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Centre for Market and Public Organisation
Bristol Institute of Public Affairs
University of Bristol
2 Priory Road
Bristol BS8 1TX
<http://www.bris.ac.uk/Depts/CMPO/>

Tel: (0117) 33 10799

Fax: (0117) 33 10705

E-mail: cmpo-office@bristol.ac.uk

Fathers, Childcare and Children's Readiness to Learn

Elizabeth Washbrook

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Elizabeth Washbrook¹

¹ CMPO, University of Bristol

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Abstract

This study explores the effects of exposure to regular paternal childcare (without the mother present) in the first three years of life on the academic and social capabilities of boys and girls when they begin school. Innovations in this paper are the use of data on children's early attributes to explore the issue of reverse causation, and a bootstrap technique that allows us to estimate standard errors on the change in the paternal care coefficient when additional groups of controls are included. The rich nature of our data (the ALSPAC UK cohort) allows us to eliminate many potential sources of bias in the estimates, and identify effects that are robust to numerous different specifications. Fathers are the most widely used form of non-maternal childcare in this period. We find that the effects of paternal childcare, relative to maternal-only parental care, depend on the gender of the child, the age at which care occurred and the weekly hours of paternal care. We find evidence that children's social development may be enhanced by time alone with fathers, but that boys seem to suffer academically from long hours of paternal care when they are toddlers. Our findings show that the changing social roles of mothers and fathers may have implications for child as well as adult well being.

Keywords: fathers, childcare, school readiness

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Address for Correspondence

CMPO, Bristol Institute of Public Affairs
University of Bristol
2 Priory Road
Bristol
BS8 1TX
Liz.washbrook@bristol.ac.uk
www.bris.ac.uk/Depts/CMPO/

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1. Introduction and summary

There is increasing evidence from a diverse range of literatures that the experiences of children in the first years of life can have a lasting impact on their future prospects. Research in developmental psychology and neuroscience has explored the mechanics of brain development and the learning process, whilst social scientists have taken a keen interest in the concept of school readiness, or the skills and abilities that children bring with them when they start school. At the same time that evidence on the importance of early experience has been mounting, there have been dramatic changes in the social roles of mothers and fathers. Maternal employment is now the norm for mothers of children under the age of 3 in two-parent families. There is also increasing evidence that fathers both wish to, and are becoming more actively involved in the lives of their children than in recent memory. The introduction of paid paternity leave for the first time in the UK in 2003 is one example of the way in which governments around the world are attempting to promote greater gender equality in family life, as well as in the workplace. This paper explores the question of whether paternal childcare in the first three years is associated with any effects on the school readiness of girls and boys. We use unique data from the ALSPAC cohort on a sample of 6010 children born in the early 1990s into two-parent families. These data contain rich measures of the childcare arrangements used in the first three years and measures of children's cognitive and socio-emotional development on entry to school, plus information on a host of environmental factors.

Our measure of shared parental care relates to regular care provided by the father without the mother present. We distinguish between care provided in the first year of life and care in the two subsequent years, and also between care of moderate intensity (5 to 15 hours per week) and care of high intensity (15 or more hours per week). We condition on non-parental hours of childcare, so that our estimated effects have the interpretation of the impact of exposure to paternal care, relative to maternal-only parental childcare. 35 percent of the fathers in our sample provided regular childcare of at least 5 hours a week in Year 1, rising to 61 percent in Years 2&3. Long hours of paternal care are less common, but still relatively frequent, accounting for 13 and 20

percent of our sample in the two periods respectively. Other types of non-maternal care were markedly less common than paternal care in this period. Examination of the data show that paternal childcare consists of a wide variety of arrangements, including many cases when the mother is not in market work and cases where the father is the sole non-maternal carer.

