during the child's early years. Fourth, we assess the role of a stimulating early home learning environment as a potential resource factor that might reduce the risk effect associated with the experience of repeated worklessness, over and above the other control factors included in the model.

Our study is guided by a developmental-contextual approach, emphasizing multiple interacting influences on human development, the importance of formative years and the timing of events (Bronfenbrenner, 1986; Elder & Caspi, 1988; Evans, 2006; Rutter, 1987; Sameroff, 2010; Schoon, 2006).

Literature review

Worklessness and associated risks

Worklessness is a particularly important aspect of socio-economic deprivation in the UK. Indeed the UK has a higher proportion of its children living in workless households than almost any other European Union country, second only to Ireland and almost twice that in France and Germany (Eurostat, 2010). 13% of households with dependent children were workless in the second quarter of 2011, which equates to just over one million workless households with dependent children (for reviews on household joblessness see also Office for National Statistics (ONS), 2011; De Graaf & Ultee, 2000; Gregg & Wadsworth, 2001). This situation is not likely to improve in the current economic situation with increasing pressures on families with dependent children (Brewer, Browne & Joyce, 2011). Hence understanding the impact of worklessness on children's early cognitive development is of crucial importance.

The adverse long-term effects of growing up in a workless household have been shown in previous studies (Ermisch, Francesconi & Pevalin, 2004; Macmillan, 2010, 2011). Living in a workless household has been found to be negatively associated with later educational and occupational attainment (McLanahan & Sandefur, 1994; Haveman & Wolfe, 1994; Cherlin, Kiernan & Chase-Lansdale, 1995; Kiernean, 1997; Schoon et al., 2012)

and children growing up in poor or workless households are more likely to be workless or poor themselves as adults, as compared to children who grow up in households where someone is in work (Ekhaugan, 2009; Gottschalk, 1996; Gregg, Harkness & Machin, 1999; Gregg & Wadsworth, 2001; Such & Walker, 2002; MacMillan, 2011; O'Neill & Sweetman, 1998; Page, 2004). There is also some evidence that the risks for children's development from living in a workless household tend to be higher when they are younger (Duncan, Brooks-Gunn, Yeung, & Smith, 1998; Ermisch et al., 2004) and that such experiences of socio-economic disadvantage in early childhood can set up a vicious cycle of cumulating disadvantage.

Existing research evidence also indicates that the relationship between any single risk factor, such as parental worklessness, and adult or child outcomes tends to be weak, and that usually many risks are involved in determining an outcome. Serious risk emanates from the accumulation of risk factors (Garmezy, 1991; Rutter, 1981, 2009). Since parental worklessness is associated with a number of other disadvantages faced by families (Evans, 2006; Ermisch et al., 2004), it is thus important that we understand the particular role parental worklessness plays in childhood development when taking into account such additional risk factors.

Parental worklessness is increasingly concentrated in certain subgroups of the population and in certain areas (Gregg & Wadsworth, 2001). For instance around 2 in 5 lone parent households in the UK were workless in 2010, compared to 1 in 20 households with two parents[i], and lone parents are more likely to experience poverty often as a result of being workless (Maplethorpe, Chanfreau, Philo & Tait, 2010; Gingerbread, 2012). The least skilled are also more likely to be workless (Grinyer, 2006; Denny, Harman & O'Sullivan, 2003; Dearden, McIntosh, Myck & Vignoles, 2002; McIntosh & Vignoles, 2001; Machin, McIntosh, Vignoles. & Viitanen, 2001; Vignoles, de Coulon, & Marcenaro-Gutierrez, 2011; Groot & Massed van der Brink, 2006), as are those experiencing family instability (Doiron & Mendolia, 2011) and poor physical and mental health (McKee-Ryan, Song, Wamberg & Kinicki, 2005). An established body of literature has shown the association between poor mental health and well-being and unemployment, with the relationship being particularly strong for men (e.g. Clarke &

Oswald, 1994; Clarke, Georgellis & Sanfey, 2001; Social Exclusion Unit Report, 2004). In our modelling we therefore take account of these other experiences and sources of deprivation to control for potential confounding factors, and to assess the independent effect of worklessness over and above these potential confounders.

We furthermore consider the duration of the risk effect. Most previous studies have conceptualised worklessness as a state, without taking into account that households may be moving in and out of worklessness over time. An earlier report for the Department for Education, Schoon et al (2012) considered the intergenerational transmission of repeated and temporary parental worklessness on a range of child and adolescent outcomes. We now add to this body of work by assessing the relationship between repeated versus temporary parental worklessness, and the academic progress of very young children in the UK context.

The home-learning environment

Previous studies have identified a number of potential resource factors that might counterbalance or neutralize the negative effects associated with exposure to early socio-economic adversity. Resource factors include, for example, positive parenting characteristics such as higher levels of education and the amount of time and energy parents invest in their children (Lerner & Benson, 2003; Rutter, 1987, 2006; Masten, 2009; Schoon, 2006). For example, more involved parenting has been associated with better adjustment than expected among children exposed to socio-economic adversity (Bradley, Corwyn, McAdoo & Coll, 2001; Melhuish et al., 2008). In this paper we focus on the role of the early home-learning environment during the first three years of life on later academic performance, to assess its long-term benefit over and above a number of other control factors, such as variations in earlier cognitive performance and child behaviour adjustment. Previous research has mostly focused on the long-term benefits of early pre-school education provision (George, Stokes, & Wilkinson, 2012; Sylva, Melhuish, Sammons, Siraj-Blatchford, & I. Taggart, 2010), although not all children, especially the most disadvantaged, are making use of this provision. A growing body of evidence suggests that the early home learning environment is one of the most important factors in explaining income-related gaps in cognitive development,

especially during the early years (Dearden, Sibieta, & Sylva, 2011; Melhuish et al., 2008; Washbrook, 2010). Key indicators of early home-learning include parent's reading to the child, teaching behaviour and early skills, encouraging literacy activities, library visits, as well as establishing rules and regularity of routines, which form the basis of the home learning measures included in this paper (see also Bradley, Corwyn, McAdoo, & Coll, 2001; Kelly, Kelly, & Sacker, 2013).

Regarding the longer-term benefits of the early home-learning environment, previous research suggests that its influence on later levels of cognitive attainment is largely mediated through earlier levels of attainment, i.e. school readiness (Dearden et al., 2011). This study however focused especially on income inequalities. Here we want to assess the role home-learning has in reducing the effect of repeated parental worklessness on children's cognitive development. It might be that a positive home-learning environment can offset any negative impact from worklessness, or even that workless parents can spend more time with their children to teach them and interact with them than parents who are employed (especially the working poor who often have more than one job).

In considering the role of the home-learning environment in reducing the negative impact of parental worklessness, we control for a number of other socio-economic confounders identified above, as well as child characteristics, such as early birth weight, age at time of assessment, health status and previous levels of cognitive and behavioural adjustment. This is done in order to take into account, that parental investments and interactions with their children might vary depending on the child's characteristics, e.g. the child's age, health, and adjustment across domains (Belsky, 1984). It is assumed that the early home-learning environment will have a beneficial effect on the child's cognitive development, reducing at least some of the negative effect of parental worklessness. Given the problems in establishing interactive effects (Rutter, 1987), we focus on main effects of the early home-learning environment.

Drawing attention to differences between families experiencing repeated or temporary worklessness, the specific research questions that we address are:
1. To what extent are workless families exposed to a number of additional risk factors, such as

poverty, low levels of education, family break-up, lone parenthood, long-term illness, overcrowded housing conditions, and area deprivation?

2. Does parental worklessness have an independent association with children's early academic attainment after controlling for other associated risk factors?

3. Do characteristics of the early home-learning environment reduce the negative association between parental worklessness and child academic outcomes at age 5?

4. Is the influence of the early home-learning environment on later levels of cognitive attainment largely mediated through earlier levels of cognitive attainment and behaviour adjustment?

Data and Methods

Data

In this paper we use two rich longitudinal data sets, namely the *Avon Longitudinal Study of Parents and Children (ALSPAC)* and the *Millennium Cohort Study (MCS)*, to investigate the relationship between parental worklessness and children's cognitive achievement in early childhood. The ALSPAC cohort were born in the early 1990s and the outcomes we consider date from the mid-1990s, a period of weak economic growth. The MCS data relate to children born in 2000, and the outcomes were observed during the period of more rapid economic growth in the early 2000s. Comparisons across the two data sets are difficult, since, unlike the nationally representative MCS, the ALSPAC data set only relates to one particular (relatively affluent) region of the UK. Nonetheless, comparing the experiences of children and their parents in the two data sets gives us an opportunity to test the robustness of any findings across differing socio-historical contexts and economic conditions.

ALSPAC is an ongoing population-based cohort study (Golding, Pembrey, Jones & the ALSPAC study team, 2001). To be eligible to participate in the study, mothers had to be resident in the former Avon Health Authority while pregnant, with an expected date of delivery between 1st April 1991 and 31st December 1992. More than 80% of the known births from the geographically defined catchment area were included, resulting in a total cohort of 14,062 live births. The study contains a wealth of data on family background, family

process, the cognitive, social and behavioural development of children, and key features of the school environment. In addition, school-level data including Local Education Authority (LEA) entry assessment scores (age 5) were obtained, and administrative data from the National Pupil Database (NPD) have been merged with the ALSPAC data. These data cover all relevant state schools in four LEAs; Bristol, South Gloucestershire, North Somerset, and Bath and North East Somerset.

MCS is an ongoing survey of 18,818 babies born between September 2000 and January 2002 into 18,552 families living in the UK (Hansen, 2010). Data collections took place at ages 9 months, 3, 5, and 7 years. In this research we use data from the first three waves of data collection, from age 9 months in 2001/2 to age 5 in 2004/5. Data have been collected from parents, children, teachers and health visitors, comprising personal interviews and self-completion questionnaires. The data include information on socio-demographic family characteristics, children's cognitive, social, emotional and behavioural development, gender roles, health and well-being. Foundation Stage Profile scores (FSP), completed by all teachers for children in England in the first year of primary school (age 5) together with administrative data from the National Pupil Database (NPD) that have also been merged with the MCS data. As the outcome measures are only available for children in England, analysis is restricted to families living in England. At sweep 1, 11,533 families lived in England.

Analytic sample

The longitudinal sample of families who participated in each of the three or four waves of data collection formed the analytic sample for this paper. This consisted of 6,942 ALSPAC families (approximately 65% of all families who completed a questionnaire when the child was 8 months of age)[ii] and 8,252 MCS families living in England (72% of sweep 1 families living in England). Despite disadvantaged families being more likely to have dropped out of both studies over time, as in all longitudinal studies (e.g. Plewis, 2007; Elliott & Shepherd, 2006), the longitudinal sample of MCS families have a similar distribution to the original sample of families along key dimensions such as parental education, family status, ethnicity and housing tenure. However, in ALSPAC, differences between the longitudinal sample and all families

participating at sweep 1 were statistically significant at the p<.05 level in all bar one of the measures included. Children and their parents in the longitudinal sample are, as expected, more advantaged. For example, parents in the longitudinal sample are marginally more educated. Thus our analysis probably underestimates the extent of worklessness in the population being considered. If those experiencing the most negative outcomes from worklessness in childhood are more likely to leave the study, we may be underestimating the negative impact from worklessness. That said, the differences between the longitudinal and the eight month questionnaire sample, defined in this study as the first sweep, are not large. See table A3 in the appendix for details of the representativeness of the longitudinal sample of families in both studies.

Measurement

Measuring repeated versus temporary worklessness

A workless family was defined as a family where no parent living in the household was in work at the time the family was interviewed. We look at worklessness in 2-parent families (both parents are not in work) and single parent families (parent not in work). As the data sets are longitudinal, we were able to identify families who were:

- never workless at any of the assessment points (*continuously working*)
- moving in and out of worklessness (*temporary worklessness*)
- workless at all assessment points (*repeated worklessness*).

It is important to note that, it cannot be assumed that families who were identified as repeatedly workless, were workless throughout the whole period, as we lack continuous data on the work status of each household and there might have been some fluctuation in household circumstances between observation points. The discussion of repeated worklessness is therefore subject to this caveat.

There were more potential counts of parental worklessness between birth and age five for the ALSPAC cohort, as data were collected more regularly than for MCS. To aid consistency, we measure parental worklessness in ALSPAC when the cohort child was closest to the age when parental worklessness was first observed for MCS children. As such, information on parental worklessness was collected from four waves of data collection in ALSPAC

(postal self-completion questionnaires) and three waves in MCS (interviews). ALSPAC children were 8 months, 1 year 9 months, 2 years 9 months and 3 years 11 months of age. MCS children were 9 months, 3 years and 5 years of age.

Measures of early academic progress

We focused on mathematics and reading outcomes for children during their first year of primary school, around age 5. For ALSPAC children we used Entry Assessment (EA) scores and for MCS children, Foundation Stage Profile (FSP) scores[iii].

Entry Assessments (ALSPAC)

The primary purpose of the Entry Assessment (South Gloucestershire Professional and Curriculum Support Service, 1996) was to measure the strengths and needs of pupils on entry to school, and to provide a baseline against which progress could be measured at the end of Key Stage 1, the end of Year 2 in primary school when children are age 7. The Entry Assessment (EA) was teacher-administered and made up of four required areas, language, reading, writing and mathematics, each marked on a scale of 2 − 7. Here we concentrate on the reading and mathematics scales, which are crucial for later school success:

- *Entry reading:* covers a range of reading skills, such as whether the child can talk about the pictures in a book.
- *Entry mathematics:* covers a wide range of skills which include understanding pairs, matching colours and counting.

Foundation Stage Profile (MCS)

Assessments are made on the basis of the teacher's accumulating observations and knowledge of the whole child. By the end of the final year of the foundation stage, the Foundation Stage Profile (FSP) provides a way of summing up that knowledge. It captures the early learning goals as a set of 13 assessment sub-scales, each of which has a scale of 0 to 9 points (for further details see Foundation Stage Handbook, QCA, 2003). To be able to compare the FSP mathematics and reading scores with the EA scores for ALSPAC children we use four of the 13 scales:

- *Reading:* whether the child has developed an interest in books for example or can recognise a few familiar words.
- *Mathematics:* this scale combines three subscales with a scale of 0 to 27. It gives a profile score for mathematics including number and counting, calculating and shape, space and measures.

All EA and FSP scores are standardised to have a mean of zero and a standard deviation of one.

Associated risks

We are able to allow for a range of additional risk factors that have been shown to be associated with parental worklessness and child academic attainment, as discussed in the literature section above. We include family characteristics such as highest held qualification and marital status, parental health and living conditions, experience of poverty and family size. These risks are quite similarly measured across the two studies with 'status' taken at the first sweep of data collection used in this paper for ALSPAC families and at sweep 1 for MCS families, when children were 8 months and 9 months respectively, which further enhanced comparability. We also control for income, however this variable is not measured in a similar way in the two data sets. We therefore use family income in ALSPAC, which was first measured when the child was 2 years and 9 months of age and a measure of income poverty at sweep 1 for MCS. The variable measuring overcrowded living conditions is not available in the first sweep of data and is measured at the last sweep of data collection in both studies. Some variables are time-varying, specifically, change in marital status, gaining qualifications or studying for an exam. An additional area-based measure was also included in the MCS analysis, namely the index of multiple deprivation (IMD). This was to take account of the different economic conditions prevailing across England. Further details of the measures specific to each study are included in Appendix Tables 3 and 4.

Child characteristics

We control for a number of child characteristics, including age, gender, earlier cognitive performance[iv], behaviour difficulties, and physical health. Regarding prior cognitive performance we have information about a child's vocabulary measured directly at age 3 in both studies. In ALSPAC, vocabulary was captured by the MacArthur Communicative Development Inventories (Fenson et al., 1993) and in MCS by the British Ability Scales Naming Vocabulary assessment (Elliott, 1983, 1996; Elliot, Smith & McCulloch, 1996). Behaviour was assessed via maternal report: in ALSPAC by the Rutter Parent Scale for Preschool Children (Elander & Rutter, 1996), in MCS by the Strengths and Difficulties questionnaire (Goodman, 1997). ALSPAC children were age 3.5 years, MCS children were age 3 at the time of assessment.

Physical health included birthweight, general health and long-standing illness. These measures were reported by the parent-figure at interview in MCS and in a self-completion questionnaire in ALSPAC.

Early home-learning environment

Indicators of the home-learning environment were assessed at age 3 in MCS and between 2 years and 3 years 6 months in ALSPAC. Measures included reading to the child, taking child to the library, parents teaching their child the alphabet, numbers/counting and songs (summarized as a teaching score) and having a regular bedtime.

As with the associated risks, there was much similarity in the measures available in both studies. Further details of all child characteristics and home-learning factors and their association with parental worklessness, can be found in Tables 3 and 4.

Analytic strategy

Data analysis was carried out in Stata 12. Our strategy for addressing the research questions (RQ) is as follows. After first establishing the prevalence of worklessness in the two studies, we use linear regression to predict the number of times a family was workless (RQ1). We present two models. The first is estimated using OLS and uses the workless variable as a continuous measure with a range 0 to 3+[v]. An alternative specification is also presented to explore the distinctions between the different types of worklessness, namely a logistic regression model which predicts never being workless versus temporary worklessness (0 v 1-2 periods of worklessness), and temporary worklessness versus repeated worklessness (1-2 periods of worklessness v 3+ periods of worklessness). We then used linear regression to assess the relationship between parental worklessness and the child's reading and mathematics achievement during the first year of schooling (RQ2-RQ4). For each child outcome (i.e. standardised EA scores for ALSPAC children and FSP scores for MCS), five separate regression models were estimated. Firstly we describe the initial direct relationship between family worklessness and the outcome measure (Model 1), i.e. not allowing for other factors that may influence both worklessness and child test scores. We then add the associated risks factors (Model 2), identified from the earlier analysis to predict worklessness (addressing RQ2). In Model 3 we add child characteristics and in Model 4 we added indicators of the early home environment (RQ3). Model 5 included all measures (RQ4).

Results

Prevalence of parental worklessness

We found that about 1 in 10 of ALSPAC families and 1 in 6 of MCS families were workless at each of the three or four time points captured by this study. Looking at the experience of worklessness longitudinally, 17.8% of ALSPAC families and 23.1% of MCS families had experienced a period of worklessness. More families in MCS had experienced long-term repeated worklessness: 8.1% had been workless at all three interviews compared with the 6.1% of ALSPAC families who had been workless at three or four observation points. As established in the literature, lone-parent families are heavily over-represented among the workless. In the longitudinal samples, 49% of lone parents, when the child was eight months old, had experienced long-term repeated worklessness in ALSPAC, as had 39% of lone parents when the child was nine months old in MCS. Comparable figures for married couples were 3% and 2% respectively. Small numbers, particularly in ALSPAC, restricted running separate additional analyses on lone parents, but this will be reported in a forthcoming paper concentrating on MCS families. Family status and changes over time are controlled for in the regression models.

MCS is representative of all the UK, whereas ALSPAC data were collected in the South West region. The incidence of workless families in the South West is similar to that observed in the ALSPAC data roughly 10 years earlier (23.1% of all MCS families had experienced at least one episode of worklessness, 16.4% of MCS families in the South West had experienced worklessness, as had 17.8% of ALSPAC families). As noted earlier, the 1990s were less economically prosperous than the beginning of the millennium.

Parental worklessness and associated risk factors (RQ1)

Bivariate correlations, between our measure of worklessness and all the variables included in the regression models, varied between -.00 and .60. The highest correlations were found between parental worklessness and income poverty (.60) in MCS and weekly income in ALSPAC (.51). These measures of income were included in the analyses, given the evidence regarding the importance of both income and working status on outcomes for young children outlined in the introduction. Other strong correlations were between qualifications and income (.49 MCS, .46 ALSPAC) and parental worklessness and qualifications in MCS (.48), but this relationship was weaker in ALSPAC (.28).

Table 1 (ALSPAC) and Table 2 (MCS) show the results from the different multiple regression models. There was considerable consistency across both data sets and the different models, suggesting similar patterns regarding the association between parental worklessness and other socio-demographic risk factors. In both cohorts the experience of temporary or repeated worklessness was significantly associated with cohabitation and single parenthood, with one or more family transitions (separating from a partner or forming a union), low income, living in social housing or private rented and overcrowded accommodation, having poor general health or a long term limiting illness. It was also significantly associated with low parental education in both cohorts, although in ALSPAC parents with level 2 or 3 qualifications ('O'Levels or 'A'Levels) were significantly *less* likely than parents with a degree to experience worklessness. Additional significant associations with worklessness found for MCS families only, were being a younger mother, not gaining further qualifications between wave 1 and 3, maternal depression and the family living in an area with higher deprivation (as measured by an Index of Multiple Deprivation).

The findings suggest some differences between the workless groups. For example, the experience of repeated rather than temporary worklessness appeared to be more likely for those families with lower qualifications and poorer health (MCS). Temporary worklessness was more strongly associated with family instability, overcrowded living conditions and low income – particularly in MCS. Most of the different risk factors showed an independent risk effect, i.e. they were associated with worklessness over and above the other factors included in the model, suggesting that to understand the experience of worklessness and its impact on child outcomes, it is necessary to take into account these multiple interlinked risk factors.