The main focus of this paper is on the effects of paternal childcare on children's development, rather than on the determinants of parental childcare choices. However, the rich nature and large sample size of the ALSPAC data provide an opportunity to explore the extent to which paternal childcare households are a positively or negatively selected group with respect to family endowments. Appendix B sets out the household production model that is our conceptual framework and highlights some of the predictions of economic theory on the determinants of paternal childcare. It also provides descriptive analysis of the relationships between paternal childcare and the parent and child endowment controls used in the multiple regression analysis. Our analysis allows us to address some common stereotypes about paternal care, such as that it is used by low-income families who cannot afford to do otherwise, or that it is used by high-wage two-career couples who are willing to sacrifice some earnings in exchange for the utility generated by variety in the allocation of time.

We tackle the problem of the potential endogeneity of childcare choices with respect to child's innate characteristics by including detailed controls for child health, temperament and ability in the first 6 months of life. Although there is some risk of reverse causation in these variables, we argue that it is likely to be minimal. In contrast to techniques such as the sibling difference estimator, this approach allows us to explore explicitly which types of characteristics in children tend to be associated with the use of shared parental care. We also estimate a 'value-added' specification that conditions on child outcomes measured between the ages of 15 and 30 months. This allows us to explore to what extent the effects of paternal childcare on school readiness have already emerged by the age of 2½.

In our empirical analysis we distinguish clearly between endowments, which can be

treated as exogenous controls that reduce selection bias, and inputs that are chosen by parents. We explore the effect of including these latter controls on our estimates of interest, whilst recognising that ‘over-controlling’ for factors that are determined simultaneously with childcare decisions can lead to estimates that are severely biased and devoid of meaning. Potential mediating factors that we explore include a number of measures of parental attitudes, parenting behaviours and the home environment, household income and the quality of the parental relationship. The relationships between these variables and paternal childcare are discussed in Appendix C. Our estimation procedure is to sequentially introduce groups of controls into our child outcome regressions. This allows us to investigate the impact on the estimated effects of removing the influence of different types of factors that are correlated with paternal childcare. Unlike previous studies of this type, we use a bootstrap technique that allows us to test whether the coefficient in question is significantly altered by each group of controls. We also conduct sub-group analyses by interacting the paternal care variables with a range of mother, father and child characteristics. This allows us to explore whether estimates of the average effect of paternal care disguise important differences between different sub-groups of the population.

To summarise our findings, our results suggest that in the majority of cases paternal and maternal childcare are interchangeable in terms of their effects on children’s school readiness. In particular, we find little evidence of differences in children’s outcomes depending on whether or not they experienced paternal care in infancy. The exception is that paternal care that is begun in Year 1 but not carried on into the following years is associated with slightly poorer behavioural outcomes at age 4. This type of arrangement is rare in our data, accounting for only 4 percent of the overall sample. This said, we do find some evidence that mothers and fathers may have systematically different parenting styles in some cases. Children who experience moderate hours of paternal care when they are toddlers seem to benefit socio-emotionally from the experience of time alone with the father. This suggests that the parenting styles of fathers, or perhaps simply the experience of care from two parents rather than one, promotes children’s early socialisation. On the other hand, we find robust evidence that boys (but not girls) performed more poorly on academic

assessments at entry to school when they were cared for by the father for long hours in Years 2&3. This suggests that some fathers may not provide the same degree of cognitive stimulation when they are responsible for care that mothers provide. We find some evidence that father-child interactions do differ in character depending on the gender of the child, but it is also possible that boys and girls respond differently to a given style of parenting. Our research highlights the fact that trends towards greater gender equality in family life, as well as in the marketplace, may have consequences for child as well as for adult well being.

Section 2 provides background on our motivation and briefly summarises the related literatures. Section 3 describes the data and Section 4 discusses the relationship between paternal childcare, parental employment and total parental time inputs. Section 5 discusses our choice of specification and econometric approach. Section 6 provides estimates of the total effect of paternal childcare on boys' and girls' outcomes. These results show the effects of controlling for selection in different types of endowments on the estimated impact of paternal care. Section 7 tests for heterogeneity in the effects of paternal childcare on child outcomes. Section 8 explores the extent to which various measures of the home environment can throw light on the processes underlying the total effects identified in Section 6 and Section 9 concludes.

2. Background

2.1. Children's school readiness and the first three years of life

The first three years are a vitally important period in children's development. A recent review of the developmental psychology and neuro-scientific evidence on children's physical, cognitive and emotional development in this period concludes that:

The early years are important. Early relationships matter. Even in infancy, children are active participants in their own development, together with the adults who care for them. Experience can elucidate, or diminish, inborn potential. The early years are a period of considerable opportunity for growth, and vulnerability to harm.

[Thompson, 2001, pp. 22]

Knudsen, Heckman, Cameron and Shonkoff (2006) draw on this body of research to argue that:

[T]he most efficient strategy for strengthening the future workforce, both economically and neurobiologically, and improving its quality of life is to invest in the environments of disadvantaged children during the early childhood years.

Recognition of the importance of the child's early environment has contributed in part to an outpouring of research on children's school readiness, or the social and cognitive skills that children bring with them when they enter the state school system. For example, a recent issue of *The Future of Children* was devoted entirely to school readiness (Spring 2005). Children's school readiness is of interest in policy terms because it plays a key role in determining the nature of the resources that schools and other agencies must spend in the endeavour of educating and socialising young people. There is also strong evidence that children who enter school with academic or socio-emotional deficits are more at risk of undesirable outcomes in later life, such as functional illiteracy, teen pregnancy, juvenile delinquency and poorer educational qualifications (e.g. Rouse et al, 2005, Baydar et al, 2003), even controlling for other influences. Research of this kind has stimulated interest in whether early intervention programmes, such as Head Start in the US and Sure Start in the UK, can reduce the inequalities experienced by low-income, disadvantaged and disabled children (e.g. Currie and Thomas, 1995, Schneider et al, 2006).

We focus on two measures of children's school readiness in this paper, one socio-emotional and one cognitive. We do this in part because we believe that school readiness is an outcome of interest in its own right, and in part because the nature of our data makes it difficult to interpret the relationships between early years childcare and later child outcomes. Specifically, the currently-released ALSPAC data contain rich measures of family circumstances and children's development for the pre-school period, and some measures of academic and socio-emotional attainment later on in childhood. However, we are lacking data on many of the contemporaneous influences

on children at the time these later assessments were taken. Whilst we can (and do) show the associations between paternal childcare in the early years and child outcomes at age 7, these results are difficult to interpret. If fathers who are more involved early in the child's life maintain this involvement at later ages, then we risk mistaking the effects of contemporaneous paternal involvement for the effects of early childcare experiences. In addition, if children who perform poorly on entry to school receive differential treatment by parents or teachers than more able children, then the effects of shared parental childcare may be either countered or exaggerated by these later inputs.

2.2. Changing maternal roles and the effects on children

Increases in the labour market participation rates of mothers of young children have been well documented. In the UK, the proportion of mothers of dependent children who are in employment has risen from one-half in the 1970s to two-thirds in 2006. The employment rate of mothers of children under 5 has risen even more rapidly, from a quarter to 55 percent over the same period (EOC, 2006). A large, mainly US-focused empirical literature has arisen on whether maternal employment in the first three years of life is associated with differences in children's cognitive and socio-emotional outcomes (e.g. Ruhm, 2004; Baum, 2003; Waldfogel et al., 2002; Harvey, 1999, all using US data; Gregg et al., 2005; Ermisch and Francesconi, 2002, using UK data). In general, this literature finds a negative association between very early maternal employment, i.e. in the first year of life, and the outcomes of school-age children. There is less consensus about the effects of maternal employment in the second and third years. For example, Waldfogel et al. (2002) find positive effects on cognitive outcomes whereas Ruhm (2004) finds some evidence of small negative effects on cognitive development.

The hypothesis implicit in much of this research is that the mother has a uniquely important role to play in caring for very young children. Given that children at this age must be in the care of a responsible adult at all times, this proposition amounts to the idea that a) the quality of non-maternal inputs are poorer than the quality of maternal inputs, b) the quality of maternal inputs are affected negatively by labour

market participation, or c) that children are harmed by interruptions to the care provided by the primary caregiver. The relative importance of these different explanations will have a bearing on whether or not paternal childcare can act as a good substitute for maternal care.