Table 1. Predicting worklessness in ALSPAC area in early-mid 1990s

	Linear Regression		Logistic Regression	
	No. of times workless (0 to 3)		0 workless v 1-2 workless	1-2 workless v 3-4 workless
	β	SE	Odds Ratio (95% CIs)	Odds Ratio (95% CIs)
Age of mother at birth (years) (S1)	-.02	.002	0.99 (0.97-1.01)	1.03 (1.00-1.06)
Ethnicity (S1) 0=White, 1=other	-.01	.049	1.17 (0.70-1.93)	0.62 (0.32-1.23)
Housing tenure (S1) 0=own, 1=rent (social)	.25***	.031	1.89*** (1.42-2.50)	3.14*** (2.19-4.51)
0=own, 2=rent (private)	.07***	.042	1.69** (1.15-2.49)	1.97** (1.18-3.28)
0=own, 3=other	.01	.054	1.24 (0.72-2.14)	0.95 (0.40-2.27)
Overcrowded home: 1+ per room (S3)	.03**	.021	1.45*** (1.18-1.80)	1.19 (0.86-1.64)
Highest qualification (household) (S1) 0=degree, 1= A'Level	-.04**	.023	1.03 (0.75-1.41)	1.60 (0.81-3.19)
0= degree, 2= O'Level	-.06***	.025	1.02 (0.74-1.43)	1.41 (0.71-2.81)
0= degree, 3= vocational	.00	.041	1.04 (0.66-1.64)	2.13* (1.00-4.58)
0= degree, 4=CSE	.03*	.037	1.27 (0.85-1.90)	2.28* (1.11-4.68)
Mother took exam (S4)	-.00	.030	1.19 (0.86-1.65)	0.81 (0.48-1.36)
Weekly family income (S3) 1= £400+….5= <£100	.32***	.009	0.41*** (0.37-0.46)	0.43*** (0.35-0.53)
Marital status (S1) 0=married, 1=cohabiting	.05***	.023	1.53*** (1.21-1.94)	1.09 (0.77-1.56)
0=married, 2=single parent	.20***	.051	2.14** (1.27-3.58)	3.22*** (2.02-5.14)
No of marital transitions (S1-S4) range: 0=none,1=1+	.13***	.024	3.30*** (2.63-4.14)	0.63*** (0.50-0.80)
Physical health (S1 – S4) 0=always well, 1=sometimes unwell	.02*	.030	1.11 (0.79-1.55)	1.47 (0.92-2.34)
Mother depression score (S1) (range: 0-16)	.01	.003	1.03 (1.00-1.06)	0.99 (0.95-1.04)
R^2	0.42			
Nagelkerke R^2			0.28	0.21
N	*5,855*		*5,506*	*1,012*

Note. S1 = 8 months; S1=1 year 9 months; 2 = 2 years 11 months; S4 = 3 years 11 months

Table 2: Predicting worklessness in MCS in early-mid 2000s

| | Linear Regression No. of times workless (0 to 3) | | Logistic Regression | |
	β	SE	0 workless v 1-2 workless Odds Ratio (95% CIs)	1-2 workless v 3 workless Odds Ratio (95% CIs)
Age of mother at birth (years) (S1)	-.05***	.002	0.95*** (0.93-0.96)	0.99 (0.98-1.02)
Ethnicity (S1)			0.72*	0.90
0=white, 1=other	-.01	.033	(0.54-0.95)	(0.65-1.25)
Housing tenure (S1)	.17***	.035	3.31***	3.35***
0=own, 1=rent (social)			(2.54-4.30)	(2.13-5.26)
0=own, 2=rent (private)	.06***	.040	3.16***	2.24**
			(2.33-4.29)	(1.26-3.98)
0=own, 3=other	.02	.051	1.29	2.77**
			(0.84-1.97)	(1.55-4.93)
Overcrowded home: 1+ per room (S3)	.01	.045	1.46*	0.87
			(1.07-2.01)	(0.60-1.27)
Highest qualification (household) (S1)				
0=NVQ4+, 1=NVQ3	-.01	.020	1.24	1.01
			(0.91-1.68)	(0.54-1.90)
0= NVQ4+, 2=NVQ2	.02*	.020	1.59**	1.72*
			(1.21- 2.11)	(1.00-2.96)
0= NVQ4+, 3=NVQ1/overseas	.07***	.047	2.46***	1.94*
			(1.69-3.60)	(1.10-3.44)
0= NVQ4+, 4= no qualifications	.14***	.058	2.94***	3.60***
			(1.97-4.40)	(2.12-6.13)
Not gained higher qualification (h'hold) (S1-S3) 0=yes, 1=no	.04***	.026	1.11 (0.83-1.48)	2.65*** (1.75-4.00)
Poverty (OECD median income) (S1) 0=above 60%, 1=below 60%	.28***	.031	4.87*** (4.02-5.90)	2.89*** (1.99-4.20)
Marital status (S1)				
0=married, 1=cohabiting	.02*	.017	1.31*	1.12
			(1.06-1.63)	(0.74-1.69)
0=married, 2=single parent	.31***	.046	7.87***	2.10***
			(5.68-10.91)	(1.41-3.14)
No. of marital transitions (S1-S3) (range: 0-2)	.04**	.016	2.74*** (2.37-3.16)	0.37*** (0.29-0.49)
Long-term limiting illness (S1-S3) 0=no LT illness, 1=at S1 &/or S3	.08***	.020	1.97*** (1.61-2.40)	2.09*** (1.61-2.72)
Mother's malaise score (S1) (range: 0-9)	.03***	.005	1.04 (0.99-1.10)	1.07* (1.01-1.14)
IMD deprivation (employment) (S1)	.01	.003	1.01 (0.97-1.05)	1.07* (1.01-1.14)
R^2	0.56			
F(df)			F(18,180) = 98.96	F(18,172) = 11.86
N	*7,793*		*7,184*	*2,258*

Note. S1 = 9 months; S2 = 3 years; S3 = 5 years

Parental worklessness, child characteristics and home-learning

Descriptive analysis showed children growing up in workless families were more likely to have poorer health and behaviour difficulties, especially in MCS (see Table A1 [ALSPAC] and Table A2 [MCS] in the appendix). Although parental worklessness was not strongly associated with our measures of parent teaching their child at an early age, workless parents were less likely to read to their child on a daily basis, to take their child to the library, and less likely to observe regular bedtimes for their child especially repeatedly workless parents.

Parental worklessness and children's early school achievement

Exposure to temporary and repeated parental worklessness was associated with lower reading and mathematics attainment scores for children in both cohorts. Figure 1 shows that the strongest associations were found for repeated parent worklessness in both cohorts, although the experience of worklessness, even at only one of the time-points, was already significantly associated with lower attainment scores in comparison to the scores of those children with persistently working parents.

Figure 1: Standardised mean reading and mathematics attainment scores
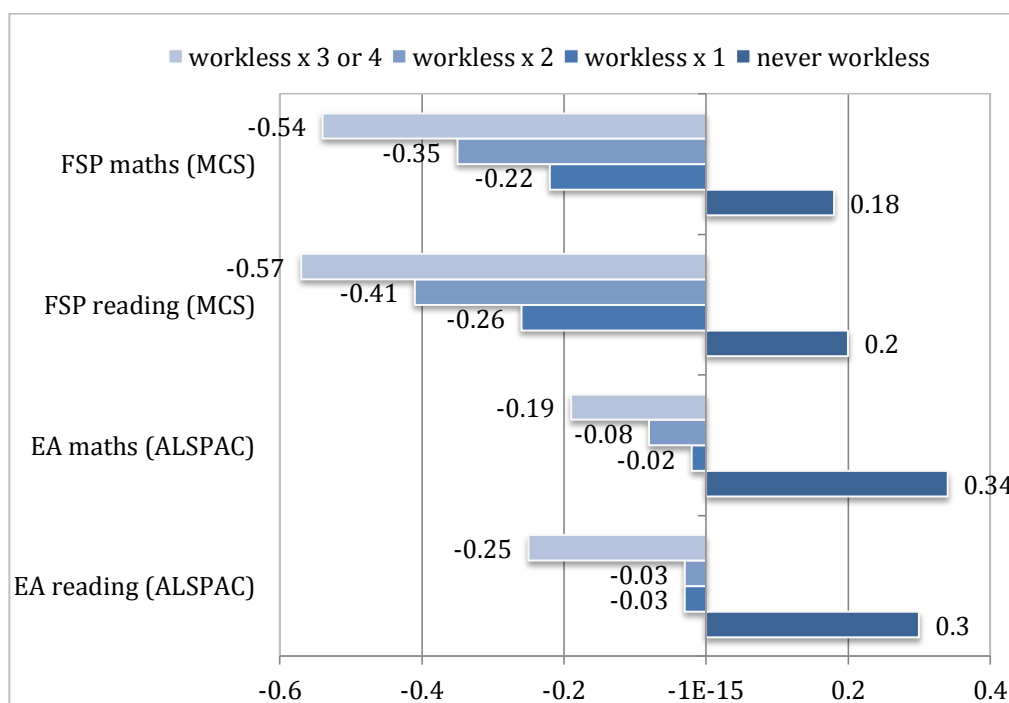
From the raw standardised mean scores shown in figure 1, it appears that there is a stronger association between parental worklessness and poor attainment in the MCS data than in the ALSPAC data, but this result has to be interpreted carefully. It may well be that for the MCS cohort, growing up during a more prosperous period, those who were workless were relatively more disadvantaged than those who were workless in the ALSPAC cohort (growing up during difficult economic conditions). Without controlling for the range of other risk factors that are correlated with worklessness and also likely to negatively impact on child attainment, we may thus wrongly ascribe the

poor outcomes of the children to the worklessness these families experience. This problem essentially arises due to selection into worklessness on the basis of factors we do not observe in our data.

Concentrating now on the results from the multiple regression analyses to answer RQ2 to RQ4, figure 2 (mathematics) and figure 3 (reading) give the standardised beta coefficients measuring the relationship between repeated worklessness and the particular assessment score for each of the five separate models. A bar with a value greater than 0 indicates that children with repeatedly workless parents had higher scores than children living with

persistently working parents; a bar with a value less than 0 indicates that children with repeatedly workless parents had lower scores than children living with persistently working parents. The greater the value of a bar, in either direction, the stronger the association between parental worklessness and the child's assessment score. The results show that the original association between parental worklessness and early school performance was much stronger for MCS children than for ALSPAC children. Once the associated risk factors were taken into account (RQ2), a much weaker, though statistically significant relationship between repeated parental worklessness and early school attainment outcomes remained in both studies. This indicates that in both studies the relationship between parental worklessness and early school academic progress is largely, but not fully, explained by other risk factors.

By adding child characteristics and indicators of the early home-learning environment separately to the regression model, we can see that the relationship between parental worklessness and reading and mathematics scores remained statistically significant in the models for children in both cohorts. For ALSPAC children, the additional reduction in the association between parental worklessness and the outcome scores was negligible when child characteristics or home-learning environment measures (RQ3) were

included, although in the MCS, child characteristics appear to play a more significant role.

However, once *both* child characteristics and indicators of the early home learning environment were included in the model (RQ4), repeated parental worklessness remained significantly associated with reading and mathematics scores for ALSPAC and MCS children. Temporary worklessness also remained significantly associated with mathematics scores for both MCS and ALSPAC children.

The results suggest that parental worklessness, and in particular repeated worklessness, was a risk factor associated with poor early school achievement for ALSPAC and MCS children. Much (but not all) of this association was attributable to other family socio-demographic characteristics. Despite the differences between the two data sets that we are analyzing, particularly the different time periods and the different geographies, we find that the negative association between parental worklessness and early child achievement holds in both data sets. This association remains even when we control for a full range of other socio-economic risks, child characteristics and measures of the home learning environment including the child's ability as captured by performance in earlier assessments. Hence this negative relationship appears to apply in different historical, social and economic contexts.

Figure 2. Regression coefficients for repeated worklessness and standardised early school achievement mathematics scores in ALSPAC and MCS
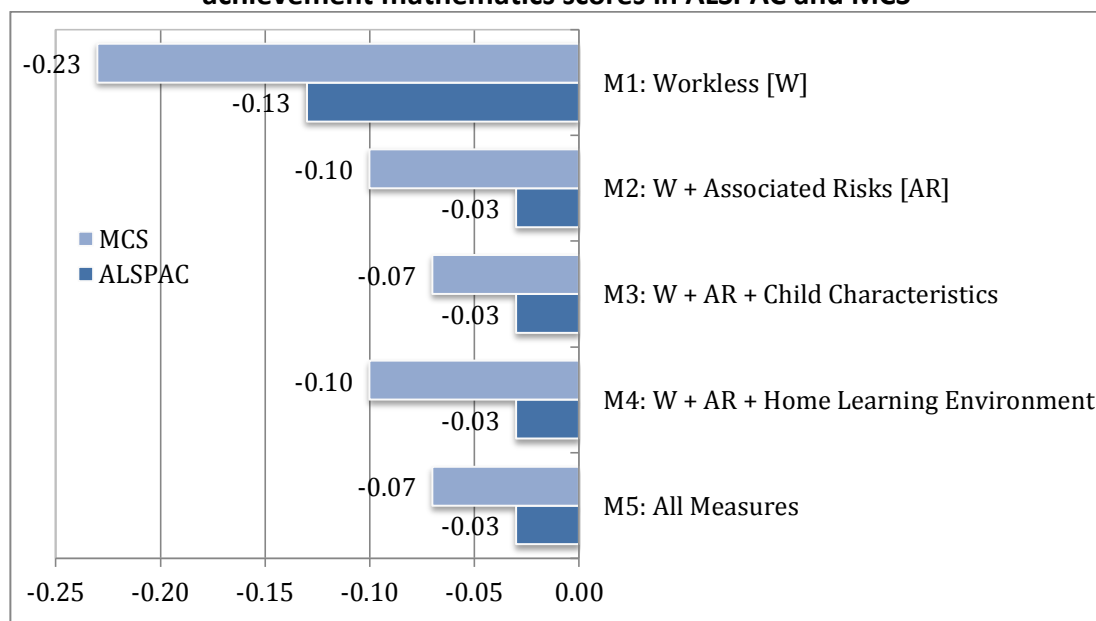
Figure 3. Regression coefficients for repeated worklessness and standardised early school achievement reading scores in ALSPAC and MCS
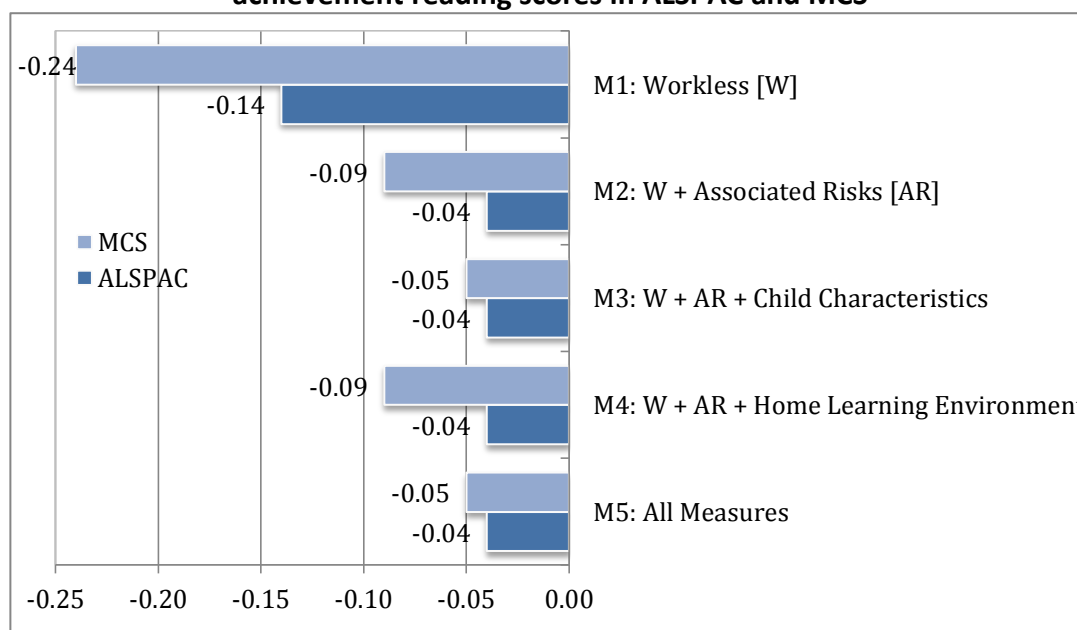
Which factors had an independent association with early school achievement?

Table 3 (ALSPAC) and table 4 (MCS) detail the results for the final model which includes all associated risks, child characteristics and the home-learning environment (Model 5).

Associated risks

After controlling for all other variables in the model, some of the family socio-economic risk factors remained negatively and significantly associated with early school performance of children. In both cohorts these risks were lower parental education levels, social or private rented, and overcrowded living conditions (especially regarding mathematics scores). Being part of a minority ethnic family was also significantly negatively associated with reading performance among MCS families, as was having a low weekly income and being a younger mother for the reading and mathematics scores of children in ALSPAC families.

Child characteristics

The child's earlier level of language ability, as measured by (different) assessments of their

vocabulary score, was identified as the most significant potential resource factor. However, being an older child was also significantly associated with early school achievement in both studies, after controlling for all the other variables in the model. Being female was associated with higher mathematics and reading scores in ALSPAC, and higher reading scores in MCS. Higher birth weight was also significantly associated with higher mathematics scores in ALSPAC, and not having behaviour problems in early childhood was associated with higher mathematics and reading performance in MCS.

Home Learning Environment

Reading to the child and teaching them the alphabet, numbers and songs at an early age were both significantly associated with the child's school achievement in reading and mathematics in both studies. Having regular bedtimes was also significantly associated with good performance scores in reading and mathematics in MCS, but only with mathematics performance in ALSPAC. Being regularly taken to a library was also significantly associated with school achievement in ALSPAC, as well as with reading in MCS.

Table 3. Regression on ALSPAC Standardised Entry Assessment scores

	Reading β (SE)	Mathematics β (SE)
Number of times workless (S1-S4)		
Workless x 1	-0.019	-0.036[*]
	(0.058)	(0.057)
Workless x 2	-0.008	-0.016
	(0.079)	(0.078)
Workless x 3+	-0.044[*]	-0.033[*]
	(0.072)	(0.071)
Associated Risks		
Age of mother at birth (years) (S1)	0.035[*]	0.033[*]
	(0.004)	(0.003)
Ethnicity (S1)	-0.001	-0.003
0=White, 1=other	(0.091)	(0.090)
Physical health (S1 – S4)	-0.009	-0.008
0=good, 1=poor S1 or S4	(0.052)	(0.051)
Mother depression score (S1)	-0.009	-0.010
(Edinburgh Post-natal depression scale, Cox et al 1987)		
range: 0-16	(0.005)	(0.005)
Housing tenure (S1)		
0=own, 1=rent (social)	-0.047[**]	-0.054[**]
	(0.054)	(0.054)
0=own, 2=rent (private)	-0.040[**]	-0.040[**]
	(0.076)	(0.075)
0=own, 3=other	-0.013	-0.021
	(0.108)	(0.107)
Overcrowded home (S4)	-0.036[**]	-0.041[**]
0= <1, 1=1+ per room	(0.035)	(0.035)
Weekly family income (S3)	-0.052[**]	-0.069[***]
1= £400+….5= <£100	(0.016)	(0.015)
Parent highest qualification (S1)		
0=degree, 1= A'Level	-0.152[***]	-0.145[***]
	(0.041)	(0.040)
0= degree, 2= O'Level	-0.161[***]	-0.152[***]
	(0.045)	(0.045)
0= degree, 3= vocational	-0.108[***]	-0.114[***]
	(0.070)	(0.069)
0= degree, 4= cse	-0.156[***]	-0.151[***]
	(0.066)	(0.065)
Mother took exam (S4)	0.017	0.013
0=yes, 1=no	(0.053)	(0.052)
Marital status (S1)		
0=married, 1=cohabiting	-0.021	-0.008
	(0.041)	(0.041)
0=married, 2=single parent	0.026	0.032
	(0.092)	(0.090)
No of marital transitions (S1-S4)	0.024	0.031
Range: 0=none, 1=1+	(0.044)	(0.043)

	Reading β (SE)	Mathematics β (SE)
Child Characteristics		
Birthweight	0.028	0.038[**]
Range: 200-5640 grms	(0.000)	(0.000)
Gender	0.106[***]	0.084[***]
0=boy, 1=girl	(0.028)	(0.028)
Health in last year (1y 6m-3y 6m)	0.008	0.014
0=never well/sometimes unwell , 1=always well	(0.051)	(0.050)
Age of child (at assessment)	0.261[***]	0.297[***]
Range: 4.1-5.3 yrs	(0.045)	(0.044)
Child behaviour (Rutter) (3y 6m)	-0.018	-0.042[**]
Range: 0-52	(0.003)	(0.003)
Vocabulary score (3y 2m)	0.185[***]	0.173[***]
Range: 0-246	(0.001)	(0.001)
Home-Learning Environment		
Reads to child (2y)	0.068[***]	0.038[*]
0=never…..4=everyday	(0.018)	(0.018)
Taken to library (3y 6m)	0.049[**]	0.065[***]
0=never….3=every week	(0.014)	(0.014)
Regular bedtime (2y 6m)	0.024	0.034[*]
0=9pm+, 1=8pm, 2=7pm	(0.019)	(0.019)
Mother teaching score (3y 6m)	0.047[**]	0.063[***]
Range: 0-3	(0.025)	(0.025)
R^2	0.237	0.257
Observations	3790	3790

Notes. Standardized beta coefficients; Standard errors in parentheses. [*] $p < 0.05$, [**] $p < 0.01$, [***] $p < 0.001$

Table 4. Regression on MCS standardised FSP scores

	Reading β (SE)	Mathematics β (SE)
Number of times workless (S1-S3)		
Workless x 1	-0.031	-0.033[*]
	(0.060)	(0.052)
Workless x 2	-0.018	-0.033[*]
	(0.066)	(0.060)
Workless x 3	-0.052[**]	-0.076[***]
	(0.073)	(0.078)
<u>Associated Risks</u>		
Age of mother at birth (years) (S1)	0.005	-0.006
	(0.002)	(0.002)
Ethnicity (S1)	-0.036[*]	-0.028
0=White, 1=other	(0.048)	(0.047)
Long-standing illness (S1 – S3)	-0.029[*]	-0.013
0=none, 1=yes [S1 or S3], 2=yes, both	(0.026)	(0.025)
Mother depression score (S1)	0.003	0.009
(Malaise scale, Rutter et al 1970)		
(range: 0-9)	(0.008)	(0.008)
Housing tenure (S1)		
0=own, 1=rent (social)	-0.059[**]	-0.040
	(0.049)	(0.046)
0=own, 2=rent (private)	-0.034[*]	-0.016
	(0.048)	(0.049)
0=own, 3=other	-0.032[*]	-0.018
	(0.067)	(0.064)
Overcrowded home (S3)	-0.033[*]	-0.054[**]
0= <1, 1=1+ per room	(0.056)	(0.064)
Poverty (OECD median income) (S1)	-0.023	0.003
0=60% or above, 1=below 60%	(0.037)	(0.038)
Highest qualification (h'hold) (S1)		
0=NVQ4+, 1=NVQ3	-0.075[***]	-0.057[***]
	(0.032)	(0.034)
0= NVQ4+, 2=NVQ2	-0.086[***]	-0.079[***]
	(0.036)	(0.034)
0= NVQ4+, 3=NVQ1/overseas	-0.060[***]	-0.066[***]
	(0.057)	(0.056)
0= NVQ4+, 4= no qualifications	-0.058[***]	-0.062[***]
	(0.064)	(0.064)
Parent gained higher level qualification	-0.001	0.001
S1-S4 0=yes, 1=no	(0.038)	(0.035)
Marital status (S1)		
0=married, 1=cohabiting	-0.023	-0.016
	(0.030)	(0.026)
0=married, 2=single parent	0.017	0.024
	(0.049)	(0.050)
No. of marital transitions (S1-S3)	-0.015	0.005
(range: 0-2)	(0.021)	(0.021)
IMD deprivation (employment) (S1)	-0.005	0.008

	Reading β (SE)	Mathematics β (SE)
	(0.006)	(0.006)
Child Characteristics		
Child's birthweight (S1)	0.022	0.032[*]
	(0.022)	(0.022)
Child's gender (S1)	0.069[***]	0.008
1=boy, 2=girl	(0.023)	(0.022)
Child's age at interview (S3)	0.190[***]	0.208[***]
Range: 4.4-6.1 years	(0.000)	(0.000)
Child's behaviour (SDQ) (S3)	-0.121[***]	-0.163[***]
Range: 0-34	(0.003)	(0.003)
BAS Naming Vocabulary Score (S2)	0.224[***]	0.229[***]
Range: 56-149	(0.001)	(0.001)
Child's General Health (S3)	-0.001	0.006
1=very poor..okay, 2=good/excellent	(0.016)	(0.017)
Child has LS Illness (S3)	0.006	0.029
1=yes, 2=no	(0.022)	(0.024)
Home Learning Environment		
Read to child (S2)	0.066[***]	0.053[***]
Range: 1=not at all….6=every day	(0.013)	(0.013)
Take to library (S2)	0.033[*]	0.023
Range:1=never...5=weekly	(0.010)	(0.009)
Regular term-time bedtime (S3)	0.045[**]	0.030[*]
1=never/sometimes, 2=usually/always	(0.018)	(0.016)
Parent teaching score (S2)	0.041[**]	0.048[***]
(e.g. alphabet, numbers, songs)		
Range: 0-3	(0.025)	(0.023)
R^2	0.257	0.257
Observations	5656	5656

Notes. Standardized beta coefficients; Standard errors in parentheses [*] $p < 0.05$, [**] $p < 0.01$, [***] $p < 0.001$

Summary and Conclusion

Between 18% (ALSPAC) and 23% (MCS) of young children in our study had experienced at least one period of parental worklessness and between 6% (ALSPAC) and 8% (MCS) had experienced repeated (persistent) parental worklessness during their first five years of life. This finding is important because it suggests that worklessness is higher in these data than in general population level estimates, which highlights the increased exposure to worklessness among families with young children even in economically 'good' times. Parental worklessness, temporary or repeated, was associated with lower levels of parental education, cohabitation or single parenthood, living in rented and/or overcrowded accommodation and low income. Our evidence on this point is informative from a policy perspective, as it shows that the experience of repeated rather than temporary

worklessness appeared to be more likely for those families with lower qualifications and poorer health (MCS). Temporary worklessness, by contrast, was more strongly associated with family instability, overcrowded living conditions and low income – particularly in MCS. These findings suggest different pathways towards repeated versus temporary worklessness, and potentially the accumulation and persistence of disadvantage among those families experiencing repeated worklessness. Parental worklessness, and especially repeated worklessness, was associated with a range of additional risk factors, that also impact on the academic performance of young children.