Breastfeeding provides an example of a case in which maternal inputs may be of intrinsically higher quality than those supplied by non-maternal carers¹. Mothers may also provide higher quality care if they have invested preferentially in human capital that raises parenting ability, for example because they anticipate one day acting as the primary carer for a child². Maternal inputs may also be of higher quality than non-maternal inputs because a parent has greater incentives than a non-parent to invest in the child's human capital (Becker, 1991, Ch. 6). We would also find negative effects of maternal employment on children if the attempt to combine work and childcare results in stress or tiredness that adversely affects the quality of mother-child interactions. Balanced against this, however, is evidence that working mothers prioritise 'quality' time with their children and 'shed load' by reducing time in other activities like sleep and leisure (Bianchi, 2000). Potential benefits of maternal employment are higher household income, increased independence, wider social contacts and a more positive sense of personal identity (Harkness et al., 1995), which may in fact improve the quality of mother-child interactions. The third way in which children may be harmed by maternal employment is one highlighted by attachment theorists (e.g. Belsky and Rovine, 1988). According to this theory, the separation of mother and infant in the first year of life may lead to insecure attachment that then starts a trajectory towards longer-term negative outcomes. This theory relates less to the idea that mothers are innately better at raising children than other carers, and more to the idea that as mothers are overwhelmingly likely to be the child's primary carer disruptions to this relationship may have adverse consequences for the child. The greater amount of time spent by the mother with the child may also be a reason why

¹ Research has shown a link between breastfeeding and cognitive development, e.g. Anderson et al. (1999).

² Becker's theory of the intra-household division of labour argues that the potential gains to specialisation create incentives for this kind of specialized human capital investment (Becker, 1991, Ch. 2).

maternal inputs are of superior quality, for example because the mother becomes more attuned to the child's needs than carers who spend less time with the child.

Alongside the literature on the effects of maternal employment there is another body of research that focuses on the form and quality of non-maternal childcare in the early years. The NICHD Early Child Care Research Network used direct observations of the interactions between carer and child to explore whether the quality of childcare was an important factor in determining children's school readiness. The study found that children who experienced high quality care had slightly better outcomes at age 4 than those who experienced lower quality care (NICHD, 2006). The language used by the caregiver was the most important aspect of quality for cognitive development, with carers who provided more stimulation, for example by asking questions and responding to vocalisations, fostering better outcomes in children. High quality care was also linked to better behavioural outcomes, although the relationship was less strong than for cognitive outcomes. Tran and Weinraub (2006) use the NICHD data to explore whether stability in care arrangements is an important facet of childcare quality. They found that some forms of unstable arrangements and those involving multiple carers were associated with poorer language development in children.

2.3. Changing paternal roles and the effects on children

Research on fatherhood and child outcomes has tended to focus on one of two themes. Firstly, there has been interest in whether children in single parent families are negatively affected by paternal absence (Francesconi et al., 2006; Cherlin et al., 1995; Gennetian, 2005; Hill et al., 2001; Lang and Zagorsky, 2001). Research has also addressed the questions of whether non-resident fathers' payment of child support and frequency of visitation are associated with improved outcomes (McLanahan et al., 1994; Amato and Gilbreth, 1999) and of how parental conflict affects children's development (Hanson, 1999).

Another research theme documents the increasing evidence, both qualitative and quantitative, that resident fathers are becoming increasingly involved in parenting and family life more generally. Time use studies that analyse the time devoted to childcare

as a 'main activity' have shown a sharp upward trend in fathers' caring responsibilities since the 1970s (Bianchi, 2000; Gershuny, 2001; Fisher et al, 1999, Sandberg and Hofferth, 2001, Yeung et al, 2001). For example, Fisher et al. show that British fathers of children under the age of 5 devoted less than a quarter of an hour per day to child-related activities in the mid-1970s in contrast to two hours a day by the late 1990s. This latter figure translates into around a third of all active parental childcare, compared with around a fifth in the mid-1970s. Qualitative evidence too suggests that fathers, particularly in younger cohorts, both desire and are expected to assume more active roles in their children's lives (e.g, Burghes et al, 1997; Warin et al, 1999).