We were also able to contribute to the existing literature by estimating the impact of worklessness on specific cognitive outcomes, namely reading and mathematics. In both cohorts, exposure to temporary

and repeated parental worklessness was associated with lower reading and mathematics attainment scores for children. Although the strongest associations were found for repeated parental worklessness, the experience of worklessness – even only once – was significantly associated with lower attainment scores. The analysis does show the value of capturing differences between repeated and transitory episodes of worklessness and not just seeing it as a static 'state'. It is important to note here, however, that any correlation observed between parental worklessness and child academic performance is not necessarily causal, since worklessness may be related to other unobserved characteristics of families that determine child outcomes. Despite this caveat, given that our analysis uses rich data and controls for many potential confounding factors, we would argue our results are indicative for policy.

The main conclusion from the research is that young children in primary school who grew up in a workless household, had poorer early academic outcomes and made less progress between age three and five than those living in working families. However, much (but not all) of the association between parental worklessness and their children's early academic progress was attributable to other family socio-demographic characteristics, highlighting the multiple challenges faced by workless families and their children. This implies that whilst targeting workless families for policy purposes might be useful, such families face myriad disadvantages which impact on their children's outcomes and hence there are many potential indicators of children at risk of low achievement in addition to family worklessness.

Regarding the role of the early home-learning environment as a potential resource factor that might ameliorate the association between parental worklessness and children's early academic outcomes, we found that although the measures of early home-learning had a significant positive association with child academic progress, they did not significantly reduce the overall association between parental worklessness and outcomes. This is an important result, suggesting that worklessness is associated with negative outcomes independently of what parents do to construct a positive home-learning environment. That said, some of the home-learning measures that had a positive independent association with early school achievement scores (over and above the other

variables included in the model), hold particular interest for future policy and intervention strategies. Reading to a child, teaching basic educational building blocks at a young age and keeping to a regular bedtime, were all positively associated with academic performance during the first year at school, highlighting the importance of the early home learning environment (Dearden et al., 2011; Waldvogel & Washbrook, 2010) and family rules (Kelly et al., 2013). A child's early verbal skills were also positively associated with their school achievement scores, as was a lack of behaviour problems, in MCS. Our findings thus support policies for encouraging parental investment of time in their children at the earliest stages, particularly regarding support for early verbal skills.

In ALSPAC data, children in a repeated workless household had school achievement scores that were between 0.03-0.04 of a standard deviation lower than those in households that did not experience worklessness. In MCS, the association was somewhat stronger at 0.05-0.08 of a standard deviation in school achievement scores. This finding might suggest increasing social polarization for the later-born MCS cohort, or children growing up outside Southern England. However, this evidence is not sufficient to draw firm conclusions on this point and further work would usefully explore changes in the impact of worklessness over time and by region.

To end, we note that the findings highlight the role of multiple and interlinked influences on human development (Bronfenbrenner, 1986), the importance of formative years and timing of events (Elder & Caspi, 1988), as well as the plasticity of development (Lerner, 1984; Rutter, 1987, 2006; Sameroff, 2010). That there remained a significant independent association between repeated parental worklessness and reading and mathematics scores for children in both ALSPAC and MCS, even after controlling for associated socio-economic risks, child characteristics and measures of early home-learning suggests the need to tackle worklessness in conjunction with the wider range of risks these families face.

Future research should examine in more detail the combination and patterns of risks in workless families, and what combination of resource factors can help young children to 'beat the odds'. Of particular interest would be the different experiences facing lone parent families and families with and without access to high quality pre-school provision.

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Appendix

Table A1. Relationship between parental worklessness and potential protective factors (ALSPAC)

	0 Workless %	1 Workless %	2 Workless %	3+ Workless %	All %	*N (all)*
Child Characteristics						
Mean birthweight (kg)	3.5	3.4	3.4	3.3	3.4	*6871*
Gender (% female)	48.6	49.1	47.7	49.1	48.6	*6942*
Good health in last year (1y 6m-3y 6m)	91.9	89.6	87.9	86.0	91.2	*6939*
Mean age of child (at Entry Assessments)	4.6	4.5	4.5	4.6	4.6	*5041*
Mean behaviour score (SDQ) (3y 6m)	12.3	12.8	13.6	13.6	12.5	*6742*
Mean Vocabulary score (3y 2m)	230.0	228.1	225.5	223.3	229.3	*6767*
Child school experiences						
Always enjoys school (4y 6m)	68.8	67.1	68.4	74.6	69.0	*6294*
Home Learning Environment						
Reads to child everyday (2y)	63.9	52.8	49.2	41.9	61.1	*6745*
Regular bedtime before 9pm (2y 6m)	86.3	79.6	81.4	78.3	85.1	*6654*
Mean teaching score (3y 6m)	2.6	2.7	2.6	2.6	2.6	*6718*
Taken to library (3y 6m)	69.3	64.2	62.4	57.4	67.9	*6733*
n(low-high)	*4109-5703*	*383-509*	*224-308*	*325-422*		

Table A2. Relationship between parental worklessness and potential protective factors (MCS)

	0 Workless %	1 Workless %	2 Workless %	3 Workless %	All %	*N (all)*
Child Characteristics						
Mean birthweight (kg)	3.4	3.3	3.3	3.3	3.4	*8232*
Gender (% female)	49.0	50.3	49.1	51.4	49.3	*8252*
Excellent health in last year (S3)	54.5	41.9	41.7	41.1	51.5	*8216*
No longstanding illness (S3)	82.2	79.1	75.1	75.1	80.9	*8207*
Mean age of child (at interview S3)	5.2	5.2	5.2	5.2	5.2	*8252*
Mean behaviour score (SDQ) S3	6.5	8.4	9.3	10.9	7.1	*7020*
Mean BAS Naming Vocabulary score (S2)	76.0	68.9	67.4	63.6	73.9	*7710*
Home Learning Environment						
Reads to child everyday (S2)	65.0	49.1	43.0	39.8	60.2	*8252*
Regular bedtime (S3)	65.0	62.6	61.3	58.2	64.0	*8218*
Mean teaching score (S2)	2.8	2.7	2.7	2.6	2.7	*8251*
Taken to library (S2)	45.9	32.9	30.5	25.5	42.0	*7730*
n(low-high)	*5275-6183*	*554-748*	*378-573*	*450-748*		

Table A3. Response bias in longitudinal sample of families compared to all families in first wave of data collection in ALSPAC (8 months) and MCS (9 months)

	ALSPAC				MCS			
	Long sample		All families		Long sample		All families	
	%	*n*	%	*n*	%	*n*	%	*n*
% white	96.9*	*6,810*	95.1	*12,392*	85.7	*8,233*	84.7	*9,124*
% home owner	82.3*	*6,904*	77.1	*11,239*	64.4	*8,236*	62.0	*9,124*
% rented (social)	11.0*	*6,904*	15.0	*11,239*	22.3	*8,236*	23.7	*9,124*
% overcrowded home (1+ per room)	22.6*	*6,671*	25.0	*9,922*	8.6	*8,211*	9.1	*9,086*
% degree (or equiv)+	23.6*	*6,827*	21.3	*12,511*	44.8	*8,241*	43.3	*9,129*
% no quals	8.7*	*6,827*	13.7	*12,511*	7.6	*8,241*	8.4	*9,129*
% married	79.1*	*6,942*	75.2	*11,246*	62.3	*8,252*	60.8	*9,146*
% single parent	3.6	*6,942*	4.4	*11,246*	12.7	*8,252*	13.8	*9,146*

In both studies t-tests were used to assess if the mean scores for the longitudinal samples differed significantly from the mean score for all participating families. An * indicates differences in the mean scores were significant at the p<0.05 level. In both studies the more affluent and privileged were more likely to be part of the longitudinal sample and the more disadvantaged to have dropped out. For example, fewer single parents and more married couples are part of the longitudinal samples as are fewer families living in social rented housing and more home owners. However, whereas these differences were not significant in MCS, all bar one measure showed a significant response bias in the ALSPAC longitudinal sample. The one exception to this was single parents.

Endnotes

[i] Workless working-age households by type of household, 2010 Release
http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-200008.

[ii] Fraser et al (2012), suggests that ~80% of the enrolled pregnancy cohort from ALSPAC completed the questionnaire when the child was 8 months old (see table 1).

[iii] Assessment score from later ages, e.g. Key Stage 1, were available for both cohorts but in this paper we have concentrated on the school assessments of children in their first full year of primary school.

[iv] Note that since we control for prior cognitive ability of the child the model is akin to a "value added" model.

[v] The dependent variable is categorical. For robustness, we estimated an ordered logit regression model and the same set of risk factors were significantly associated with parental worklessness. We present the OLS results for ease of interpretation.

Exploring household dynamics: the reciprocal effects of parent and child characteristics

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Abstract

A burgeoning line of literature has shown there are strong effects of maternal mental health on child socio-emotional development (Cummings & Davies, 1994; Downey & Coyne, 1990; Mensah & Kiernan, 2010; Smith, 2004). This literature is often based on the examination of dyadic relationships, where maternal mental health is hypothesised to have an effect on child development and well-being, and the mother-child relationship is examined in isolation of other household relationships. This may also be true in clinical practice: while family dynamics are often considered when treating children for behavioural problems or other psychological symptoms, this is often not the case when the parents are treated. However, household dynamics are complex, and other household members may have an effect both on the well-being of the mother and the child. Furthermore, children's characteristics can also have a feedback effect on their parents' outcomes. While the literature often concentrates on the effects of parents' characteristics on child outcomes, the reverse might also occur. In this paper, we employ a structural equation model with cross lagged effects, to understand the reciprocal relationships between the mother's mental health, the child socio-emotional development, and the quality of the parental relationship. Analyses were conducted using longitudinal data from the Millennium Cohort Study, a prospective national birth cohort of children born in the UK in 2000-2001. The Millennium Cohort Study has a wealth of information on the socio-economic background of the household, and has collected data on the mother's mental health, the quality of the parents' relationship, and the children's socio-emotional development. In this work we look at data relating to the pre-school age, a crucial developmental age which has often been missing from the literature.

Keywords: reciprocal influences; family effects; parent-child effects; child development

Maternal mental health and child well- being

Mental health problems affect more than 25% of all people at some time in their lives, and rates of diagnosis are increasing (World Health Organization, 2001). Mental health issues have been found to be particularly prevalent in parents of young children. Oates (1997) found that a quarter of female patients newly referred to psychiatric services in the UK were caring for a child under the age of five, and that a similar proportion of adults with a diagnosis of schizophrenia were living in households with children aged under 16. Overall, 60% of adults with serious *chronic* mental illness had children under 16 (Oates, 1997). There are few statistics quantifying this phenomenon from the child's perspective. Using a number of British national surveys on psychiatric disorders and 2001 Census figures of the numbers of dependent children by household type, Gould (2006) calculated that there are just over 1.25 million children in England and Wales living with parents or carers who have a mental health problem.

There is a longstanding recognition and concern that parental mental health difficulties can impact on children's development (e.g. Downey & Coyne, 1990; Smith, 2004). The negative impact of maternal depression (the most studied parental mental health problem) on child development has been found for children from infancy to adolescence; the association has been observed in both clinic and community populations, and in a number of different countries and cultures. It is apparent in a wide range of child outcomes such as language development, behaviour, social and emotional competence, sleeping problems, and physical health (Cleaver, Unell, & Aldgate, 1999; Cummings & Davies, 1994; S. H. Goodman & Gotlib, 1999; Hay et al., 2001; Smith, 2004). The effects appear to be both concurrent and longitudinal (Rothbaum & Weisz, 1994; Waschbusch, 2002). A "parent effects" model, in which conflictual/negative parenting styles cause and/or exacerbate child problems, has traditionally been cited as responsible for this association (Collins, Maccoby, Steinberg, Hetherington, & Bornstein, 2000; Maccoby, 2000). This is supported by research which shows that, for example, improving parents' discipline strategies leads to a reduction in children's externalizing problems (Dishion & Kavanagh, 2000).

There are indications that the experience of maternal mental health problems has a larger impact on child behavioural outcomes than either cognitive or educational problems. It has been estimated that children of depressed parents are between two and five times more likely to develop behavioural problems than children whose parents are not depressed, with up to 40% of children of depressed parents presenting behavioural or emotional problems (Cummings & Davies, 1994). In addition to concurrent impacts, there are long-term associations. A longitudinal study that conducted a 10-year follow-up investigation of children of depressed parents found a threefold increase in depression, and an even greater increase in the likelihood of developing alcohol dependence or panic disorders, compared to children of non-depressed parents (Weissman, Warner, Wickramaratne, Moreau, & Olfson, 1997).

These relationships have been tested recently in young British children. Mensah & Kiernan (2010) found poorer outcomes for a range of cognitive, social and emotional problems among children whose parents reported psychological distress compared to children whose parents did not report distress. Although parents' socio-economic resources mediated some of these effects, an independent effect of mother's psychological distress was retained (Mensah & Kiernan, 2010). Persistent maternal distress was particularly shown to increase the risk of behavioural problems among 3 year olds (Kiernan & Mensah, 2009).

Mental health difficulties frequently co-occur with unemployment (Bartley, 1994), socio-economic deprivation and financial difficulties (Hudson, 2005; R. Jenkins et al., 2008), family instability, early parenthood and low education (Kiernan & Pickett, 2006). Socio-economic adversity also has a strong influence on early childhood development (see for example reviews by the National Institute of Child Health and the Human Development Early Childcare Network, 2005, and Shonkoff & Phillips, 2000; and Kiernan & Huerta, 2008, and Kiernan & Mensah, 2009 for British examples). Socio-economic adversity may thus be an important mediator between parents' mental health difficulties and poorer child development.

There are a number of proximate mechanisms through which maternal depression can impact on child well-being, such as increased household chaos, or the quality of the parenting the parent can provide to the child. In a meta-analysis of 46 observational studies, Lovejoy and colleagues (2000) concluded that depressed mothers of infants and young children were more hostile and irritable, more disengaged, and registered lower rates of play and other positive social interactions. Schoon and colleagues have shown that the impact of persistent financial hardship on child outcomes is partially mediated by maternal distress, which affects the quality of parent-child interactions and the provision of a stimulating home environment (Schoon, Hope, Ross, & Duckworth, 2010).

Most previous research has focused on the impact of maternal depression on child outcomes and not vice-versa; in fact it has often been limited to this. There is some limited literature on the effects of child characteristics on maternal well-being. This tends to focus on specific populations, notably children with disabilities (Hauser-Cram et al., 2001), and especially with developmental disabilities (Olsson & Hwang, 2001; Singer & Floyd, 2006). There is, however, growing evidence that a dual child-to-parent effect may also exist in the general population: child maladjustment has been shown to

influence parents' relationships with one another (Belsky & Rovine, 1990; Leerkes & Crockenberg, 2002; Papousek & von Hofacker, 1998) and parents' own psychological functioning (Ge, Conger, Lorenz, Shanahan, & Elder Jr, 1995).

Support for a "child effects" models comes from studies such as that carried out by Anderson, Lytton and Romney (1986), in which the authors observed children with conduct disorder problems and their mothers, during play and structured tasks. They found that, when playing with children who did not have conduct problems, mothers of children with conduct problems did not differ from mothers of non-problem children in commands and negative and positive behaviours. However, all mothers responded negatively and gave more commands when playing with children with conduct problems. They therefore concluded that maladaptive interactions between children with conduct problems and their mothers were driven mainly by the child. Similarly, child effects have also been demonstrated during drug treatment experiments: Barkley and Cunningham (1979) found that when the behaviour of non-attentive and non-compliant children was improved through stimulant drugs, the mother-child interactions nearly normalised.

However, one of the cornerstones of contemporary thinking about parenting is the idea of reciprocity in parent-child relationships (Maccoby, 2003), implying that both parent and child effects are at play. Such a reciprocal model has implications for the aetiology, maintenance, assessment, and treatment of psychological and behavioural problems (Downey & Coyne, 1990). Much of the work exploring reciprocal effects has been based on small, often community-based samples. Few studies have attempted to establish simultaneous models that test the reciprocal relationship between maternal mental well-being and child adjustment problems in a larger, general population. Exceptions include Elgar and colleagues (2003), who used cross-lagged correlations and regressions to examine temporal relations between maternal depressive symptoms and three domains of child functioning: hyperactivity, aggression, and emotional problems in a national sample of Canadian children aged 4-11 years. They found that maternal depression increased the risk of adjustment problems in children, and vice versa, with the mother's effect appearing to be the antecedent.

Furthermore, other actors are often not considered when estimating the relationship between maternal depression and child outcomes. Restricting the analysis to the dyadic pair of mother-child is limiting, as it excludes the influence of other potentially important household members, such as other parents, siblings and other cohabiting adults such as grandparents. Father interactions and father characteristics are increasingly recognized as also being important for child development (Lamb, 2004; Tamis-LeMonda, Shannon, Cabrera, & Lamb, 2004), and father characteristics may in fact play a moderating role in the effect of maternal depression on child outcomes such as behaviour (Mezulis, Hyde, & Clark, 2004). While some previous literature has found limited direct effects of father characteristics when added to a mother-child model, how we consider the father vis-à-vis young children may be important. For example, in Conger's classic model of the effects of family stress on children, the father's mental well-being often does not remain significant when modelled alongside maternal mental well-being and relationship quality on child well-being, however relationship conflict (to which the father clearly contributes) does (Conger et al., 1992). As young children may be more often looked after by their mothers, their experience of paternal well-being might be manifested, from their perspective, through interactions with the mother. There is a large literature showing that parental conflict has an impact on outcomes such as child behaviour, externalizing problems and peer relations (Benzies, Harrison, & Magill-Evans, 2004; J. Jenkins, Simpson, Dunn, Rasbash, & O'Connor, 2005; Katz & Gottman, 1993; Katz & Woodin, 2002; Najman et al., 1997).

Few models attempt to bring together a number of actors in explaining the dynamics within the household, and quantitative analyses of large population-based samples have been limited. Furthermore, while these types of models have been used to study other aspects of family dynamics (for example, adolescent depression, marital conflict over child rearing and marital dissatisfaction (Cui, Donnellan, & Conger, 2007), marital conflict and siblings behaviour (Jenkins et al., 2005)), few have focused on maternal depression and child difficulties. Those that have were restricted to small samples and related to older children. Ge and colleagues used cross-lagged models with three waves of panel data that were collected over 2 years from

368 parent–child dyads (Ge et al., 1995). Both parents and children provided self-report data on symptoms of depression, anxiety, and hostility. They found that parent and adolescent distress were reciprocally related over time after earlier symptoms were statistically controlled. More recently, Steele, Rasbash & Jenkins (2013) used the Avon Brothers and Sisters Study, a study of 235 families within ALSPAC (Avon Longitudinal Study of Parents and Children) birth cohort to test the reciprocal lagged effects of maternal depression and siblings' delinquency scores. They found that while the mother's depression did not have a lagged effect on boys' delinquency 2 years later, higher maternal depression was associated with a lower delinquency score among girls, controlling for the child's prior level of delinquency. There was, however, no feedback effect: there was no association between child delinquency and change in maternal depression. The model also tested for sibling effects, however once family-level random effects were included there was no evidence that sibling delinquency predicted the child's delinquency 2 years later (Steele, Rasbash, & Jenkins, 2012).

Conceptual model

The present study extends earlier research by proposing that early childhood difficulties will be reciprocally linked with maternal mental distress and the functioning of the parental dyad. The conceptual model therefore attempts to depict relationships between the 3 key variables (maternal psychological distress, child behaviour, and parental relationship quality) at 2 time points. The model is organised in a temporal fashion, taking into account the longitudinal nature of the data, with variables collected at age 3 conceptualised to have an effect on variables at age 5 (see Figure 1). Figure 1 presents a cross-lagged auto-regressive model, a model well-suited for testing hypotheses related to reciprocity and mutual influence (Ge et al., 1995; Steele et al., 2013). The conceptual model does not include potential moderators, such as ethnicity, which will be returned to.

The model is adjusted for a number of controls for the family and social context which may affect our key relationships of interest, including markers of socio-economic status that have been shown to predict variation in family interaction processes and child adjustment (Conger & Donnellan, 2007; Conger & Elder, 1994). They are further described in

more detail below. Although the main part of our cross-lagged model is saturated, the whole model is not saturated, as the covariates we adjust for are time-varying.

We focus on the early years (3 to 5 years old), a critical developmental period which has often been overlooked by the literature on this subject. Because these analyses focus on mutual influences in the parent–parent and the parent–child relationships, this period of the life course is particularly interesting, as we know that early childhood relationships have long-lasting effects on childhood and adult adjustment.

Data

A recent, nationally representative prospective cohort study is used for this work. The Millennium Cohort Study (MCS) includes 18,818 children living in the UK at 9 months of age and born over a period spanning 2000-01 (Dex & Joshi, 2005). The sample has a probability design and is clustered at the electoral ward level. The survey design over-sampled areas with high ethnic density, areas of high child poverty, and Northern Ireland, Scotland and Wales. The study mainly consisted of interviews with the main carer. At sweep 1, this was the mother in 98% of cases. A proxy interview with the main respondent was conducted if the resident partner could not be interviewed directly.

To date, four sweeps of data collection have been archived, when cohort members were aged about 9 months, 3, 5 and 7 years. Here we use data for ages 3 and 5 (sweeps 2 and 3). We focus on the pre-school data, since, for most children, the family is the main environment they spend time in and the major source of socialization in the pre-school period. The overall response rate for sweep 1 was 68%, and following this response rates for sweeps 2 and 3 were 78% and 79%, respectively. Final sample sizes were 18,818 children in sweep 1; 15,808 at sweep 2; and 15,459 at sweep 3 (Hansen, 2008). Here we limit our sample for analysis to cohort members living with the same two parents at both age 3 and 5, with complete data on key variables (maternal mental health, child difficulties score, and parental relationship quality) available at both sweeps, producing a final sample size of 6,572 households.

As for all cohort studies, attrition is present and the households lost to follow-up were more likely to come from disadvantaged backgrounds than

those retained in the study (data available on request). Survey weights to correct for cohort members having unequal probabilities of selection in the study due to the stratified and clustered sample design, as well as to take account of attrition between sweeps and unit non-response (Plewis, 2007) are applied in these analyses.

Measures

Maternal psychological distress was assessed using the six item (K6) Kessler Psychological Distress Scale (Kessler et al., 2002; Kessler & Mroczek, 1994). This was administered using a computer-assisted, self-completion form. Each parent was asked how often in the past 30 days they had felt: 'so depressed that nothing could cheer you up ', 'hopeless ', 'restless or fidgety', 'that everything you did was an effort', 'worthless', 'nervous'. Individuals scored four points for responding 'all of the time'; three points for 'most of the time'; two points for 'some of the time'; one point for 'a little of the time' and no points for 'none of the time'. The Kessler scale has good reliability and validity (Kessler et al., 2002; Kessler & Üstün, 2004), and correlates with previously diagnosed depression and currently treated depression. Within our analytical sample, Cronbach's alphas indicated good internal consistency (Sweep 2: α=0.82; Sweep 3: α=0.85). We use the questions included in the survey to create a continuous score, with higher scores indicating higher distress levels.

To measure *parental relationship quality*, the Golombok Rust Inventory of Marital State (GRIMS) was selected. The scale is a 28-item questionnaire designed to assess the quality of the relationship between a married or cohabiting couple (Rust, Bennun, Crowe, & Golombok, 1986), asking respondents items such as 'my partner is usually sensitive to and aware of my needs' and 'sometimes I feel lonely even when I am with my partner', with responses ranging from strongly agree to strongly disagree. The GRIMS includes not only negative items (which would only tap into parental conflict), but also positive ones, constructing a more holistic description of the parents' relationship. Only four questions from the scale were available in the self-completion part of the age 3 and 5 sweeps, so we use these questions to create a continuous score, with higher scores indicating more conflict and poorer relationship quality. Cronbach's alphas

indicated good internal consistency (Sweep 2: α=0.67; Sweep 3: α=0.81).

The Strengths and Difficulties Questionnaire (SDQ) is a behavioural screening questionnaire designed to measure psychological adjustment in 3-16 year olds (R. Goodman, 1997, 2001). It includes 20 items, some positive and others negative, where an item is a description of an attribute of the child's behaviour. The 20 items are divided into four scales of five items each: Hyperactivity/inattention (e.g. restless, overactive, cannot stay still for long); Conduct problems (e.g. often fights with other children or bullies them); Emotional symptoms (e.g. has many fears and is easily scared); Peer problems (e.g. is rather solitary, tends to play alone). The main carer indicates whether each item is: Not true; Somewhat true; or Certainly true of the child in question, and responses are scored 0, 1 or 2, such that higher scores indicate more problematic behaviour. Responses across all scales are summed to derive the Total Difficulties Score, which can range from 0 to 40. Here, we use this as a continuous score, with higher values indicating more problems. As a guide to interpretation, the SDQ defined cut-off scores are: normal (0-13 points), borderline (14-16), or abnormal (17 or above); the latter two categories may signal problems that require clinical intervention.

Model variables

The *income* earned by the resident partners was reported by the main respondent at all sweeps using a banded show card. It is important to note that this relates to the resident partners' income, not the overall household income, as other earners in the household were not included. It does, however, include any regular payments made by a non-resident parent to the resident carer. The variable used for modelling purposes is a continuous measure of parental income.

Questions on the highest *educational qualifications* achieved by the main carer were classed according to the National Vocational Qualification (NVQ) classification. Categories for analyses are: no qualifications, overseas qualifications only, NVQ 1, NVQ 2, NVQ 3, NVQ 4, and NVQ 5. Roughly, an NVQ 5 is equivalent to a graduate degree; an NVQ 3 is equivalent to two A-levels. We could not further classify those with overseas qualifications (which make up about 1% of our sample), as further details were not asked in the survey.

A series of questions asked of the main respondent aim to tap into the ***atmosphere in the home***. These items were derived from the CHAOS scale (Matheny, Wachs, Ludwig, & Phillips, 1995). The CHAOS scale is designed to assess the level of confusion and disorganization in the child's home environment, and is targeted for homes with infants and toddlers. In the Millennium Cohort, three questions from the CHAOS scale were included. The main respondent was asked whether they thought the following statements applied to their home: "the atmosphere in your home is calm", "it's really disorganised in your home" and "you can't hear yourself think in your home". Answers are on a five point scale and range from "strongly agree" to "strongly disagree". These three variables appeared to load on the same factor (sweep 2: Eigenvalue 1.04, factor loadings respectively 0.58, 0.55, 0.63; sweep 3: Eigenvalue 1.07, factor loadings respectively 0.61, 0.52, 0.66), and therefore capture an underlying common construct, which we will refer to as "household chaos". We summed the three variables to give a score ranging from zero to twelve, with higher scores indicting a more chaotic home atmosphere.

Methods

Initial descriptive analyses, regressions and correlations were used to examine the stability in, and relations between, the 3 key variables at 2 data points.

To model intra-household dynamics between maternal mental health, child socio-emotional behaviour and parental relationship quality, we conducted a cross-lagged structural equation model, which allowed us to simultaneously estimate the nine sets of longitudinal relationships described above (see Figure 1). Analyses were restricted to two-parent households, in which the parents were continuously partnered across sweeps 2 and 3 (ages 3 and 5), with no missing data on any of the six key variables.

We conducted sensitivity analyses to explore whether hypothesised associations were affected by the inclusion of 540 ethnic minority households in our sample (or 7.5% of our final sample). Restricting the sample to White British participants did not significantly alter the results, and therefore we did not exclude the ethnic minority population from our final analyses. We also ran our models for male and female cohort members separately and found that, although there was some loss of statistical significance, likely due to reduced sample sizes, the direction and magnitude of effect sizes were similar for boys and girls. We therefore decided to run our final analyses on boys and girls together. Further sensitivity analyses were carried out by adding a measure of mental health at baseline (9 months) as one of the co-variates, including this measure in the model did not significantly improve model fit and led to over-adjustment with the mental health measures already present in the model.

Model fit was assessed using several goodness-of-fit criteria. The chi-square is highly sensitive to sample size and distributional assumptions (Hu & Bentler, 1995), so we used three other measures of model fit: the comparative fit index (CFI), the Tucker–Lewis index (TLI), and the root mean square error of approximation (RMSEA). The CFI and TLI range in value from 0 to 1, with values greater than 0.9 indicating a good fit. RMSEA values range from 0 (perfect fit), to 1 (not acceptable). Values up to 0.05 are considered a good fit (Browne, Cudeck, Bollen, & Long, 1993).

Models were adjusted for maternal age at birth, sex of the cohort member, maternal education (measured at age 3), and household income, household composition, and household chaos (all measured at ages 3 and 5). Descriptive statistics were weighted for non-response and the unequal probability of being sampled. All analyses were conducted using Stata (StataCorp, 2011).

Results

Descriptive results

Table 1 describes our sample in terms of the model variables. We note that our sample is relatively advantaged, with a mean parental income of £31,600 at age 3, and a mean maternal age at birth of the cohort child of 30 years, likely due to the exclusion from our final sample of lone parents and households that experience parental separation.

Table 1. Means and proportion of the sample at cut-off point for selected variables

		Age 3		Age 5	
			SD		SD
Cohort member's SDQ, mean score		8.61	4.73	6.33	4.39
Maternal Kessler, mean score		2.86	3.19	2.59	3.28
Golombok Rust Inventory mean score		4.47	2.88	4.79	3.00
Parental annual income, £1000s		31.6	19.1	34.8	20.2
Maternal age at cohort member's birth, age		30.07	5.12	-	-
Cohort member's sex (female), %		49.19	-	-	-
Maternal education, %	None	4.26	-	-	-
	Overseas	1.23	-	-	-
	NVQ 1	5.59	-	-	-
	NVQ 2	25.78	-	-	-
	NVQ 3	16.59	-	-	-
	NVQ 4	37.08	-	-	-
	NVQ 5	9.47	-	-	-

As shown in Table 2, regression analysis showed that in households where children had greater behavioural problems, mothers reported more symptoms of psychological distress, and more relationship problems, were reported to be more chaotic and tended to have lower incomes.

Table 3 displays the correlations among study variables that provided some tentative support for our hypotheses. Maternal psychological distress, parental relationship quality and child socio-emotional behaviour are correlated.

Table 2. Regression of age 5 outcome variables

		Cohort member's SDQ (age 5)			Maternal Kessler (age 5)			Golombok Rust Inventory (age 5)		
		βcoeff.	95% CI	p value	βcoeff.	95% CI	p value	βcoeff.	95% CI	p value
Cohort member's SDQ, age 3		0.56	0.54, 0.57	<0.001	0.18	0.16, 0.19	0.001	0.12	-0.14, -0.11	0.328
Maternal Kessler, age 3		0.38	0.35, 0.41	<0.001	0.50	0.48, 0.52	<0.001	0.02	0.00, 0.04	0.091
Golombok Rust Inventory, age 3		0.33	0.30, 0.36	0.004	0.04	0.02, 0.06	0.001	0.56	0.54, 0.59	<0.001
Household chaos, age 5		0.83	0.75, 0.92	<0.001	0.73	0.65, 0.82	<0.001	0.64	0.56, 0.72	<0.001
Maternal age at cohort member's birth		-0.52	-0.43, 0.61	<0.001	0.02	0.00, 0.03	0.011	0.02	0.01, 0.03	<0.001
Parental annual income (in £1000s), age 5		-0.04	-0.04, -0.03	<0.001	-6.65	-10.11, -3.20	<0.001	-4.18	-7.33, -1.03	0.009
Cohort member's gender		-0.95	-1.13, -0.75	<0.001	-	-	-	-	-	-
Maternal education, age 5	None	0.00	-	-	0.00	-	-	0.00	-	-
	Overseas	0.37	-0.45, 0.86	0.422	0.86	0.22, 1.49	0.009	0.07	-0.51, 0.65	0.808
	NVQ 1	-0.38	-0.21, 0.62	0.195	0.52	0.11, 0.92	0.012	0.22	-0.14, 0.59	0.233
	NVQ 2	-1.39	-0.43, 0.25	<0.001	0.34	0.01, 0.67	0.040	0.16	-0.14, 0.46	0.302
	NVQ 3	-1.67	-0.55, 0.16	<0.001	0.31	-0.03, 0.66	0.074	0.17	-0.15, 0.46	0.302
	NVQ 4	-2.52	-0.42, 0.26	<0.001	0.42	0.08, 0.75	0.014	0.20	-0.10, 0.50	0.186
	NVQ 5	-2.59	-0.34, 0.43	<0.001	0.29	-0.09, 0.66	0.138	0.32	-0.02, 0.67	0.066
Additional household members, age 5		0.12	-0.14, 0.00	0.021	-0.02	-0.09, 0.04	0.502	-0.09	-0.15, -0.03	0.003

Table 3. Unadjusted correlations among variables in the models

		Age 3			Age 5		
		SDQ	Kessler	GRI	SDQ	Kessler	GRI
Age 3	SDQ	1.00	-	-	-	-	-
	Kessler	0.46	1.00	-	-	-	-
	GRI	0.39	0.39	1.00	-	-	-
Age 5	SDQ	0.64	0.21	0.14	1.00	-	-
	Kessler	0.36	0.58	0.30	0.41	1.00	-
	GRI	0.31	0.28	0.60	0.35	0.38	1.00

Cross lagged models

Our hypothesised model, shown in Figure 1, fitted the data well (CFI: 0.966; TLI: 0.905; RMSEA: 0.054). All except one of the coefficients for the cross-lagged paths were significant at the .01 or .05 level (using one-tailed tests) and were consistent with the reciprocity hypothesis. First, the correlations suggested the possibility of significant reciprocal effects between maternal psychological distress and child behaviour. Second, although the most robust correlational evidence of reciprocity was for maternal psychological distress and child behaviour, similar patterns of correlations also occurred for parental relationship quality with both child behaviour and maternal psychological distress. However, we did not find a significant feedback effect of parental relationship quality on child behaviour. Finally, there were robust auto-regressive lagged effects over time for all key variables, indicating continuity in these variables.

Figure 1. Model results
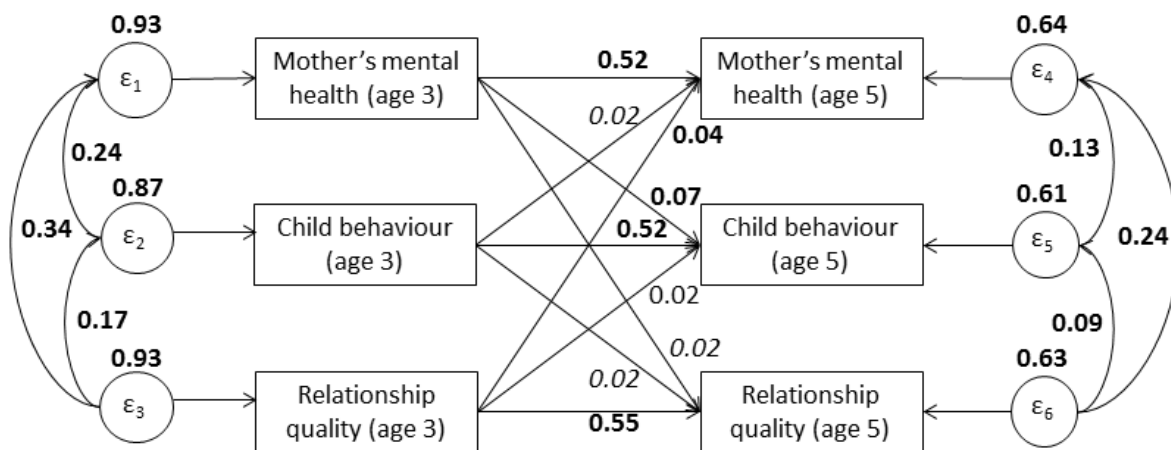
Notes. Standardised estimates: emboldening indicates statistical significance p<0.001; italics p<0.05. Model adjusts for maternal age at cohort member's birth, cohort member's age, cohort member's gender, household income, maternal educational level, household chaos, and maternal post-natal depression.

Conclusions

Based on contemporary developmental psychology theories that emphasise interdependent family systems and mutual influence (Maccoby, 2003), we hypothesised that maternal psychological distress, parents' relationship quality and early childhood behavioural difficulties would be reciprocally linked over time. Results from the autoregressive, cross lagged model mostly provided support for this hypothesis. Briefly, we found evidence that maternal psychological distress when the child was aged three significantly predicted both early childhood behavioural difficulties and parental relationship quality when the child was aged five. Although effect sizes were smaller, early childhood behaviour also significantly predicted maternal psychological distress and parental relationship quality 2 years later. Parental relationship quality when the child was aged three predicted maternal psychological distress, but not child behaviour, when the child was aged five.

These results support studies indicating that maternal mental health is associated with childhood difficulties (Cummings & Davies, 1994; Downey & Coyne, 1990; Mensah & Kiernan, 2010; Smith, 2004), and confirm that such correlation may extend to early childhood. Previous work focused on the uni-directional influence of maternal distress on child difficulties, with debates on which effect comes first, maternal distress or child difficulties. The present results indicate that this association involves reciprocal effects, and, rather than focusing on the "which comes first" issue, the focus should be on recognizing the bi-directional nature of maternal well-being and child difficulties.

Previous studies which considered the reverse relationship (child effects on parental well-being) have largely been focused on children with marked developmental problems or have examined how children may or may not be associated with certain parenting practices. The current study examined the interplay between maternal well-being and child difficulties during early childhood in a general population, and generate support for revised theorizing about the complex nature of parent–child relationships (Kerr & Stattin, 2003).

Another important contribution of this study is to show the importance of considering relationships beyond the mother-child dyad. To do so, we included a measure of parental relationship quality in our models. Our results indicated that parental relationship quality was influenced by earlier maternal mental health and child behaviour, and that the relationship with maternal mental health was reciprocal over time. In other words, parental relationship quality appeared to contribute to, and be influenced by, the context in which parent-child relationships occur. This finding further illustrates the interdependent nature of family relationships and linked family systems (e.g., couple and parent–child).

In evaluating the significance of these findings, it is helpful to consider the advantages and disadvantages of our study. First, the reciprocal model was evaluated using a prospective, longitudinal design involving repeated measures on two occasions. The availability of longitudinal data provided the opportunity to demonstrate the hypothesized reciprocal process. Second, the rich dataset available to us and the large sample size, allowed us to include controls on a number of variables such as gender, household socio-economic background, the presence of other household members, and a broader measure of the household environment. Third, we tested the reciprocal model in early childhood, a critical developmental period. Similar work has been tested at different periods of development, notably adolescence (Cui et al., 2007). Our study shows that the relationships which have been observed at adolescence are replicable at earlier developmental periods.

Although there are a number of methodological strengths of the present work, the study also has several limitations. First, due to the nature of our research question we were obliged to restrict our sample to stable two-parent families. Clearly, family instability will have an impact on all our key variables, and it was not possible to explore this here. Furthermore, although we made statistical adjustments for various aspects of the family context, we did not specifically analyse whether the relationships we observed varied according to the family context. For example, rates of both maternal depression and child adjustment problems tend to be higher among low-income, single-parent families than more advantaged, two-parent families (Curtis, Dooley, Lipman, & Feeny, 2001; Offord, Boyle, & Jones, 1987). This raises the question of whether our findings apply in both advantaged and disadvantaged contexts. In addition to focusing only on stable two-parent families, we further restricted our sample to observations with complete cases on

key variables across the two sweeps. Given the disproportionate representation of attrition in disadvantaged households, it is likely that our findings are an under-representation of the strength of the relationships presented. Future research should test the generalisability of our findings, in particular whether they can be replicated in different socio-economic contexts, or across different ethnic groups.

Second, the child behavioural problems were reported by mothers. This raises the possibility that mothers who experienced greater levels of psychological distress may have a tendency to perceive their children's problem behaviour to be more severe. However, studies in which maternal reports of child behaviour were compared with behavioural observations and teacher reports have not consistently found that depressed mothers are less accurate in assessing their child's behaviour than non-depressed mothers (Richters, 1992). Generally, studies have shown that mothers (depressed or not) provide reliable and accurate assessments of child psychological well-being and that depressed mothers are not significantly biased to misreport child symptoms compared to non-depressed mothers (Faraone, Biederman, & Milberger, 1995; Querido, Eyberg, & Boggs, 2001). Nonetheless, other sources of method variance (e.g., social desirability) may have inflated associations between maternal psychological distress and child behavioural difficulties.

Finally, there are questions about the size and practical significance of the reciprocal effects. Our large sample meant that we were able to capture small but statistically significant effects. Small effects are not necessarily trivial, especially when they reflect an on-going process related to the well-being of individuals and families (see Rosenthal & Rubin, (1979), for a discussion of the importance of small effects). This research literature includes a great deal of evidence that numerically small or moderate effects often translate into larger practical effects (Abelson, 1985; Lipsey, 1990; Rosenthal & Rubin, 1982). Furthermore, while the size of our effects may be small, on a population level these relationships are nevertheless important. It is also important to remember that our effect sizes may be underestimated due to our selected sample, and therefore in reality these relationships might be larger. Therefore, observed reciprocal effects may have a substantial and practically significant impact on family functioning and child well-being, as they play out over the life-course.

Concluding, our results support the idea that maternal psychological distress and child behaviour are intertwined phenomena which do not play out in isolation from other family actors. Intervention programmes and policy should recognize the complicated nature of these reciprocal influences, and consider an integrated and dynamic family system. From a clinical standpoint, some treatment models still focus on individuals' symptoms and tend not to account for the contribution of family dynamics. For example, parent training programmes for managing externalizing behaviour in children are based on the notion that change in parent behaviour leads to change in child behaviour. The results of this study underscore the potential for enhancing such "unidirectional" treatment models by considering reciprocal, complex household dynamics.

Acknowledgements

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The link between mother and adolescent substance use: inter-generational findings from the British Cohort Study

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Abstract

The objective of this study was to identify mother, family, and individual factors associated with adolescent alcohol, tobacco, and marijuana use, using mother and child self-reports. Adolescents aged 12-15 (N=276) and their mothers, who were participants in the British Cohort Study (BCS; born 1970), were both surveyed when mothers were 34 years old. Predictors included mothers' substance use as well as characteristics of the child (gender, age, conduct problems) and family (social class, two-parent family, parent-adolescent conflict). Outcome variables were adolescent alcohol, cigarette, and marijuana use. Child characteristics were predictive, with older children more likely to engage in all behaviors. After controlling for other predictors, mothers' current drinking frequency and problems predicted adolescent reports of ever drinking and of drinking sometimes/regularly; mothers' marijuana use was a marginally significant predictor of adolescent marijuana use. Results suggest that mothers' substance use is an important component of adolescent use, even after accounting for characteristics of the child and the intergenerational family context.

Introduction

A large body of literature has explored family factors that may contribute to the inter-generational transmission of substance use. This research suggests that families can shape adolescent alcohol and drug use through a number of pathways including parental human capital resources, parent-child interactions and relationships, and behavior modeling (Vakalahi, 2001). Positive family relationships, such as parent-child closeness, are linked to less substance use whereas parent-child conflict is associated with greater substance use (Hawkins, Catalano, & Miller, 1992; Kuntsche & Silbereisen, 2004). In addition, parental educational and other resources have been linked to youth substance use (e.g., Koning, Engels, & Verdurmen, 2010; Maggs, Patrick, & Feinstein, 2008; Melotti et al., 2011). Parental modeling and other inter-generational transmission mechanisms are also important, given the large body of research suggesting that parents who engage in heavy drinking and use drugs are more likely to have children who drink alcohol and use drugs

themselves (Donovan et al., 2004; Dooley & Prause, 2007; Fawzy, 1983; Osborne & Berger, 2009; Zucker, Jester, Fitzgerald, Puttler, & Wong, 2003).

Although associations between parent and child substance use have been well-documented, extant research is unclear about whether this association remains after accounting for confounding factors that may be correlated with both parental and child substance use. In other words, it is uncertain whether parental substance use itself matters (e.g., having available substances or modeling alcohol and drug use) or whether other factors—such as socio-economic status or family relations—account for this association. Whereas many studies continue to find a robust association after controlling for a host of family and individual characteristics (e.g., Hemphill et al., 2011), others find that accounting for these factors reduces the association between parent and child substance use to non-significance (e.g., Koning et al., 2010). In addition, a link between parent and youth substance use has been found for some substances, but not others, once control variables are included in the models (Macleod et al., 2008; Schinke, Fang, & Cole, 2008).

The present study builds on and advances this literature by testing the extent to which mothers' substance use is associated with the substance use of their adolescent children, using self-reports from both generations. We add to the literature in three primary ways. First, we control for a number of family factors, to better understand whether the link between parental and youth substance use remains after accounting for factors predictive of substance use for both generations. Second, we test the inter-generational linkages across the three most commonly-used substances (i.e., alcohol, cigarettes, and marijuana) rather than focusing on only one type of substance use. Third, we utilize self-report measures of substance use from both mothers and adolescents, which enables us to get more accurate information from each generation and reduces single-reporter bias. Understanding predictors of early substance use is critical in the light of research demonstrating that early onset of alcohol and drug use predicts substance use and disorders in late adolescence and young adulthood (Agrawal et al., 2006; Clark, Cornelius, Kirisci, & Tarter, 2005; Dooley, Prause, Ham-Rowbottom, & Emptage, 2005; Grant and Dawson, 1997).