These trends should not obscure the fact that traditional roles are still deeply embedded in contemporary society. More detailed analysis of the time use data has suggested that there is great variation in the time fathers spend with children, with some fathers recording zero hours of active parental time. It is also the case that fathers' childcare time tends to be concentrated at weekends, particularly where work hours are long. In addition, qualitative evidence suggests that the role of the father as provider for the family remains a key element of fathers' perceptions of their place within the family, and employment rates tend to be highest among the fathers of dependent children. Fathers in two-parent households in the UK had an employment rate of 90 percent in 2001. Only 3 percent worked part-time, and many worked long hours, often in excess of 60 hours a week³. Nevertheless, it is still the case that the traditional household of female housewife and male breadwinner is becoming increasingly obsolete in contemporary society.

A number of US studies have examined the determinants of paternal childcare (e.g. Presser 1988; Brayfield, 1995). This literature tends to characterise parental employment schedules as a determinant of father care, and documents the strong association between non-standard work schedules such as rotating shifts and the use of paternal childcare. However, an economic model of the family suggests that the characterisation of employment as a 'determinant' of childcare arrangements is

³ O'Brien and Shemilt (2003).

misguided. Observed work and childcare patterns are both outcomes of the household decision-making process in which parental time is allocated simultaneously amongst competing uses, and hence the observed relationship cannot be interpreted as causal in either direction. Parents do not make choices about work patterns independently of choices about childcare. Our analysis is based on this view and considers how both types of decisions are related to an underlying set of parental tastes and human capital endowments.

Research on the consequences of father involvement for children's well being has tended to focus on qualitative measures that can be grouped under the heading of 'authoritative' parenting (see Marsiglio et al., 2000 for a review of this literature). Types of father-child interactions examined include emotional support, monitoring of behaviour, everyday assistance and disciplining practices. Positive father involvement is generally found to be associated with beneficial effects on children's educational attainment and social development. For example, Flouri and Buchanan (2004) use data from the NCDS cohort of children born in the UK in 1958 and examine four measures of father involvement at age 7 – 'outings with father', 'father manages child', 'father reads to child' and 'father is interested in child's education' – and find that these variables independently predict educational outcomes at age 20.

The consequences of regular primary childcare provided by the father in the early years have received relatively little attention, perhaps because measures of fathering in large-scale surveys have tended to focus on the kinds of qualitative variables just described. Averett et al. (2005) is one exception. This study uses data on employed mothers from the NLSY and explores the effects of paternal childcare in the first three years on child outcomes, relative to other sources of non-maternal care. Hence this study has a different focus to our research, which is concerned with the effects of paternal care on all children, including those whose mothers did not work in the labour market, and measures the effects relative to maternal-only parental care. Averett et al. rely on retrospective reports of childcare arrangements in the early years and find that only around 10 percent of households report using paternal childcare. This results in a sample of only 253 children who experienced care by their fathers,

too few for the authors to be able to explore whether the effects varied with certain child or family characteristics. They do, however, have data on siblings, which they use to construct a family fixed effect estimator. They find no evidence that paternal care in the first year of life is associated with effects on developmental outcomes compared to other types of care. Children in non-paternal modes of childcare, however, have slightly better cognitive outcomes in the second and third years compared to paternal care. The authors argue that the negative effects of paternal care may reflect time-varying unobserved heterogeneity in the characteristics of fathers who provide care. Specifically, they speculate that paternal carers in the toddler years may be drawn disproportionately from men in low skilled insecure occupations who adopt care responsibilities as a by-product of involuntary employment. The large sample size and rich nature of the ALSPAC data allow us to explore this hypothesis in some detail.