Method

Data are from the British Cohort Study (BCS), an ongoing birth cohort study that sampled all individuals in Britain who were born in one week in 1970 (Butler, Golding, & Howlett, 1985; Bynner, Butler, Ferri, Shepherd, & Smith, 2000; Schoon, 2006). After an initial assessment of 16,571 infants (96% of live births), follow-ups were conducted at ages 5, 10, 16, 26, 30, 34, 38, and 42. Multiple sources of data were collected. Parent data in the present analyses were obtained from the primary BCS cohort members in 2004, when they were age 34 (N=9316; n=5039 women; 70% retention excluding emigrants and deceased). At age 34, 15% (N=772) of BCS women had at least one biological or adopted child aged 12 to 15 years old (born 1989-1992) who was living with them[i], 49% of whom (N=375) were selected for a sub-study about parents and children. Of those selected, 36 were missing all parent or child data, 60 were missing data on covariates of interest, and 3 lacked a parent report and child self-report for the same child, yielding a final analytic sample size of 276 (74% of those eligible). Data comprised mother reports (interview and self-completion) of demographics, parent-child conflict, and child temperament; and adolescent reports (self-completion) of their own attitudes and behaviors (see also Simmonds, Fuller, Lessof, & Foudouli, 2007). Only the eldest child of each mother was included.

Measures

Adolescent substance use outcomes

Adolescents were asked how often they used alcohol, cigarettes, and marijuana, with response options of (a) I have never drunk alcohol; (b) I have drunk alcohol once or twice only; (c) I used to drink alcohol but I don't now; (d) I sometimes drink alcohol, but I don't drink alcohol every week; and (e) I drink alcohol regularly, once a week or more. This measure of drinking frequency was used to derive primary dichotomous dependent variables in which youth who self-reported that they *ever drank alcohol* (i.e., responded b-e, coded 1) were compared those who never drank alcohol (i.e., responded a, coded 0). Those who *drank alcohol sometimes or regularly* (i.e., d-e, coded 1) were compared to those who drank less often (i.e., a-c, coded 0). Other substances were coded using the same response scale as alcohol. Adolescents who

reported *ever using cigarettes* or *ever using marijuana* (coded 1) were compared to those who had never used the substance (coded 0).

Mothers' substance use

Mothers' current drinking frequency (i.e., how often she has an alcoholic drink of any kind) was reported on a scale of 0=never had an alcoholic drink, 1=never nowadays, 2=less often or only on special occasions, 3=two to three times a month, 4=once a week, 5=two to three days a week, 6=on most days. *Mothers' problem drinking* was measured with the CAGE (Bradley, Boyd-Wickizer, Powell, & Burman, 1998; Ewing, 1984; Liskow, Campbell, Nickel, & Powell, 1995; Mayfield, McLeod, & Hall, 1974), which asked mothers whether they had ever experienced 4 alcohol-related symptoms in their lifetime and, if so, whether the symptoms had occurred in the past year. Responses were coded to contrast those who reported one or more alcohol problems in the prior year (coded 1) with those reporting no problems in the prior year (coded 0). *Mothers' frequency of cigarette use* was coded as 0=has never smoked cigarettes, 1=used to smoke cigarettes but does not now, 2=smokes cigarettes occasionally but not every day, 3=smokes cigarettes every day. *Mothers' frequency of marijuana use* was coded as 0=has never tried cannabis, 1=never nowadays, 2=less often or only on special occasions, 3=once a month, 4=two or three times a month, 6=two or three days a week, 7=most days.

Adolescent characteristics

Adolescent controls were *gender* (male [1] vs. female [0]), *age* (14-15 years [1] vs. 12-13 years [0]), and *conduct problems*, measured with the conduct problems subscale of the Strengths and Difficulties questionnaire (α=.75; Goodman, 1997) as reported by the mothers. The scale is the sum of five items with response options ranging from 0=not true to 2=certainly true.

Family characteristics

Family social class/ employment was coded based on two measures. First, the Registrar General's social class measure, a categorization of six social groups based on current occupational attainment, was used to classify mothers and their partners into skilled versus unskilled/partly skilled occupations (Rose & Pevalin,

2001). The parent/guardian with the highest occupational status was used to determine the social class of the family, as non-manual (including professional/managerial) status or manual status. In addition, a dichotomous variable captured if the mother was employed or not employed (i.e., unemployed, disabled, or looking after the family). The two variables (social class and mother employment) were coded together into three groups: non-manual social class with mother employed [reference group], manual social class, and mother not employed. Living situation was included with adolescents living with *two parents* coded as 1 (all else=0). Last, *parent-adolescent conflict* was assessed with the conflict scale of the Child-Parent Relationship Scale-Short Form (Pianta, 1992). The scale was created by summing the 7 items (α=.86; e.g., "My child easily becomes angry at me"), with response options for each item ranging from 0=definitely does not apply to 4=definitely applies to me.

Results

Descriptive statistics regarding predictor and outcome variables are shown in Table 1. Although the current sample of adolescents is not nationally representative, the substance use patterns are generally consistent with those of the UK adolescent population as a whole.[ii] Mothers of young adolescents included in the analyses presented here were similar to other women in the BCS 1970 cohort: there were no significant differences for marijuana use or CAGE scores. However, mothers of young adolescents were more likely to be daily cigarette smokers than other women. Logistic regression analyses were used to predict adolescent substance use as a function of adolescent gender, age, conduct problems, family social class, mothers' employment, two-parent family status, parent-adolescent conflict, and mothers' substance use. Indicators of mothers' substance use were tested in separate models, due to collinearity between the two indicators of alcohol use and problems, and our interest in testing domain-specific transmission of substance use. Results shown are multi-variate, due to our primary interest in whether the link between maternal and youth substance use remained after accounting for other individual and family factors.

Table 1. Descriptive statistics for British Cohort Study mothers (age 34) and their adolescent children (age 12-15) (*N*=276)

	% or *M (SD)*
Adolescent characteristics	
Male gender	52.2%
Older age (14-15 years)	44.6%
Conduct problems	2.00 (2.05)
Ever drank alcohol	76.4%
Sometimes drank alcohol	30.8%
Ever smoked cigarettes	34.4%
Ever used marijuana	10.2%
Family characteristics	
Social class - non-manual	49.3%
Social class - manual	33.7%
Mother not employed	29.7%
Two-parent family	72.5%
Parent-adolescent conflict	9.21 (6.88)
Mother characteristics	
Mothers' current drinking frequency	4.3% Never
	7.2% Never nowadays
	23.2% Less often or only on special occasions
	15.9% 2-3 times/month
	19.2% Once a week
	21.4% 2-3 days/week
	8.7% Most days
If drinks, units of alcohol in prior week	6.31 (9.12)
Mothers' drinking problems	20.6%[a]
Mothers' smoking frequency	29.0% Never
	21.4% Used to smoke, but not at all now
	7.2% Occasionally, but not every day
	42.4% Every day
If smokes, number of cigarettes per day	15.75 (7.30)
Mother current marijuana use frequency	82.5% Never tried
	5.5% Never nowadays
	7.3% Less often or only on special occasions
	0.7% Once a month
	0.7% Two to three times a month
	0.7% Two to three days a week
	2.6% On most days

Note: [a]There were 14 missing cases for the mothers' CAGE score.

Table 2. Logistic regressions predicting adolescent substance use by adolescent, family, and mother characteristics

	Ever drank alcohol *N*=262	Sometimes drank alcohol *N*=262	Ever smoked cigarettes *N*=276	Ever used marijuana *N*=273
	OR [CI]	OR [CI]	OR [CI]	OR [CI]
Intercept	1.05	0.11***	0.13***	0.00***
Mother characteristics				
Mothers' drinking problems	2.50 [1.01 6.16]*	2.11 [1.05, 4.26]*	---	---
Mothers' smoking frequency	---	---	1.10 [0.87, 1.39]	---
Mothers' frequency of marijuana use	---	---	---	1.32 [0.99, 1.76]+
Adolescent characteristics				
Male gender	0.73 [0.38, 1.41]	1.01 [0.56, 1.84]	0.43 [0.24, 0.78]**	1.92 [0.75, 4.93]
Older age (14-15 years)	5.34 [2.51, 11.38]***	6.38 [3.49, 11.66]***	5.52 [3.08, 9.87]***	43.72 [5.61, 340.48]***
Conduct problems	1.20 [0.92, 1.55]+	1.05 [0.86, 1.29]	1.21 [0.99, 1.47]+	1.20 [0.93, 1.54]+
Family characteristics				
Social class [a]				
Manual social class (unskilled/partly skilled)	0.73 [0.38, 1.41]	0.76 [0.40, 1.43]	0.84 [0.45, 1.57]	1.25 [0.49, 3.17]
Mother not employed	0.97 [0.49, 1.94]	1.05 [0.55, 2.00]	1.08 [0.57, 2.02]	1.04 [0.39, 2.80]
Two-parent family	1.83 [0.91, 3.68]+	0.96 [0.50, 1.84]	1.15 [0.61, 2.20]	1.01 [0.37, 2.75]
Parent-adolescent conflict	1.01 [0.94, 1.08]	1.03 [0.97, 1.09]	1.04 [0.98, 1.10]	1.04 [0.95, 1.13]

[a]*Reference group: one or both parents reported professional/managerial/technical/skilled non-manual social class, and the mother was employed.*
+*$p < .10$ (one-tailed test, $p < .05$),* **$p < .05$,* ***$p < .01$,* ****$p < .001$. OR = odds ratios. CI = 95% confidence intervals.*

With regards to predicting adolescent drinking (see Table 2), while controlling for the adolescent and family characteristics, adolescents whose mothers reported at least one alcohol problem in the prior year, as indexed by the CAGE, had greater odds of ever and of sometimes drinking. In these multivariate models, none of the other adolescent or family predictors was significant, with the exception of age, with 14-15 year old adolescents showing a much greater likelihood of both ever drinking and of sometimes drinking than 12-13 year old adolescents. Adolescents with more conduct problems had marginally significant greater odds of ever drinking ($p<.10$) and adolescents in two-parent families had marginally significant greater odds of ever drinking ($p<.10$). In additional models (not tabled), adolescents whose mothers drank more frequently, also evidenced greater odds of ever drinking (OR=1.44, CI=[1.18, 1.76], $p<.001$) and of sometimes drinking (OR=1.39, CI=[1.15, 1.69], $p<.001$).

In terms of predicting adolescents' likelihood of ever smoking cigarettes, while controlling for adolescent and family characteristics, mothers' smoking did not predict the odds of adolescent smoking. In these multivariate models, none of the family predictors was significant, but the adolescent predictors were: boys were less likely, and 14-15 year olds were more likely, to have smoked. Conduct problems approached significance ($p<.10$) as a positive predictor of ever using cigarettes.

Finally, in reference to predicting the likelihood of adolescents ever having used marijuana, while controlling for adolescent and family characteristics, mothers' marijuana use was a marginally significant predictor of a greater likelihood of adolescent marijuana use ($p<.10$). In a separate model (not tabled), the frequency of mothers' current marijuana use was a marginally significant predictor of adolescent marijuana use (OR=1.32, CI=[0.99, 1.76], $p<.10$). None of the family predictors was significant. The relatively older adolescents were more likely to have used marijuana. Conduct problems were marginally significant as a positive predictor of ever using marijuana ($p<.10$).

Discussion

There is little doubt that as a psychosocial system the family contributes extensively to adolescent substance use (Hawkins et al., 1992; Kuntsche & Silbereisen, 2004; Vakalahi, 2001). However, adequately specifying the inter-generational links between substance use and abuse by mothers and children remains difficult (Hemphill et al., 2011; Koning et al., 2010). This study addresses some key gaps in the literature by including several possible family factors, multiple forms of adolescent substance use, and both mothers' and children's reports. Our key findings are that, after controlling for other individual and family factors, mothers' current drinking problems predicted adolescent drinking. In addition, mothers' current marijuana use approached significance predicting adolescent marijuana use. These findings are in line with other research highlighting linkages between maternal and child substance use (e.g. Dooley & Prause, 2007; Macleod et al., 2008).

It is notable that maternal substance use remained among the strongest predictors of adolescent substance use even after controlling for other family and child effects. Prior theory and research suggest that mothers may shape adolescent substance use in various ways. Mothers may model substance use for their children and they may shape youths' access to substances (e.g., by having their preferred substances accessible at home). Mothers may also influence social norms and perceptions of the risks and benefits of early substance use. Furthermore, problematic maternal substance use may increase adolescent substance use by interfering with successful parenting strategies such as adolescent monitoring. It is also possible that the associations documented in the current study result not from environmental factors but from genetic similarity between mother and child (Rowe, 1994). The current study does not test these mediating pathways, and thus cannot identify which may be responsible for the inter-generational transmission of substance use. However, regardless of the underlying pathways, the results of the current study suggest that policies and interventions should aim to identify youth whose mothers are problematic substance users. These youth are particularly at risk for substance use during early adolescence and thus

early intervention among this population may be especially important.

This national sample of mothers born in 1970 brings important strengths to the understanding of family and child influences on adolescent substance use. Large national data sets offer confidence in terms of population coverage and generalizability. However, the sampling frame included the mothers when they themselves were children, so the sample is potentially biased due to any selective attrition. The relatively small sample size also leads to a lack of power to detect statistical significance for some findings. In addition, the sample is restricted to mother-adolescent dyads in which the children were born when mothers were aged 19 to 22 (in 1989 to 1992); therefore, it is unclear whether the results would generalize to mothers who were older when their children were born. Of course, this age limitation also is advantageous because it reduces the age heterogeneity that typically arises for the second generation, when the first generation is the sampling target. Strengths of the study include that having both maternal and child reports helps overcome limitations of sole-source data. Future research, building on our findings and using a larger sample, should test mediational models specifying family mechanisms that connect maternal and adolescent substance use and abuse, as well as the family moderators of this link.

Acknowledgements

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Endnotes

[i] Small number of A resident fathers (*n*=81) had children aged 12 to 15. Analyses focused only on mothers due to the smaller sample of fathers. Mother and father data were not combined due to potential differences in the impact of mother and father substance use.

[ii] National estimates from 2003 documented that 94% of UK youth aged 15-16 had consumed alcohol, 58% had smoked cigarettes, and 38% had used marijuana or hashish. Substance use initiation often occurred early in life: At age 13 (or younger) 61% of UK youth had already consumed at least one glass of beer, 65% had consumed at least one glass of wine, 41% had used cigarettes at least once, and 13% had used marijuana or hashish (Hibell et al., 2004).

RESEARCH NOTE

Assessing recall of early life circumstances: evidence from the National Child Development Study

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Abstract

Cross-sectional studies and longitudinal studies alike make regular use of retrospective questions about childhood circumstances. However, little is known about the accuracy with which adults can recall this kind of information. This paper seeks to address this topic by comparing retrospective reports of the number of people and the number of rooms in one's household at age 11 provided by 50 year old members of a birth cohort study, with responses provided contemporaneously by their parents. The paper demonstrates encouraging levels of consistency between retrospective and contemporaneous reports. By examining reports of number of rooms provided by parents living at the same address in two earlier sweeps of the study (at ages 7 and 11), the paper shows that responses to contemporaneous questions may also be inconsistent, suggesting that retrospective questions of this nature may not be hugely less reliable. A retrospective measure of overcrowding at age 11 is derived using the two variables, and compared with a contemporaneous measure. The two measures lead to the same estimate of the extent of overcrowding, but when used in a model examining the odds of experiencing lung problems as an adult, the two measures behave differently. The paper also demonstrates that there are particular groups who are more likely to provide inconsistent responses than others. Around one in five participants were identified as having particularly poor recall, and the likelihood of being in this group was considerably higher amongst those whose childhood circumstances were more complex. The paper also finds that performance in a delayed memory assessment at age 50 was associated with better recall of childhood circumstances.

1 Introduction

Childhood circumstances are of vital importance to understanding adult outcomes. Birth cohort studies which collect details of childhood experiences contemporaneously, play a crucial role in understanding the processes by which childhood experiences affect later life. Cross-sectional studies, or longitudinal studies beginning in adulthood, can only gather this information by using retrospective questions. For example, the English Longitudinal Study of Ageing (ELSA) (Banks, Nazroo & Steptoe, 2012) and the Survey of Health,

Ageing and Retirement in Europe (SHARE) (Börsch-Supan, Hank, Jürges & Schröder, 2008), two longitudinal studies following adults aged 50 and over, have both recently conducted retrospective life history questionnaires which gathered information about life experiences prior to joining the studies (Ward, Medina, Mo & Cox , 2009, Borsch-Süpan & Schröder, 2011).

It is recognised that use of retrospective questions will inevitably lead to a degree of recall bias, caused by differences in the accuracy with

which study members can recall experiences or events from their past. Within the field of survey methodology there is a long tradition of attempting to understand the factors affecting a respondent's ability to accurately recall past events and circumstances (e.g. Gray, 1955; Cannell, 1977; Sudman & Bradburn, 1973).

Past research has generally concluded that longer reference periods, defined as the period over which one is asked to recall events or circumstances, will typically result in reduced accuracy (Sudman and Bradburn, 1973; Cohen, Erickson & Powell, 1983; Bound, Brown & Mathiowetz, 2000). Research has also shown that respondents are typically able to recall events of greater salience or psychological importance with greater accuracy (Linton, 1982; Loftus, 1979; Mathiowetz & Duncan, 1988). Sudman and Bradburn hypothesised that events of greater salience leave a stronger memory trace which reduces the effort required to recall information about such events from memory. Events of great salience to one respondent may be of less importance to another, meaning salience can be difficult to evaluate, but Mathiowetz and Duncan (1988) offer a useful definition, defining salient events as those which 'evoke emotion at the time of occurrence, mark a transition point, have economic or social costs or benefits, or have continuing consequences after the event'. 'Telescoping' is a further source of bias, whereby events that happened in the past are recalled as having occurred more recently (forward telescoping) or earlier (backward telescoping) than they actually did (Bradburn, Huttenlocher & Hedges, 1994). Related to this is the 'accessibility principle' (Brown, Rips & Shevell, 1985), which refers to the phenomenon in which events most easily recalled are assumed to have occurred more recently (and perhaps more frequently), and conversely that events recalled with difficulty are assumed to have happened longer ago. A final source of bias is the difficulty of the reporting task; classical interference theory (Crowder, 1976) contends that individuals who have experienced multiple similar events will be less likely to recall any particular one. In a study seeking to evaluate ability to recall periods of unemployment over a two year period, Mathieowetz and Duncan (1988) found that the difficulty of the reporting task, measured by the number of spells of

unemployment experienced, had a bigger impact on the accuracy with which dates associated with a particular spell of employment could be recalled, than the time which had elapsed since that period.

To date, the number of studies attempting to assess the accuracy with which adults can recall information about their childhood have been very limited. The few studies that have sought to evaluate ability to recall childhood circumstances typically rely on one of three strategies. The first is to employ some form of test-retest, whereby retrospective reports are collected on two occasions and compared for consistency. For example, Haas (2007) compared retrospective reports of childhood health (rated from poor to excellent) provided on two occasions, two years apart, by panel members of two longitudinal studies in the United States (U.S.), and concluded that retrospective measures of childhood health were reasonably reliable.

A second strategy is to assess whether retrospective reports on several measures are logically consistent. For example, Elo (1998) examined the extent to which retrospective reports of overall childhood health provided by members of the Health and Retirement Study in the U.S., a longitudinal study of ageing, were correlated with responses to other questions about childhood health limitations, and found that that the self-reported health measure was highly consistent with these other measures.

The third strategy involves the comparison of retrospective reports with some form of administrative data, often viewed as the "gold" standard for validation, although it must of course be acknowledged that this approach is only feasible when appropriate records are available. Auriat (1993) compared retrospective reports of all changes of address since the age of 14, which were collected in a Belgian survey of couples aged between 41 and 57, with the Belgian National Population Register. When focusing on the first three moves after marriage (if applicable), Auriat found that around 30 per cent of couples misreported the dates of moves by more than three months.

This paper makes use of a rare opportunity to compare retrospective survey responses with survey data collected contemporaneously. We examine responses to two questions about childhood experiences that were answered by 50

year old members of the National Child Development Study (Power & Elliott, 2006), a British birth cohort study following the lives of all those born in one week in 1958. The questions re-collected information about the number of people lived with and the number of rooms in the household at age 11, which was first provided contemporaneously by study members' parents in 1969. The accuracy with which individuals can recall these details some 40 years later was assessed by comparing the data recorded at age 50 with that recorded at age 11. Such evidence can be used to inform decisions about the validity of including these kinds of questions in other surveys. The paper makes a significant contribution to the literature on recall bias by exploiting the rich life-history information collected from and about study members, to investigate the factors that might cause variation in recall of childhood circumstances. The impact of performance in a delayed memory test, conducted at age 50, was also explored.

2 Data and methods

The National Child Development Study (NCDS) began in 1958 and has followed the lives of around 17,000 infants born in one week in March ever since. Over the years there has inevitably been some attrition from lost contact, refusals, emigrations and deaths, but response rates remain high. Just under 9,800 respondents participated in the age 50 follow-up, which took place in 2008/9.

Two retrospective questions asking about the number of people and rooms in the household at age 11 were asked of a random subset of approximately 25% of respondents (n-=2,498) in the self-completion section at the end of interview. The questions were specifically added to facilitate the analysis of recall bias and were selected on the basis that they were widely used basic socio-demographic variables. When taken together they can provide a measure of over-crowding, a commonly used measure of living standards. Furthermore, the two questions were both included in the ELSA and SHARE life history questionnaires, so an assessment of the accuracy with which individuals can recall these precise measures was considered particularly useful. Finally, both questions elicited straightforward numerical responses which could be directly compared with responses provided by their parents (typically mothers) to the same questions in 1969, when study members were aged 11.

The retrospective number of people questions was: "*For the next two questions we would like you to think back to your childhood, specifically to the time when you were 11-years-old. When you were 11, including yourself, how many people normally lived in your household? Please exclude any children or others who only lived at home for short periods such as school holidays*". In 1969 the contemporaneous information was collected from the parent by an interviewer who completed a quasi-household grid. The contemporaneous question asked *"Who normally lives in the Study Child's household?"* and the same instruction about excluding those who only lived at home for short periods was included. An additional definition of the household was used in the pre-amble to this question that was not included in the retrospective question which stated that '*a household comprises the group of persons living together partaking of meals prepared together and benefitting from a common housekeeping*'. The interviewer collected the details of each household member (name, age and relationship to study member) and the total number of individuals was recorded.

The retrospective number of rooms *"How many rooms did your accommodation have? Please exclude bathrooms, kitchens or sculleries unless they were used as a living room."* The contemporaneous question to the parents was exactly the same, but was framed in the present tense.

Both questions include fairly detailed instructions about people or rooms which should be included or excluded. The number of people question mentions excluding those who only lived at home for 'short periods' but as no precise definition of a 'short period' was provided, it was potentially open to multiple interpretations. The retrospective question included this instruction within the question text which, given that it was administered via self-completion, should have been read by all respondents. At age 11 this instruction was provided on the form the interviewer used to complete the household grid and interviewers may therefore have varied in the extent they made this instruction clear to respondents. Similarly the retrospective question included the instruction about rooms to exclude within the text of the question, whereas the contemporaneous measure included the instruction as supplementary information for interviewers, and so it may not always have been read out.

Recall error may therefore not be the only source of any inconsistency between the retrospective and contemporaneous questions. The differential way in which supplementary information was provided to respondents may also have had an effect.

Survey questions asking respondents to report the number of rooms in their household are always difficult as they inevitably involve the use of detailed instructions which are open to differential interpretation. There may have been rooms in the house that either the parent or the study member were unsure about whether to include. There is, perhaps, therefore a question as to whether the contemporaneous measure of number of rooms should necessarily be treated as the most reliable measure or 'gold-standard'. Using data from earlier sweeps, the paper will examine this question more closely.

Given that the contemporaneous measure of number of people was collected using a quasi-household grid, it seems reasonable to assume that, despite the potential problem discussed above, the contemporaneous measure will in the vast majority of cases be accurate.

3 Hypotheses

Specific hypotheses are as follows:

It is anticipated that both the number of people lived with and the number of rooms in one's household will be of reasonably high salience to the respondent, and therefore, that consistency between the retrospective and contemporaneous measures will be high.

H1: Consistency between retrospective and contemporaneous measures will be high.

However, it is envisaged that the people one was living with in childhood will have greater salience to the respondent than the rooms in one's household, so we expect to see greater consistency between retrospective and contemporaneous measures for number of people. Additionally, the fact that the contemporaneous measure of number of people is assumed to be more reliable than the measure of number of rooms is also thought likely to contribute to a higher level of consistency.

H2: Consistency between retrospective and contemporaneous measures will be greater for number of people than number of rooms.

By identifying a subset of cases living at the same address when surveyed at ages 7 and 11 it is possible to assess the reliability of the age 11

measure of number of rooms, by comparing the consistency of responses to the number of rooms question at these two time points. It is anticipated that the level of consistency between these responses will be greater than the level of consistency between the study members' retrospective responses and their parents' contemporaneous responses.

H3: For those living in the same address at age 7 and 11 years, it is anticipated that consistency of parental responses on the number of rooms at these two time points will be higher than between the study members' retrospective response and their parent's contemporaneous response.

Given that consistency between retrospective measures and contemporaneous measures is expected to be high, it is anticipated that analyses will not be affected by substituting an overcrowding measure based on retrospective responses, with one based on contemporaneous responses.

H4: Analyses will not be affected by the substitution of a retrospective measure of overcrowding for a contemporaneous measure.

It seems likely that those living in smaller households in terms of people and rooms would have an easier task than those living in larger households or houses where one could overlook a particular individual or room.

H5: Consistency between retrospective and contemporaneous measures will be lower for those in larger households.

Similarly, it seems likely that if one's childhood circumstances had been stable in terms of family and housing circumstances, then recalling details about a particular period (i.e. age 11) would be more straightforward than recalling details from a childhood involving multiple changes of household composition or address.

H6: Consistency between retrospective and contemporaneous measures will be lower for those who moved home most and whose family circumstances changed more frequently.

Retrieval of information from memory is a key stage of the cognitive process required to respond to any form of survey question (Tourangeau, 1984). It is reasonable therefore to assume that one factor associated with being unable to provide accurate reports of childhood circumstances would be poor memory. The age 50 survey included an assessment of memory (Brown, Elliott, Hancock, Shepherd & Dodgeon, 2010) which took the form of

a word-list recall task, where study members were read ten simple words and then asked to recall as many as they could, both immediately and after about five minutes. The nature of this task is very different to recalling information from some 40 years previously, but it is nevertheless hypothesised that those with better 'delayed memory' as measured at 50 will be better at storing and retrieving information, and will therefore recall childhood circumstances with greater accuracy.

H7: Consistency between retrospective and contemporaneous measures will be higher for those with better 'delayed' memory as measured at 50.

4 Results

Section 4.1 examines the level of consistency between the retrospective measures and the contemporaneous measures (referred to as R-measures and C-measures) in terms of both the proportion providing consistent responses and the magnitude of difference in the case of any discrepancy. The reliability of the contemporaneous measure of number of rooms is also

explored. As noted above, the two measures are often used in combination to create a single measure of overcrowding; an overcrowding variable based on the R responses is derived and compared with a measure based on the C responses, in order to identify the extent to which individuals could potentially be misclassified if the R measure were to be used. The extent to which any mis-classification could impact on substantive findings is also examined by running logistic regression models to examine the associations between the R and C measures of overcrowding and adult respiratory problems.

Section 4.2 explores the impact of the complexity of one's childhood circumstances and section 4.3 examines impact of performance in the delayed memory task.

4.1. Consistency between retrospective and contemporaneous measures

Figure 1 compares the distribution of R and C responses of number of people and number of rooms at age 11. Reassuringly it is immediately evident that the distributions are similar.

Figure 1. Number of people and number of rooms – comparison of distributions of R-measures and C-measures
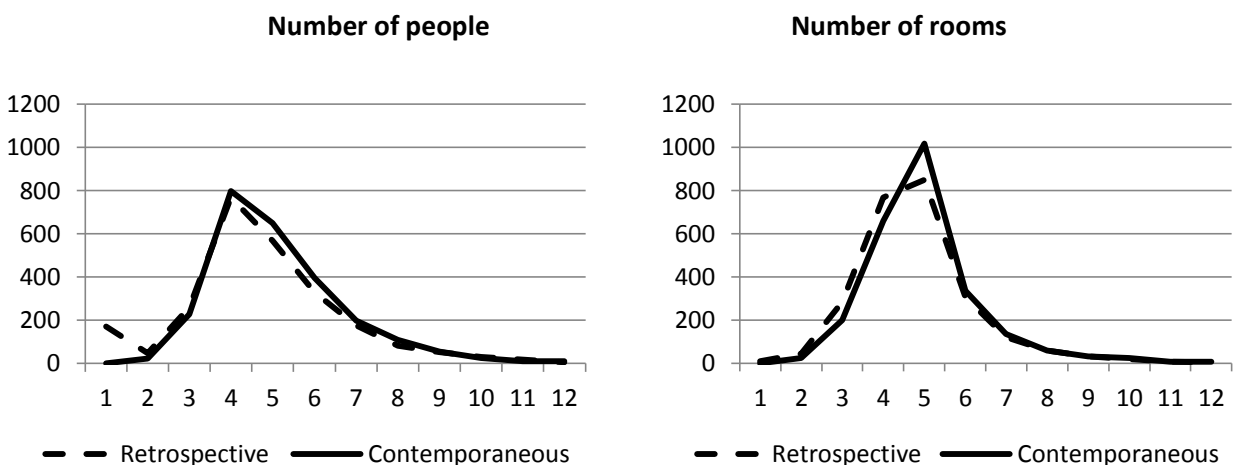
*Base: All in random sub-set (n=2,498)

** A small number of respondents reported more than 12 people / rooms on both the R and C measures. These responses are not shown above.

R-measures and C-measures were highly correlated for both number of people (r=0.69, p<0.001) and number of rooms (r=0.68, p<0.001), which provides initial support for Hypothesis 1, that consistency between the R and C responses will be high.

Despite the similarity of the distributions, the mean R responses were lower on both measures than the mean C responses, and two sample paired t-tests show the differences are both highly significant (p<0.001). The mean C response to number of people was 5.12 (SD = 1.65) compared with a mean R response of 4.74 (SD = 1.95). The mean C and R responses to number of rooms were 5.01 (*SD*= 1.45) and 4.81 (*SD*= 1.46) respectively.

One clear difference on the number of people measure is that seven per cent retrospectively reported that at age 11 they lived in one-person households (i.e. lived alone) whereas there were no C reports of living alone. As noted, the retrospective questions were included in the self-completion section at the end of the questionnaire. It is possible that respondents could have entered an answer of 'one' as a way of skipping the question, but it seems likely that if they had done this to the number of people question they would also have done so on the number of rooms question, but that was not the case. It seems clear therefore that these individuals had misunderstood the question in some way. A series of four cognitive assessments were completed as part of the age 50 survey (Brown & Dodgeon, 2010) and those who retrospectively reported living in one person households achieved significantly lower scores on all assessments than those who did not[i], which could be indicative of a greater propensity to misunderstand although no evidence of any systematic misunderstanding was found[ii].

The level of agreement between the C and R measures are shown in Figure 2. For number of people, the measures were consistent for just over two thirds of individuals (68 per cent), whilst for number of rooms the figure was 50 per cent, thus providing support for Hypothesis 2, that consistency will be greater for number of rooms. On both measures, retrospective under-reporting was around twice as common as over-reporting (23 per cent compared with 10 per cent for people, and 32 per cent compared with 18 per cent for rooms).

Figure 2. Magnitude of inconsistencies - difference between C and R responses
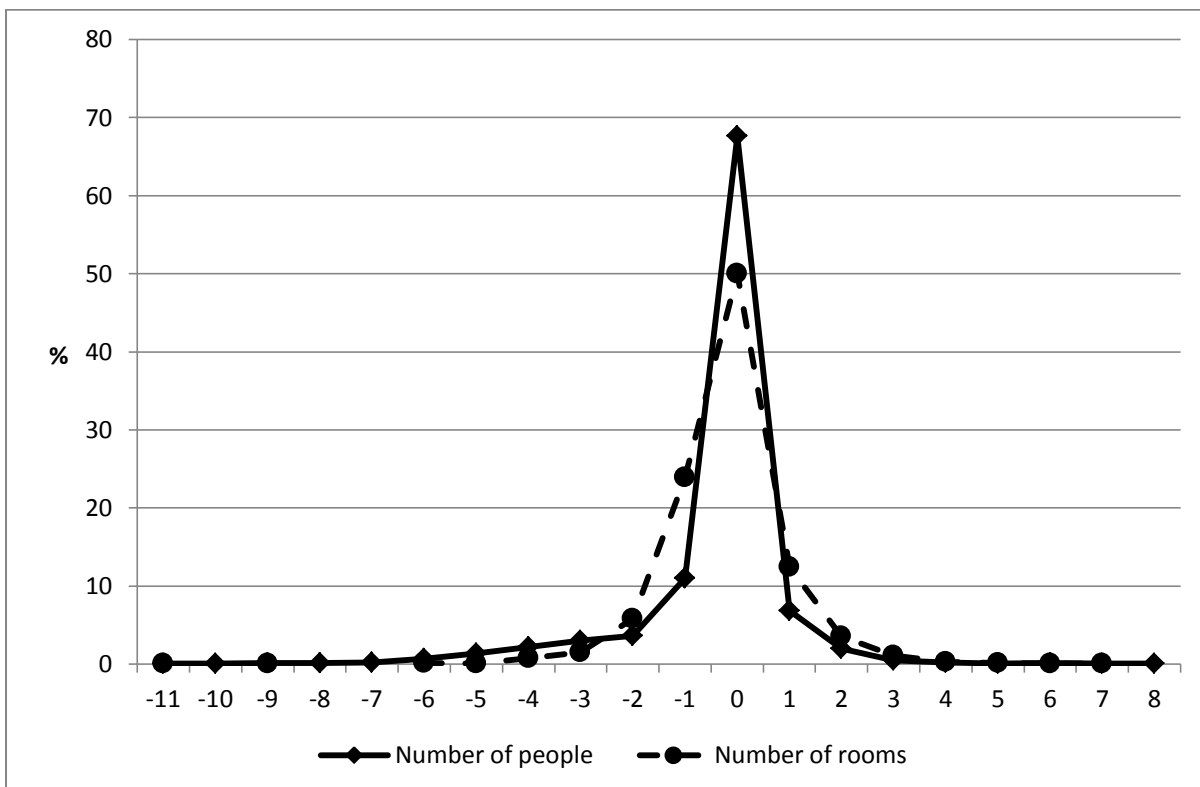
*Base: All in random sub-set (n=2,498)
** The differences here are calculated by subtracting responses to the C-measures from responses to the R-measures.

On both measures it is encouraging that where R and C measures did differ, the magnitude of the difference was typically small; it was most common for R and C responses to differ by one. Cases where R responses differed from C responses by more than 3 people or rooms were rare (9% for number of people and 4% for number of rooms).

Table 1 shows that just over a third of cohort members (36 per cent) provided consistent R and C responses on both measures, around half (47%) provided consistent responses on one of the two, leaving less than one in five (18 per cent) providing inconsistent responses on both. This final group could potentially represent the group with the poorest recall ability.

More than half (55%) of those providing inconsistent responses to the number of people also provided inconsistent responses to the number of rooms. However, amongst those providing inconsistent responses to the number of rooms, only a third (36%) also provided inconsistent responses to the number of people. This perhaps suggests that an inability to 'correctly' recall the number of people lived with at 11, is a better indicator of overall poor recall than an inability to recall the number of rooms in one's house.

Table 1. Consistency of R and C measures of number of rooms vs number of people

		Number of rooms		
		R <or> C	R=C	TOTAL
Number of people	**R <or> C**	446 (17.9%)	362 (14.5%)	808 (32.3%)
	R=C	802 (32.1%)	888 (35.5%)	1690 (67.7%)
	Total	1248 (50%)	1250 (50%)	2498 (100.0%)

As noted above recall bias may not be the only source of error in measurement. Both questions included detailed instructions about which people and rooms should be included or excluded, and in the C measures in particular, these were not necessarily provided to respondents in a uniform way. It is therefore possible that a number of C responses may have included people or rooms which should have been excluded, which could explain at least some of the apparent under-reporting in the R responses.

Collecting information about number of rooms using survey questions is always difficult as will inevitably involve the use of detailed instructions which are open to differential interpretation. Both parents and study members may have had difficulty deciding whether to include particular rooms in their responses, which raises the question as to whether the C number of rooms response is necessarily more reliable than the R response. Using data from earlier sweeps, it is possible to examine this matter more closely. The 'number of rooms' question put to parents in the age 11 survey was also asked four years earlier (with exactly the same wording) in the age 7 survey. There were 619 cases (25 per cent) where it was established that at age 11 they were living at the same address as they had been at the time of the age 7 survey. Amongst these cases, seven in ten (70 per cent) provided the same response on both occasions, and the Pearson's correlation coefficient between number of rooms reported at the two time points was 0.81. Although this finding confirms Hypothesis 3, that consistency between responses at 7 and 11 will be higher than the level of consistency between retrospective responses at 50 and parental responses at 11, it is illuminating to note that the difference is not huge, which suggests that the responses collected by a retrospective question may not be significantly less reliable than those from a contemporaneous question.

Additionally, C responses were collected from parents on one particular date during the year when study members were aged 11. In contrast, the two R questions asked respondents to think back to the "time you were 11-years-old". A proportion of the R responses which seemed inconsistent might therefore have been provided in

respect of a different period within that same year, when a change in housing situation or household composition had occurred. A greater degree of specificity within the wording of the question may have reduced the amount of inconsistency.

It must also be acknowledged that some of the more radical disparities between R and C responses may have resulted from data entry errors at one or other time point. It seems unlikely that someone whose parent reported living in a one-room house would genuinely recall living in an eight-room house as a child.

On the basis of these initial comparisons it is concluded that, at least on these particular measures, an individual in adulthood is typically able to recall childhood circumstances with a level of accuracy that will be useful to most researchers. Researchers requiring very precise measures would need to approach these retrospective measures with a degree of caution. However researchers who are content with classifying individuals into groups (e.g. large, medium and small households) could fairly confidently identify these groups. There remains a small percentage of respondents whose R and C responses are dramatically different. Such individuals would likely be mis-classified by a researcher relying solely on retrospective measures.

As mentioned previously, a commonly used practical application of measures of number of people and rooms is to use them in combination to define a measure of overcrowding. Many researchers have looked at the impact of overcrowding in childhood on subsequent adult outcomes. In one example, Marsh, Gordon, Pantazis & Heslop (1999) used NCDS data to examine the impact of poor housing during childhood (including overcrowding) on adult health, and demonstrated a link between overcrowding in childhood and respiratory problems in adulthood.

A way of examining the potential impact of the typically minor inconsistencies between R and C responses is to derive a childhood overcrowding variable using the R responses, and then to derive a second measure based on C responses as a validity check. A commonly used definition of overcrowding, and that used by Marsh and colleagues, is there being more than one person per room in a household. Applying this definition to the R responses gives an estimate that 37% lived in overcrowded conditions at 11, and the C estimate is almost exactly the same (38%). However, Table 2 shows that the R and C measures do not necessarily result in the same cases being classified as living in overcrowded conditions.

Table 2. Overcrowding at age 11 as measured by C and R measures of number of people and number of rooms in household

		Contemporaneous			
		Cut off = 1+ per room		Cut off = 1.5+ per room	
		Not overcrowded	Overcrowded	Not overcrowded	Overcrowded
Retrospective	**Not overcrowded**	1322 (52.2%)	250 (10.0%)	2073 (83.0%)	140 (5.6%)
	Overcrowded	224 (9.0%)	702 (28.1%)	115 (4.6%)	310 (12.4%)

Of the upmost importance is establishing whether any misclassification that might occur as result of using the R measure of overcrowding has an impact on analyses that might make use of the variable. Table 3 compares the results of logistic regression models which use the R and C overcrowding measures and a similar range of controls[iii] to those used by Marsh and colleagues, to assess the impact

of childhood overcrowding on the odds of reporting asthma or wheezy bronchitis at age 50. Model 1 uses the one or more persons per room definition of overcrowding. It is concerning to observe that using the C measure of overcrowding would lead us to conclude that the odds of suffering from asthma in adulthood are significantly increased by experiencing childhood overcrowding, whereas

using the R measure would suggest there is no significant association. However, if we use a 1.5 person per room threshold to define overcrowding, then the C measure would show no significant association with adult respiratory problems whereas the R measure suggests that overcrowding in childhood is associated with *lower* odds of adult lung problems. We therefore find no support for Hypothesis 4, that substituting a retrospective measure of overcrowding for a contemporaneous measure will not affect analyses. This somewhat puzzling finding must in fact lead us to conclude both the R *and* C measures of overcrowding must be treated with caution.

Table 3. Odds of reporting asthma or wheezy bronchitis at age 50 using R and C measure of overcrowding

		R measure of overcrowding		C measure of overcrowding	
		Exp(B) (Odds)	Sig.	Exp(B) (Odds)	Sig.
Model 1	Overcrowding at age 11(1+ people per room)	0.87	0.40	1.58	0.01***
Model 2	Overcrowding at age 11 (1.5+ people per room)	0.56	0.04**	1.01	0.96

*Included in analysis (n=2,047)

4.2. Is an inability to provide accurate reports of childhood circumstances the result of the complexity of the task?

Figure 5 shows how inconsistency varied by the number of people and rooms reported at age 11. For number of people, the lowest level of inconsistency was found among those where the parent's C response was 4 (mainly 'nuclear' families), where inconsistent responses were provided by just under a quarter (23 per cent). Inconsistent responses increased as C responses increased, so that in the largest households (10 or more), six in ten (60 per cent) R responses were inconsistent. For number of rooms the pattern was very similar**.**

Figure 5. Inconsistent retrospective responses by number of people / rooms in household at age 11
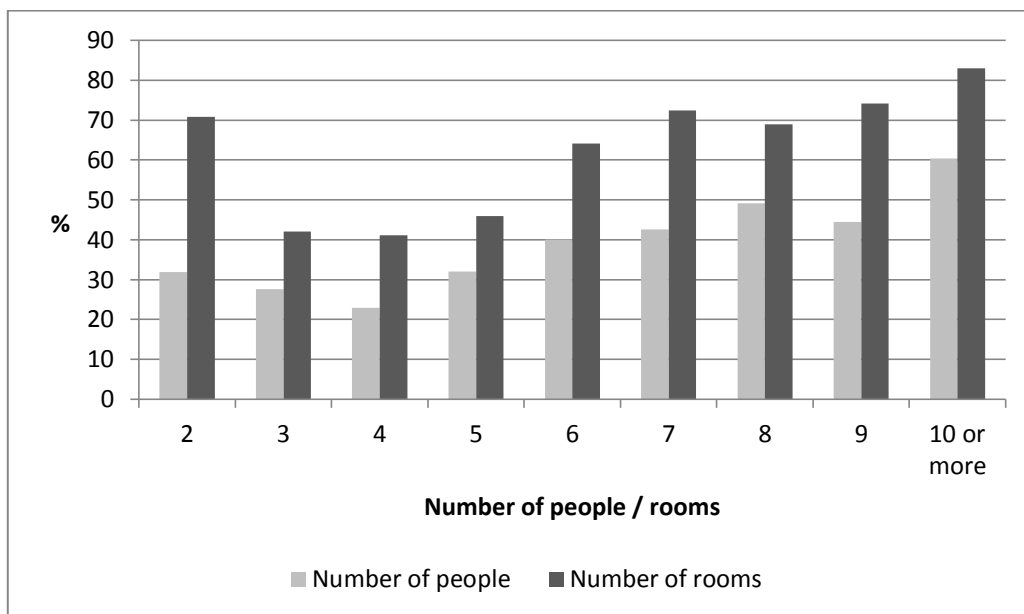
*Base: All in random sub-set (n=2,498)

Figure 6 shows how inconsistent R responses on the 'number of rooms' varied by the number of household moves experienced by age 11. Those who moved more, were most likely to provide an inconsistent R response.

Figure 6. Inconsistent retrospective 'number of rooms' responses by number of moves by age 11
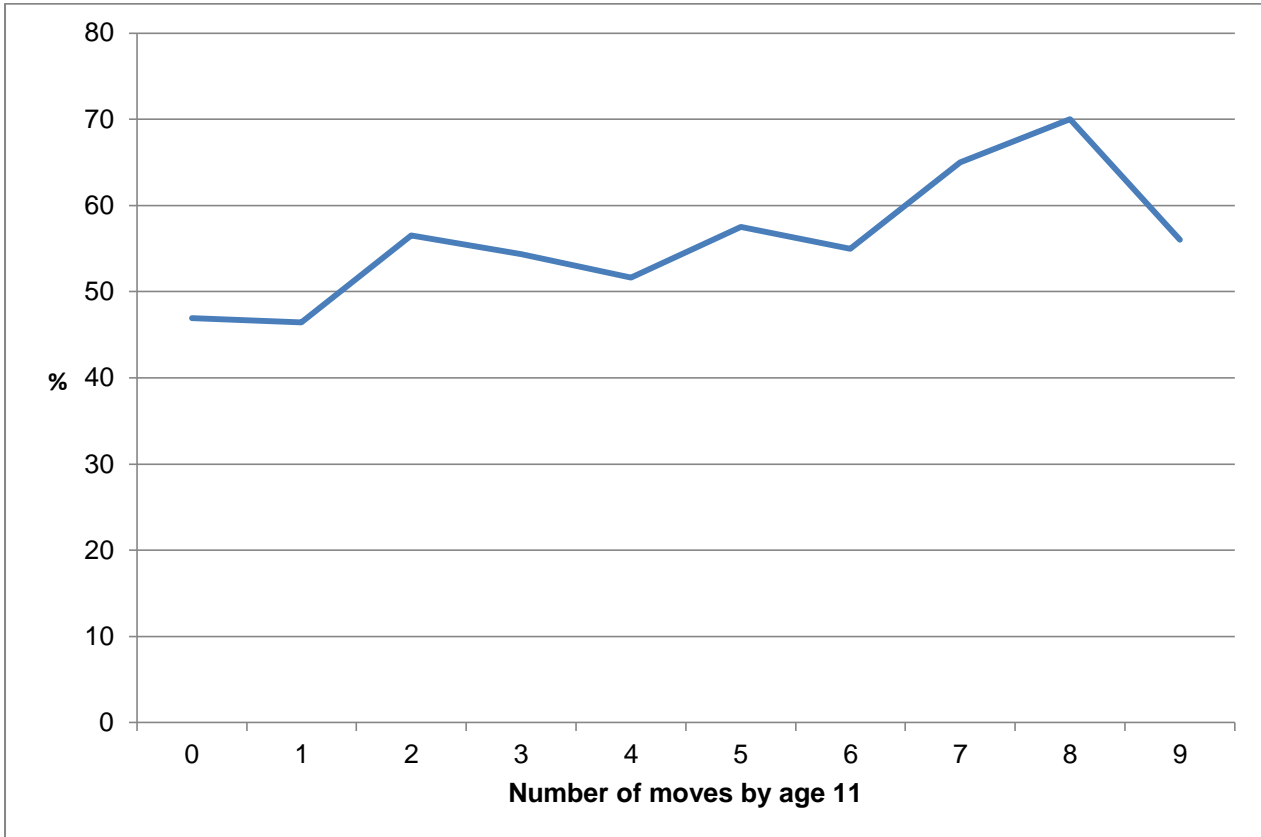
*Base: All in random sub-set who reported number of moves (n=2,466)

Table 4 shows that the one in five respondents who did not provide a consistent R response to either measure, lived in larger homes (in terms of both rooms and people) than those who provided either one or two consistent responses. Comparing the means with t-tests showed that the magnitudes of all the differences were highly significant (p<0.001). The differences between the three groups in terms of number of moves was in the anticipated direction, and the difference between those who provided inconsistent R and C responses to both measures, and those who provided two consistent R and C responses, was marginally significant (p=0.1).

These analyses provide support for Hypotheses 5 and 6, that consistency between R and C responses will be greater for those who lived in smaller households and had more stable childhoods.

Table 4. Number of people, number of rooms and number of moves by inconsistent R and C responses.

	Number of people in household (C response)		Number of rooms in household (C response)		Number of household moves by age 11	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
R and C responses inconsistent on both measures	5.58	2.00	5.43	1.95	1.67	1.95
R and C responses inconsistent on one measure	5.12	1.6	5.09	1.43	1.64	1.71
R and C responses consistent on both measures	4.89	1.45	4.69	1.07	1.51	1.58
Base	**2,498**		**2,498**		**2,466**	

4.3 Is an inability to provide accurate reports of childhood circumstances the result of poor memory?

Figure 7 shows how levels of inconsistency varied on the two measures by performance in the delayed word-list recall task at age 50. Higher scores indicate better memory and we see that, at least on the 'number of people' measure, there is evidence of a bivariate association between performance in the test and recall ability. For the 'number of rooms' measure, the association is not so apparent.

Figure 7. Inconsistent retrospective responses by delayed memory test score at age 50
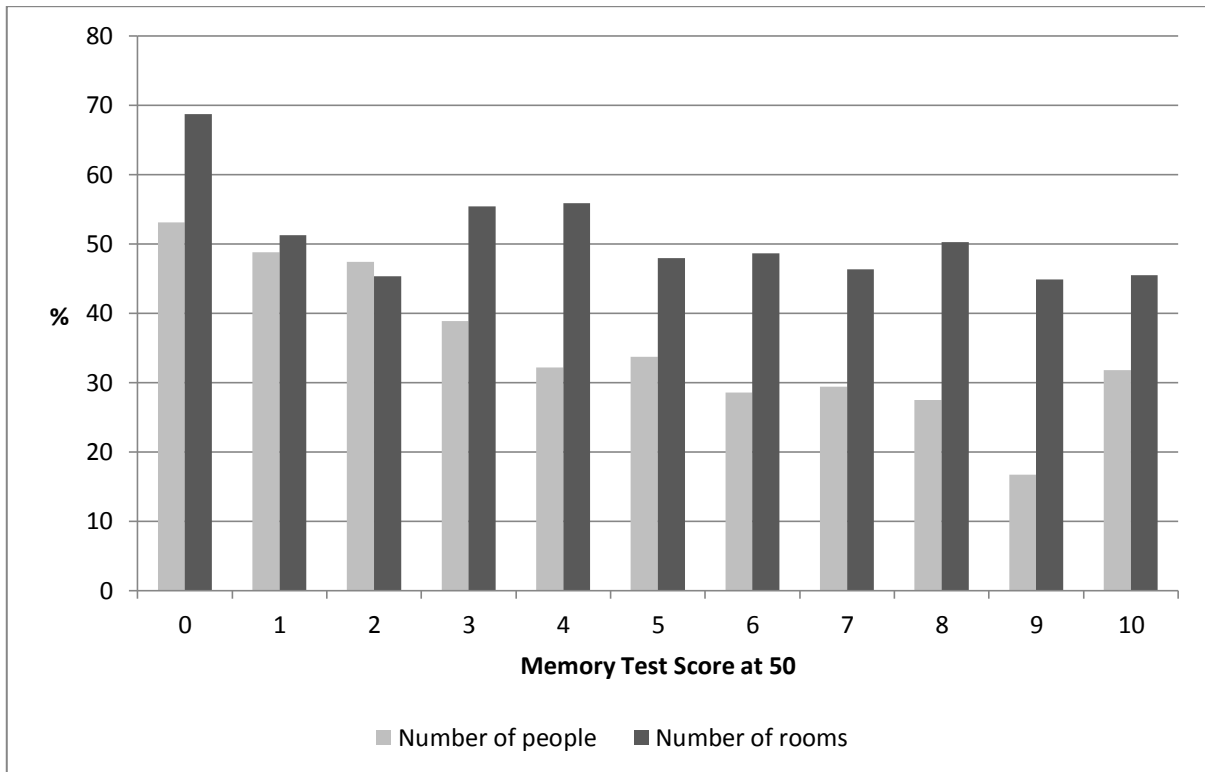
*Base: All in random sub-set who completed memory test (n=2,474)

One might also hypothesise that the magnitude of any inconsistencies would be higher amongst those with the poorest scores. This is confirmed, for number of people, by Table 5 which shows the mean difference and absolute mean difference (i.e. taking no account of the direction of any discrepancy) between the R and C responses broken down by performance in the delayed memory test.

The mean absolute difference reduces from 1.5 among those scoring zero, to 0.3 among those scoring nine. The mean difference reduces from -1.2 to -0.1. As shown above, for 'number of rooms' the level of inconsistency was not greatly associated with performance in the test and so there is similarly no clear association between test scores and the magnitude of any inconsistencies.

Table 5. Mean differences between retrospective and contemporaneous responses by performance in delayed memory test score

Delayed memory test score	Number of people		Number of rooms		N	%
	Mean difference (absolute) R-C	Mean difference (R-C)	Mean difference (absolute) R-C	Mean difference (R-C)		
0	1.5	-1.2	0.9	-0.5	32	1.3%
1	0.9	-0.5	0.7	-0.3	41	1.7%
2	0.9	-0.5	0.7	-0.2	97	3.9%
3	0.8	-0.4	0.7	-0.3	193	7.8%
4	0.7	-0.4	0.8	-0.3	367	14.8%
5	0.8	-0.5	0.7	-0.2	534	21.6%
6	0.6	-0.3	0.7	-0.2	539	21.8%
7	0.6	-0.3	0.6	-0.2	378	15.3%
8	0.5	-0.3	0.6	-0.2	193	7.8%
9	0.3	-0.1	0.6	0.0	78	3.2%
10	0.6	-0.3	0.6	-0.1	22	0.9%

*Base: All in random sub-set who completed memory test (n=2,474)

One in five respondents provided inconsistent R responses on both measures and it was suggested earlier that this group could be those with the poorest recall. If so, we would also expect this group to achieve lower scores in the delayed memory test (see Table 6). The mean score of those providing two inconsistent R responses was compared with the mean score of those providing one consistent response with a t-test, and found to be significantly lower (p<0.001). The mean score of those providing one consistent response was in turn significantly lower than those providing two consistent responses (p<0.001).

Table 6. Delayed memory test score at age 50 by inconsistent R and C responses

	Mean memory test score
R and C responses inconsistent on both measures	4.97 *(SD=1.98)*
R and C responses inconsistent on one measure	5.37 *(SD=1.87)*
R and C responses consistent on both measures	5.58 *(SD=1.80)*

*Base: All in random sub-set who completed memory test (n=2,474)

On the basis of these bi-variate analyses, we do find support for Hypothesis 7, that those with poorer memory at 50 appear to have poorer ability to recall circumstances from their childhood. On the number of people measure at least, there was also evidence that poorer performance on the memory test was associated with a greater magnitude of inconsistency between C and R responses.

5 Summary and discussion

Cross-sectional studies and longitudinal studies alike make regular use of retrospective questions about childhood circumstances. However, to date, little has been known about the accuracy with which adults can recall this kind of information. This paper therefore makes a vital contribution to the literature on recall accuracy by comparing retrospective questions about childhood circumstances answered at age 50, with questions answered contemporaneously by parents, and thereby demonstrating that 50-year-olds were typically able to recall these aspects of their childhood with reasonable accuracy. As hypothesised, the level of consistency between retrospective and contemporaneous responses was greater for number of people than for number of rooms.

Although a significant proportion failed to provide retrospective responses that matched precisely those collected contemporaneously, the difference between responses was typically small. Retrospective responses tended to 'under-report' when compared with contemporaneous responses. One cause of this possibly stems from the fact that, unlike the retrospective questions, the contemporaneous questions in the age 11 survey

did not present clarifying information about which people and rooms should be included in a consistent way, which may well have resulted in a degree of contemporaneous over-reporting. This underlines the importance of ensuring when designing questions, whether contemporaneous or otherwise, that all the relevant information required to answer a question is provided to all respondents.

Using a subset of participants whose address had remained stable between ages 7 and 11 made it possible to assess, to an extent, whether the reliability of the retrospective measure of number of rooms at 11 was any more reliable than the responses collected contemporaneously. Comparing the level of consistency between number of rooms reported at 7 and 11 with the level of consistency between the retrospective report of number of rooms at 11, and the number recorded contemporaneously, led to the encouraging conclusion that the retrospective measure was only marginally less reliable. This finding provides strong support for the use of retrospective questions of this nature.

The two retrospective measures were used in combination to produce a measure of overcrowding, which was compared with a measure of overcrowding using contemporaneous information. Estimates of the proportion living in overcrowded conditions in childhood did not differ between the retrospective and contemporaneous measures. However, substituting the retrospective over-crowding measure for the contemporaneous measure in a logistic regression model, examining the odds of suffering from lung problems at age 50, was found to have a significant impact on how the

variable would be interpreted. Altering the definition of overcrowding was also found to affect how the two measures performed in the models. We must take from this that researchers using retrospective measures of this nature must be cautious, but that this applies equally when using contemporaneous measures.

Previous evidence about the characteristics associated with poor recall has been very limited. This paper has demonstrated that that there are particular groups who are more likely to provide inconsistent and therefore potentially inaccurate responses than others. In particular around one in five respondents were identified as having the poorest recall on the basis of providing inconsistent retrospective responses to both questions. The likelihood of being in the group identified as having poorest recall was considerably higher among those with less stable family backgrounds and those living in larger households. Researchers making use of retrospectively collected data on these measures

would therefore be advised to use a degree of caution when interpreting the responses of these particular groups.

Additionally, the paper made use of a unique opportunity to examine the impact of memory as measured by a simple delayed recall task on ability to recall childhood circumstances correctly. Performance in this test at age 50 was found to have a significant impact on ability to 'correctly' recall details from childhood. If feasible, researchers conducting a study with a significant focus on the collection of retrospective information about childhood might be advised to consider the inclusion of a brief objective assessment of memory, as a way of identifying individuals whose responses might potentially be less reliable.

It is highly probable that future follow-ups of NCDS will involve repeated tests of cognition similar to those included at age 50. It will be of interest to see whether poor retrospective recall at age 50 is predictive of later life problems with cognition.

Acknowledgements

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Endnotes

[i] The four assessments completed were an immediate memory test in which respondents were read a list of 10 words and asked to recall as many as they could. An animal naming task in which respondents were given one minute to name as many animals as they could. A letter cancellation task in which respondents were given a grid of randomised letters and had to cross out as many Ps and Ws as they could in one minute. A delayed memory task where respondents were asked to recall the words from the immediate memory test after a delay of approximately 5 minutes. Scores were compared using an independent samples t-test and all differences were significant ($p<0.05$).

[ii] It was not the case that these individuals lived in two person households at 11 and were not including themselves in the total reported. Parents of these individuals provided a full range of responses from two to 12, with the most common responses being four and five. These individuals were also no more likely to live in one person households at age 50 so it does not appear that they were mistakenly reporting their current circumstances.

[iii] Age 50 characteristics: sex, smoking, social class, highest qualification. Age 11 characteristics: free-school meals, financial hardship, tenure, indoor WC, hot water in household, paternal unemployment

Focussing and funding a birth cohort study over 20 years: the British 1946 national birth cohort study from 16 to 36 years

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Abstract

The first British national birth cohort study was initially concerned principally with health at the birth of its sample in 1946. Throughout its first fifteen years it received only short-term financial support, but still managed to undertake ten follow-up data collections and broaden its focus to include educational and cognitive outcomes. Then in 1962, when cohort members were aged 16 years, the Medical Research Council (MRC) agreed to be the principal funder. Over the next twenty years, during the cohort's adolescence and early adulthood, discussion about the study's focus was influenced by the funding source, the cohort's age, the data, current policy concerns, and current thought and innovations in measurement in epidemiology. That period began with pessimism about the study's future. However, towards the end of the twenty years, the MRC review of options for continuation revealed new epidemiological questions on mental health and ageing that required life course data. Consequently the study was continued, and extensively revised health outcome indicators and methods of data collection were first used at age 36 years. They provided new baselines against which to measure future health change with age, and new outcomes with which to test life course effects of hypothesised earlier life exposures, experiences and health. This paper shows how the focus of the study was changed and developed by internal and external pressures and influences between 1962 and 1982, when the cohort was aged 16 to 36 years.

Introduction

Longitudinal studies that continue over many years of their subjects' lives must inevitably adjust their focus, in terms of aims and measures as the sample ages, and as the scientific, policy, and socio-economic contexts change. Such adjustment is conditioned also by the nature of the data already collected, and the longer the study continues the more some existing data may deviate from current standards. Consequently, long-term continuation can be difficult to maintain, even though if achieved it can offer unique and valuable research opportunities. In the United States these problems were experienced by many of the long-running multi-disciplinary studies of child growth and development, set up between 1927 and 1932 to assess the impact of the Great Depression

on children; the Fels study is a notable example (Roche, 1992).

Inevitably such questions had to be addressed and resolved in the first of the British national birth cohort studies, the MRC National Survey of Health and Development. It began at the birth of its 5,362 subjects in 1946, and has continued, with the most recent data collection at age 60-64 years (Kuh et al., 2011). An earlier paper showed how the study's aims were shaped during its first fifteen years by contemporary science and policy concerns, and by its director's scientific and policy interests (Wadsworth, 2010). After an initial concentration on survival, health, growth, and health care, the aims were broadened in the school years to include mental development, and educational attainment. The end of the years of compulsory schooling was a second significant change point for the study's aims. By then the cohort's age, the current policy questions, and the existing data, argued for new measures to include employment, development of occupational skills, adjustment to independence through adolescence to early adulthood, and the development of health-related habits such as smoking, exercise, nutrition, and changes in body shape.

This paper describes the range of influences that actually and significantly affected the study's focus during the twenty year period when cohort members were aged 16 to 36 years (1962 to 1982). Rather than reviewing the research which used the study data, the intention is to show the sources of influence which concentrated the study's aims on mental and physical health. Those influences moved the study's focus towards a programme of research on the processes of ageing, which remains its primary concern (Kuh et al., 2011; www.nshd.mrc.ac.uk).

Methods and sources

Four sources of information were used, namely: 1) the Medical Research Council (MRC) committee papers stored at the National Archive; 2) the study's publications and papers kept by the MRC Unit for Life Long Health & Ageing, which now continues the study; 3) publications describing contemporary scientific and policy concerns; and 4) the author's experience as a member of the study staff during part of the period (1968 to 1979), as co-principal investigator from 1979 until the end of the period studied here (1986), and then director until retirement in 2006.

Redefining the study's research focus for late adolescence and early adulthood

The contemporary research environment

In 1961 the study was at a decision point about the future because a) participants were at the end of compulsory education; b) the principal investigator who had started and maintained the study was at a decisive career point;[i] and c) because each of the previous eleven data collections during the study's fifteen years had been individually funded. James Douglas (the principal investigator and study director was a physician) and David Glass (its founder who was a demographer and holder of the Martin White Chair of Sociology at the London School of Economics) decided that more consistent funding was required if they were to continue the study.

The legacy of data from earlier times included a remarkably sensitive characterisation of the cohort members' growth, cognitive development, illness, educational experience and attainment, behaviour and aspirations at school, and the home environment and parental influences from birth to age 15 years. Much additional data had been collected on family and school circumstances, and on cohort members' behaviour and aspirations, for use in the analysis of the main topics, and as topics in themselves. Further follow-up into young adulthood would provide a unique opportunity to capitalise on what had already been achieved, and to contribute to current research and policy concerns in the social sciences and health.

From the point of view of social science research and socio-economic policy in 1961, there were good arguments for continuing. It was the beginning of the era when factually accurate data was first recognised as essential and attainable for the formation and evaluation of policy (Titmuss, 1957; Marwick, 1982). There was concern to understand the wide extent of social change in terms of work, marriage and family life, social behaviour, the rise of the consumer society, and the institutional, political and individual means of escaping poverty (Young & Willmott, 1957; Hoggart, 1957; Stacey, 1960; Wootton, 1959). The question of whether social mobility had increased in relation to the new educational opportunities provided in the post-war years was particularly relevant (Glass, 1954). Yet the 1946 birth cohort study was still the only British

national birth cohort study and remained so until it was 12 years old in 1958, when the first data collection took place in what was to become the second national birth cohort study, the National Child Development Study (www.cls.ioe.ac.uk/mcs). The third national birth cohort study, the Child Health and Education Study, was to follow in 1970 (www.cls.ioe.ac.uk/mcs).

From the point of view of health, arguments for continuing were also robust. From before the Second World War there had been a flourishing research interest in the impact of social factors and related effects such as malnutrition, on the risk of disease and its care (Morris & Titmuss, 1942, 1944; Morris, 1967; Martin, Gunnell, Pemberton, Frankel, & Davey Smith, 2005), which was reflected in the establishment of the Society for Social Medicine in 1956 (Pemberton, 2002). The value of integrating the teaching of social and preventive medicine with clinical studies had been recognised (Murphy, 1999), and there was growing interest in extending population screening for early signs of illness. By 1961 two other longitudinal population studies of child health had been started, and each still continues. One was the Thousand Families Study in Newcastle-upon-Tyne, a study of child health begun in 1947 to investigate the high incidence of infectious disease in the first year of life (Spence, Walton, Miller, & Court, 1954; Pearce, Unwin, Parker, & Craft, 2009). The other was the 1958 national birth cohort study, designed initially to show, in comparison with the 1946 study findings, the impact of the new National Health Service (begun in 1948) on the health and survival of infants and mothers in the first week of life (Butler & Bonham, 1963; Power & Elliott, 2006). That study became a longitudinal investigation in 1965, at the time of the first follow-up data collection.

New funding and organisation

Sources of long-term funds were much less well established for social science than for medical research in 1961. Empirical social science research in Britain was then mostly undertaken by individuals, or single university departments; the exception was the Institute of Community Studies inaugurated by Michael Young and Peter Willmott in 1954.[ii] Although the British Sociological Association had been founded in 1951, still in 1961 most social science research was funded by single grants from philanthropic and charitable sources;

the Social Science Research Council, forerunner of the present Economic & Social Research Council, was not established until 1965, and Social and Community Planning Research, forerunner of the National Centre for Social Research, began in 1969.

The Medical Research Council (MRC) had, by contrast, been established in 1913. It funded research units as well as projects, and in 1961 was already extensively concerned with the social, psychological and illness interface. In 1948 it had established a Social Medicine Research Unit to investigate 'the incidence and causation of various diseases in relation to social conditions including occupations' (Murphy, 1999). The MRC Unit for Research in Occupational Adaptation was also created in 1948 and became the MRC Social Psychiatry Research Unit. The MRC Obstetric Medicine Unit was established in 1955 to study how poverty affected reproductive health and birth. There was also concern that medical education should include the social sciences, as advised by the Goodenough (1944) enquiry. The Royal Commission on Medical Education, established in 1965, recommended the inclusion of social science in medical school teaching (Royal Commission, 1968).

For Douglas as a physician and Glass as a demographer, who had together set up this national birth cohort study (Wadsworth, 2010), the Medical Research Council (MRC) must have seemed, in 1961, the obvious and only potential source of stable funding for the continuation of the study.

Their bid was successful and guaranteed funding for an initial five years and possibly thereafter, subject to review at five yearly intervals. Funding began in 1962 for the new MRC Unit for Research on the Environmental Background of Mental and Physical Illness, based in Glass's research group (the Population Investigation Committee, which had initiated the study) at the London School of Economics, with Douglas as study director; it continued there until Douglas retired in 1979.

The study's research programme was overseen by a steering committee. Initially, in 1962, this consisted of academic specialists in mental health, paediatrics, statistics, occupational psychology and education. Later the committee also included representatives from government departments (the Home Office, General Register Office, Department of Health) and relevant professional bodies (e.g.,

the Health Visitors Association, Society of Medical Officers of Health).

Additional funding was obtained for specific analyses from the Social Science Research Council, and some government departments, including the Home Office, Department of Industrial and Scientific Research, and Department of Health and Social Security.

Initial definition of aims

Glass and Douglas pitched their bid for a research unit to appeal to the MRC's concerns, and allay possible anxieties about commitment to a long-term study. They emphasised the value of a unit because it could train medical and social science graduates to 'become effective research workers in such new fields as the epidemiology of mental disorder' (Glass, 1960). About the study itself they did 'not think that there should be any commitment to an extension…beyond the five year period. ….It would be more useful to study specific sections of the sample after the first five years than to continue general studies of the sample as a whole' (Glass, 1960). However, the committee reviewing the application commented that the study 'was of unique value and should be continued for as long as possible' (Medical Research Council, 1961a). In the confirmation letter the MRC 'were glad to know that clinical facilities which are essential if the Unit is to carry out the remit as effectively as possible, would be available at the Maudsley hospital' (Medical Research Council, 1961b)[iii]. The strength of the Department of Statistics at the London School of Economics was also favourably noted (Medical Research Council, 1961c).

In partial fulfilment of the MRC requirement for clinical relevance Douglas, with others at the Maudsley hospital and the Institute of Child Health, began two new observational studies of child and maternal behaviour. These were known as the child behaviour studies, and they were intended to look more deeply into some of the findings from the birth cohort study. A psychiatrist reviewer noted to the MRC that 'Dr. Douglas's group have pioneered survey methods but they seem now to be making a large leap from a relatively superficial study of large numbers of children' (Miller, 1964). The new observational studies used video recordings and electronic monitoring methods, developed in the electronics laboratory set up in the unit, to study the interaction of mothers and their twin babies in early life. These were important aspects of the unit's work, and Douglas directed them as well as the birth cohort study. His commitment to this work is shown by his request to the five-yearly review committee in 1970 to re-name the unit the 'MRC Unit for Child Development and Behaviour' (Medical Research Council, 1970a).

The initial focus of the birth cohort study was agreed by its steering committee to be a) vocational education and technical training; b) maladjustment and delinquency; and c) education of the survey members who were still at school. However, following MRC concern that 'a good deal of the work…could be considered rather marginal to the Council's interests '(Medical Research Council, 1962), Douglas and Cooper (1964) added new aims concerned with a) the health of those of lower birth weight and those who had many childhood accidental injuries, asthma, eczema, or chronic illness; b) work and marriage histories in relation to earlier education, training, teachers' assessments of behaviour and life chances, and psychological and behavioural problems including delinquency; and c) use of health services. In line with Douglas and Glass's view, expressed in their initial application to the MRC, that the birth cohort study had a time-limited useful life, the second meeting of the steering committee in October 1964 agreed that there should be two final interviews with the cohort, one in 1967 and the other in 1971.

Data collection methods

Initially, the new research unit's data collections addressed the steering committee's initial concerns with social and educational outcomes. Youth Employment Officers interviewed those who had left school at the earliest opportunity, to collect information about employment experience and intentions. Douglas and his colleague Jean Ross interviewed those who had gone on to university. In all topic areas it was thought possible to obtain good quality data during the cohort's late adolescence and early adulthood through monitoring information collected by service providers, rather than relying on self-reports. While negotiations took place with government departments concerned with higher education, employment, social welfare and health, as well as the National Health Service and professional bodies, the study returned to earlier forms of data

collection to maintain the collection of information about health and social circumstances. Health visitors undertook a data collection in 1965, and postal questionnaires were used in 1966 and 1968. However, it became clear that the only viable data sources were (a) the National Health Register, which agreed to provide data on dates and causes of death, and (b) hospital records which could, with the agreement of each hospital and each consultant, permit study staff to follow-up cohort members' reports of admissions in order to add details of diagnoses and treatments. These options were taken up.

It was decided that the final data collection should be by a home interview in 1972 (at age 26 years), preceded by a postal questionnaire to establish addresses and trace missing study members. Douglas asked the Government Social Survey to undertake that home interview data collection, using their national panel of interviewers, but eventually, after much indecision, they declined because of the sample's geographical spread and the prospect of much evening interviewing (Medical Research Council, 1970b). Consequently, a bid was accepted from Social and Community Planning Research (two other firms were bidding), and they undertook the work in 1972-3.[iv] Following that data collection, all reported hospital care was checked with hospital records, and reported deaths were monitored through the National Health Service Central Register.

An additional dimension to the study began in 1969, when data was first collected at home interviews to study cohort members' upbringing of their first born, and the birth, health, growth, cognitive development and education of that child.[v] Data collection was completed in 1981.

Concerns about the long-term

Within two years of the new research unit's inauguration Douglas affirmed to the steering committee that 'the National Survey would for practical purposes cease after 1971, but it was recognised that it would be extremely valuable to maintain contact for as long as possible'(Douglas, 1964a). Five years later an MRC review concluded that the study's aim should be the establishment of 'groups of medical interest' who might be examined at a later date 'to determine for example lung function or the extent of specific disabilities' (Medical Research Council, 1969), reflecting the

argument put forward in the original application (Glass, 1960). In their review in 1972, the MRC agreed with the proposal that the data collection in that year should be the last, because 'returns in sociological, developmental and medical information obtained from the NSHD cohort during the next two decades are likely to be low and the cost of maintaining contact with the subjects increasingly high' (Medical Research Council, 1972). Nevertheless, a short postal questionnaire was used in 1977 to maintain contact and the collection of information about health and social circumstances, and the MRC agreed to continue the unit until Douglas's retirement in 1979.

Modifications of long-term aims

Despite Douglas's earlier doubts about the continuation of the study, however, new ideas were emerging. Glass, who had initially been pessimistic about the long-term future of the study (Glass, 1960), became convinced that it should continue (Glass, 1970), and arguments in favour of continuation were made in relation to policy and science.

During this period there were two expressions of interest in continuation of the study for policy purposes. The first source of interest developed from the unit's research that had been funded by grants from government departments and sources other than the MRC on, for instance, occupation and training and their associations with health (Cherry, 1974a and b, 1976; 1978), housing deprivation (McDowell, 1979), delinquency (Wadsworth, 1979), and social mobility (Kerchoff, 1974). The second source of policy interest was the largely positive response to the Government Social Survey's request to government departments in 1969, indicating their interest in continuation of the study[vi]. Consequently, in December 1974, the Central Statistical Office (CSS) emphasised to the MRC that they saw 'this survey as a valuable source of longitudinal data', and suggested that at a minimum the study's records should be preserved, and ideally a live address list 'should be kept so that cohort members could be contacted for further surveys' (Boreham, 1974). The CSS thought the data on transition from home to school, and from school to employment, 'likely to be useful as a means of comparing different generations', and highly relevant to the current Social Science Research Council and Department of Health and Social

Security joint project on transmitted deprivation (Medical Research Council, 1974). However, some government departments were not enthusiastic because of the relatively small sample available for their purposes (e.g., studies of drug use). Although one academic social scientist was unenthusiastic about the quality of the data on income and earnings (Medical Research Council, 1971), the Royal Commission on Income and Wealth showed a strong interest in the potential value of the study for their purpose (Boreham, 1975). The Central Statistical Office convened a new meeting of representatives from the Royal Commission, the Social Science Research Council and government departments, which concluded that the study had 'enormous potentiality for providing information about longer term social and socio-biological interrelations whose understanding is fundamental to the development of social policy' (Central Statistical Office, 1975).

There were also new expressions of interest by health scientists in maintaining the study. In June 1974 the MRC noted that interest in the cohort was likely to increase after 1979, and 'although the 1972 follow-up was intended to be the final one, this was stated after most of the earlier sweeps, and opinions may again change'. Douglas recommended to the 1974 MRC five yearly review committee that the next data collection should be when cohort members were in their early forties (i.e. in 1986-1990), and should focus on 'psychiatric state, respiratory illness, marriage, fertility, employment, earnings and criminal records. Respiratory function and other physiological tests would also be desirable' (Douglas, 1974). The MRC Environmental Medicine Committee noted in 1975 that 'the there was a strong case for maintaining an active up-dating of the Survey', and considered it 'essential that the medical aspects of the survey should be maintained for the future, particularly with a view to obtaining data relevant to the diseases of middle life' (Medical Research Council, 1975).

In 1976 the MRC set up an Advisory Group on the future of the study after Douglas's retirement, and also asked ten specialists for their views. The Advisory Group did not reach a consensus. Some reviewers were against continuation on the grounds of sample size in relation to expected illness incidence, including the British lead researcher on smoking and lung cancer (Doll, 1970). A social scientist argued against continuation, because in such studies 'there tends to be a somewhat haphazard searching for problems that can be tackled by the existing data base…. The danger faced by such cohort studies stems from lack of theory- from narrow and atheoretical measures that become locked into the overall design' (Brown, 1979). Others had already argued for continuation in order to study the outcomes of childhood illness (Woolf, 1974) and the impact of adult illness (Rose, 1977). Douglas argued for continuation to study life-long etiology of mental and physical illness, socio-economic differences in illness prevalence and its impact on the family, inter-generational variation of illness risk, and the cohort's blood pressure, respiratory function, body shape, experience of stress, exercise, alcohol consumption and smoking habits (Douglas, 1977). A mental health reviewer argued in favour of continuation because of the study's potentially important contribution to current hypotheses that required life history data, and because of newly developed methods of measuring mental health in the general population (Cawley, 1978).

In the end the MRC concluded that 'the Survey should concentrate primarily on medical objectives, and in particular the diseases of middle age over the next decade, but social data should continue to be collected' (Medical Research Council, 1977). The Department of Epidemiology at the London School of Hygiene was invited to submit detailed scientific plans for continuing the study. Their proposals were for new data collections and studies on: a) psychiatric disorder; b) other chronic disease and c) health and ageing (Alberman & Marmot, 1978). However, the MRC rejected the proposals, which they saw as a 'substantial departure from the recommendations made by the Advisory Group and from the Board's own expressed view', mainly because they included recruitment of an ethnic minority comparison sample, and considerable expansion of staff numbers (Medical Research Council, 1978). The Board then invited, and eventually accepted, proposals from Bristol University's Department of Social Medicine (Colley, 1978). Concern about the proposed extensive coverage of health topics, described by one reviewer as 'so large as to make strong men feel weaker', prompted the Board to wish to see detailed proposals for the next data collection 'before coming to a final decision on the level of support needed', whilst nevertheless agreeing to relocate the study to Bristol (Medical Research Council, 1979).

Continuation after the first principal investigator retired

New funding and organisation

Following Douglas's retirement in 1979, only one member of his staff (Wadsworth) moved to Bristol. The MRC funded the head of the Bristol University Department of Social Medicine, Professor John Colley (as honorary director), to establish a small external scientific staff team[vii] and to make detailed new proposals and an application for funding a new data collection. Support staff and two scientific staff were initially appointed (an epidemiologist and a psychiatrist), and others were later funded by the data collection grant successfully applied for in 1981.

Establishing a new focus

The Bristol team's thinking about aims and methods of a new data collection was influenced by six new kinds of ideas:

- Recent research had shown that, over extended periods of the life course, adverse interactions of temperament and behaviour with social and/or occupational environment were associated with increased risk of depression (Brown & Harris, 1978) and cardiovascular illness (Marmot, Syme, & Kagan, 1975; Haynes, Levine, Scotch, Feinleib, & Kannel, 1978a, 1978b).
- There was evidence, some from ongoing longitudinal studies, for the adverse effects of poor health-related behaviour over long periods (e.g., smoking, poor nutrition, and little or no physical exercise) on risk of specific illnesses, for example lung cancer (Doll & Hill, 1964) and cardiovascular disease (Kannel, 1978).
- An MRC trial of treatment of mild hypertension at ages 35 to 64 years showed that blood pressure change in young adulthood had predictive value for future illness and could be effectively treated (Miall & Chinn, 1974).
- Although the model of the life-long effect of early growth on physical health would not be put forward for another twelve years (Barker, 1991), the beginnings of new ideas about early established vulnerability were already evident in epidemiological research. Reid (1966) had suggested that typical mid-life onset of chronic bronchitis might be associated with a vulnerability established in childhood. Illsley and Kincaid (1963) used data from the 1958 perinatal mortality study (which became the 1958

national birth cohort study) to show that mothers who grew up in poverty in the pre-war economic depression were at greatest risk for having a child die in the first week of life. They attributed this to the mother's poor childhood nutrition, which led to poor skeletal growth, and restricted pelvic size in adulthood. In the United States a bacteriologist, a psychologist and a physician reviewed animal and human studies of factors that promoted or retarded growth in early life, and concluded that early life health and environmental influences were strongly associated with adult health (Dubos, Savage & Schaedler, 1966).

- The suggestion that the study had a potentially valuable role in research on health change with age had been put forward both by Douglas and his staff (1974) and Alberman and Marmot (1978).
- Wing (1978) suggested that the study should use the Present State Examination, a clinically validated method of screening for psychiatric illness, which could be used by lay interviewers to assess 'caseness' on a wide range of symptoms[viii]

Consequently, the new team decided to measure the health of every member of the cohort (rather than relying on self-reported illness and treatment, and self-assessed state of health, even though they had been checked with clinical records where possible), and to do so by measuring physical function, and state of mental health. Together with data on health-related behaviour, those functional measures would be valuable as outcomes of hypothesised earlier life effects and exposures, as indicators of future health potential, and as baselines against which to measure subsequent change. The grant application for funding the new data collection exemplified the importance of these functional measures by referring to the future value of an established baseline from which to measure the trajectory of 'blood pressure change with age' (Medical Research Council, 1981a). The MRC review board particularly commended mental health aspects of the proposal (Medical Research Council, 1981b)[ix].

This was a fundamental change in the study's concept and measurement of health, which had until then been assessed in the cohort in terms of a) physical growth as measured by nurses and doctors; b) disability and signs of health problems as

assessed by school medical officers, and c) self-reports of illness, injury, disability, health care (hospital admissions were checked with hospital records), smoking and exercise habits. The new team's first data collection added measures of function (blood pressure, respiratory function, pulse rate), a clinically validated measure of mental health, measures of shape (height, weight, and upper arm and abdomen circumference), a 7-day diet diary (with the MRC Dunn Nutrition Unit as collaborators), reports of prescribed medication, and detailed validated questions about exercise, functional physical impairment, and smoking. Means of measuring exercise under stress and carotid artery blood flow were explored but not found to be viable for home interview use. An attempt to include replication of Brown and Harris's (1978) hypothesis on social origins of depression was not possible because of the long time required for interviews.

The grant for data collection was awarded in 1981 (Medical Research Council, 1981b) and fieldwork was undertaken in 1982, when cohort members were aged 36 years.

Data collection methods

Some contemporary developments in methods of data collection and measurement, and the team's earlier experience, made it possible to measure function and mental health at home visits. They were:

- the random zero sphygmomanometer, developed for the measurement of blood pressure in population studies with minimum observer measurement bias;
- the mini Wright peak flow meter for measuring respiratory capacity;
- the Present State Examination screening of mental health symptoms (Wing, Cooper, & Sartorius, 1974);
- new methods of collecting reliable data on diet and exercise and new methods of coding such information;
- the availability in many parts of the country of research nurses who had recently worked on the MRC mild hypertension study;
- the team's experience in selecting interviewers, teaching them data collection methods, and managing all aspects of fieldwork administration of home visit data collection for the study of cohort offspring.

The research team undertook all aspects of the fieldwork in the data collections at ages 36 years (in 1982) and 43 years (in 1989). Fifty six nurses were recruited and employed as data collectors because they were familiar with the measures and could be provided with professional indemnity insurance to undertake the measures: they collected information completing questionnaires by hand. The research team and their nutritionist collaborators recruited the nurses, trained them on regionally-based five day courses, and undertook all aspects of the fieldwork administration, quality control and coding, using the experience gained in the study of cohort offspring. At age 53 years (in 1999), the National Centre for Social Research was contracted to collect data using nurses (trained by the research team) and computer-based questionnaires.

Each of these three adulthood data collections included an extensive series of questions about family life and personal relationships, occupation, leisure time activities, social life and social engagement, as well as measures of physical and mental health and function, and health-related behaviour. Over these collections the range of health data was expanded to include cognitive function, measures of muscle strength, muscle power and balance, and a source of DNA (Wadsworth, Kuh, Richards, & Hardy, 2006). Since then data collection has been undertaken in research clinics, at ages 60-63 years, and the range of health information has continued to be expanded (Kuh et al., 2011).

Discussion

The twenty years reviewed here were preoccupied with concerns about the future purpose of the study. At the beginning of the period reviewed the study's work was clearly focussed on health. The most recent book at that time (*Children under five.* Douglas & Blomfield, 1958) and most papers, were about health[x]. The Medical Research Council (MRC) were approached for funding because they were thought likely to be interested, and they were then the only national source of funding for a research unit. When they agreed to funding, the MRC had been optimistic about the future value of the study for health research. However, once the new research unit began work in 1962, the MRC had concerns about the low emphasis on health, and they may have been disconcerted by the publication two years later of what was to become a well-publicised book about

the cohort's educational experience (*The home and the school.* Douglas, 1964b)[xi], followed by another, four years later (*All our future.* Douglas, Ross, & Simpson, 1968).

The research unit struggled during the 1960s and 1970s with possible options for the study's future. Health research then commonly used illness as its outcome, but the sample size, and low incidence of illness in adolescence and early adulthood, would in that case restrict the future of the study to comparisons of sample members who had illnesses with selected sample members who did not, i.e., controls, as proposed in Glass's (1960) original request for MRC funding. For that purpose Douglas proposed to maximise the quality of data on illness by using clinical record sources, but that proved to be possible on only a limited basis.

A second possible future focus was to use the unique value of the study's findings based on longitudinal data to explore in much greater depth, in new investigations, the questions revealed. Douglas attempted to do that by designing two new detailed observational studies of child development, separate from the birth cohort study. The MRC funded those studies which, in practice, took up a great deal of the unit's and Douglas's time, as shown by the notes of the five-yearly reviews. Undoubtedly these new studies were for him a distraction from the birth cohort study.

A third future possibility became clear as a result of the unit's work on socio-economic and educational outcomes, and the enthusiasm for the study expressed by some government departments when asked whether the Government Social Survey should undertake a data collection for the study[xii]. Government departmental interests were reflected also in government grants for study staff to undertake analysis, and in the range of departmental representatives who, later in the period studied, joined the academics and clinicians on the steering committee.

That evidence of a wider interest, together with a high response rate in what was intended to be the final data collection (at age 26 years in 1972), began to challenge the pessimism of Douglas and the MRC about the study's future. As Douglas's retirement approached, an MRC-initiated review of possibilities for the future revealed new thinking about the development of risk in the individual for some mental and physical illnesses, which required longitudinal, and ideally life course data to explore

and verify. It also revealed the study's potential and unique value for developing new ideas about and new research into the processes of ageing.

Consequently, the MRC agreed to short-term funding for a small and essentially new team to develop ideas for the future. The team re-defined the study's health outcomes in line with new epidemiological ideas and with the study's existing data, and developed new continuous measures of physical and mental state of health which were undertaken at home visits in 1982 (at age 36 years) to all cohort members.

Thus by the end of the twenty years reviewed here the study had found a new focus appropriate to contemporary concerns in health sciences. That new focus was determined by internal factors (the sample's age, the existing data, and the scientific concerns of its staff), as well as by external factors (thinking and changes in thinking in the science and policy communities, developments in data storage and processing[xiii], innovation in measurement techniques, and available funding options).

In a similar way the study had found a new policy focus in its concern with the processes of mental and physical ageing. That came to be recognised in due course as a question for which longitudinal data on health was essential (House of Lords, 2005). Both the new scientific and the new policy concerns were built on the sufficiently detailed base of existing data. For example, the cognitive data collected in the cohort's school years for studies of cognitive development and educational attainment, became of value for research and policy studies of ageing when supplemented with new data on adult cognitive function (Richards, Shipley, Fuhrer, & Wadsworth, 2004). Similarly, weight at birth, collected originally for studies of child health, became valuable in studies of how pathways of risk to adult health develop throughout the life course (Wadsworth et al., 2006; Kuh et al., 2011).

During the period reviewed, large-scale longitudinal studies had a low profile in Britain compared with today. They tended to be regarded as too broadly focussed and too expensive of research resources for the returns they provided (Welshman, 2012). The view that such studies suffered from lack of theory (predominantly expressed by social scientists, exemplified here by Brown, 1979) and should be more specifically hypotheses-driven (mostly expressed by

epidemiologists, exemplified here by Wing, 1978[xiv]) than they generally were, was challenged by Douglas. In his final report to the MRC he concluded that 'We did not set out to test specific hypotheses because of the sad fate of the American longitudinal studies of the twenties and thirties… (which) were then largely written off, and their recent resurrection as the only source of reliable data linking early childhood experience with adult health and behaviour was not yet foreseen. … The requirements for a successful longitudinal study seem to be a large sample, national coverage (to avoid loss from internal migration), general rather than specific hypotheses, the avoidance of high technology, and the recruitment of staff with wide interests.' (Douglas, 1979). Douglas's comment here on hypotheses, is concerned with study designs which focus on a specific hypothesis; the study under Douglas, and since, has been designed to explore a range of hypotheses.

This paper could have also described how, during the period reviewed, the birth cohort studies gradually came to be regarded as cost-effective and increasingly valued as longitudinal data sources (Social Science Research Council, 1970), (see 'Modification of long-term aims' above). That must be the subject of another paper. After the period reviewed here (1962 to 1982) new questions arose about research ethics, data access and sharing, and national funding strategies, as the potential value of large-scale longitudinal studies for science and policy purposes became much more widely understood and encouraged in Britain. That is shown by reviews of their aims and future development (Medical Research Council, 1992; Economic and Social Research Council, 1993; 2002; 2006), by investment in three new, large-scale longitudinal studies beginning in early life (the ALSPAC study in 1991-2 www.bristol.ac.uk/alspac; the Millennium Study in 2000-1 www.cls.ioe.ac.uk/mcs; the Life Study which begins in 2014 www.lifestudy.ac.uk), by the development of similar studies in other countries, and by the continuation of the study described here.

Acknowledgements

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Endnotes

[i] Douglas took the study to the Department of Public Health and Social Medicine at Edinburgh University in 1954. After another candidate was appointed to the Chair in that Department in 1956 Douglas decided to concentrate on the birth cohort study rather than pursuing a conventional academic career.

[ii] In the Foreword to *Family and Kinship in East London,* Young and Willmott (1957) wrote "We were able to establish the Institute for Community Studies and to start the research reported in this book on the strength of a grant made by the Elmgrant Trust, which was supplemented by Professor Edward Shils out of monies made available to him by the Ford Foundation. At a later stage, we received a welcome grant direct from the Ford Foundation."

[iii] This hospital cares for mental health and is attached to London University's Institute of Psychiatry. Professor Sir Aubrey Lewis held the first chair of psychiatry at the Institute of Psychiatry and had worked with Douglas during the Second World War, before the study began (see Wadsworth 2011). He chaired the study's steering committee during part of the period reviewed.

[iv] Social and Community Planning Research was an independent not-for-profit organisation, which later became the National Centre for Social Research.

[v] The Second Generation Study, designed and run by Wadsworth, was concerned with cohort members as parents. Interviewers, recruited and trained by the study, collected data at home interviews (when the first born children were aged 4 years and again at 8 years) on child rearing methods, parental aspirations for education, and health of the child. At 8 years the child took the same cognitive test as the cohort member parent had at that age, and teachers completed a postal questionnaire about the child's behaviour, attitudes, and attainment (Wadsworth, 1986: Byford, Kuh, & Richards, 2012). Details of the birth of the children were also recorded (Kuh et al., 2008).The aims were (a) to investigate in greater detail the finding in the cohort generation that educational attainment was consistently associated with parental concern for the child's education (Douglas, 1964); and (b) to compare cognition, educational attainment, growth and health in infancy and childhood in the two generations.

[vi] The departments included the General Register Office, the Home Office, and the Departments of Health & Social Security, Education & Science, Employment & Productivity

[vii] MRC External Scientific Staff appointments were generally offered to those who had been members of MRC Units, and were made and funded on an individual basis.

[viii] Wing suggested to the MRC that he should run a separate data collection for this purpose. However, the Bristol team agreed to use the method but to undertake data collection and analysis with the help of a psychiatrist, Dr Sheila Mann, newly appointed to the Bristol team.

ix It was regrettable that Douglas had declined Goldberg's request to include an early version of his General Health Questionnaire (Goldberg & Williams, 1988) in the data collection in 1972 at age 26 years, since it was designed to identify minor psychiatric disorders in the general population. The decision was taken because of pressure on time at interview, and because Douglas had doubts about the reliability and validity of what was a relatively new method.

x Up to and including 1961, the unit had published 1 paper on methodology, 2 on social and demographic topics, and 24 papers and 2 books on health.

xi *The home and the school* (Douglas 1964b) was reprinted 3 times and re-issued in paperback, which was reprinted 5 times. *All our future* (Douglas, Ross & Simpson 1968) was also re-issued as a paperback.

xii The study might have changed under this influence to become much more responsive to government policy requirements for longitudinal data. However, the inclination of Douglas and his staff was to maintain the study's independence. After discussion, the steering committee agreed 'that every effort should be made to preserve the identity of the Unit as a research rather than a service organisation' (Medical Research Council, 1964).

xiii The period studied began with all data held on punched cards, and analysis undertaken on card sorting machines and mechanical calculators, and ended with all data held in electronic files and analysis undertaken using computers and electronic calculators. Similarly, over the same period, the original data was copied from paper documents onto microfiches, for preservation purposes. The extent and demands of those changes, undertaken mostly by study staff, were considerable.

xiv In the mid-1980s a clinical epidemiologist research director suggested to the author that the study should become a clinical trial for long-term blood pressure treatment.

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