Two papers have explored whether early paternal employment is associated with child outcomes in the same way found for maternal employment. These studies are hampered by the fact that there is far less variation of paternal work hours than in maternal work hours. Ruhm (2004) finds a positive association between paternal work hours and children's developmental outcomes, but this association becomes negative when controls for paternal heterogeneity are included. Ruhm interprets this as evidence that paternal and maternal inputs are substitutes in the production of child outcomes, with higher father work hours proxying reduced time investments in children. Ermisch and Francesconi (2002) also find a small negative association between paternal employment and children's educational attainment when heterogeneity between fathers is taken into account. Their conclusions are in accord with Ruhm's, i.e. that higher paternal work hours have a negative effect on children's development because of the accompanying reduction in fathers' child-related time inputs.

2.4. Gender differences in parenting ability

Our discussion in Section 2.2 highlighted some arguments for why maternal care in the early years may be better for children's development than non-maternal care. Mothers

may be biologically and culturally adapted to provide a higher quality care environment than other carers. In addition, if there are increasing returns to the inputs of one parent then child well being will be maximized by maternal specialization in child rearing. On the other hand, fathers share a number of characteristics with mothers that may mean the distinction between parental and non-parental care is more useful than the distinction between maternal and non-maternal care. Fathers have equally strong incentives to invest in the human capital of their off-spring and are a stable and consistent figure in the child's home environment. Evidence (discussed below) that mothers and fathers have distinct parenting styles raises the possibility that children may benefit from exposure to the two different influences. In addition, it is possible that there are diminishing returns to the time inputs of one parent, for example because a parent brings more energy and enthusiasm to childcare when it is only one of a number of activities in which they spend their time.

Research in developmental psychology provides evidence on whether the ability to breastfeed is only one of a number of advantages that the mother has over the father in terms of childrearing ability. The discussion in this section is taken from an excellent and detailed review of the literature provided in Lamb (1997). We therefore refer the reader to this publication for details of the studies that underpin our conjectures.

There has been much research on the early years in developmental psychology that questions whether mothers and fathers differ in their sensitivity and responsiveness to young children, and in their parenting styles. Attachment theorists argue that parental responses to infant signals such as cries and smiles determine the extent to which the child comes to perceive the parent as stable and predictable. Where the adult does not respond promptly or sensitively insecure attachment may result, with adverse consequences for later psychological adjustment. There is some evidence in the literature that fathers may be less responsive and sensitive than mothers during this early stage of development, for example from observational studies that find fathers responding less sensitively to infant cues and being less likely to retrieve crying infants than mothers. Yet in general the balance of evidence seems to be in favour of no gender differences in these dimensions of parenting ability. Even if fathers are equally

able in fostering secure attachment in children, there may be a hierarchy of attachment figures in which mothers typically are preferred over fathers. This is likely to result simply because the mother is the primary caregiver in most cases, and children form stronger attachments to them as a result. This suggests that even if fathers are equally sensitive and responsive as mothers, children's psychological functioning may be adversely affected by time away from their primary caregiver. The longer that the child spends with the father, however, the more likely that secure attachments will form to both parents.

There is stronger evidence that fathers and mothers have distinct parenting styles, although disagreement about whether these differences are biologically or culturally determined. Fathers tend to engage in physically stimulating and play activities when looking after children to a greater degree than mothers, whilst mothers' interactions tend to be more caretaking or instructional in nature. Both mothers and fathers tend to modify their speech when speaking to pre-school children to suit the linguistic capabilities of the child. However, fathers were observed to breach such modification more frequently by using words that are beyond the capabilities of the toddler. The 'bridge' hypothesis asserts that as a result of this relative incompetence men may in fact stretch their children's linguistic skills, and so act as a 'bridge' to the outside world. Another way that mothers' and fathers' parenting styles have been observed to differ in their treatment of boys or girls. Some studies find that fathers interact more sensitively and preferentially with sons from shortly after delivery. Other findings are that fathers may prohibit boys more than girls, and may be more demanding of girls' than boys' cognitive and linguistic ability. There has also been much discussion of how fathers influence children's adoption of sex roles and gender identity, but there is little consensus on the effects.

In this paper we analyse school readiness outcomes separately for boys and girls, to allow for gender differences in paternal (and maternal) parenting styles. We also distinguish paternal care that takes place in infancy from care of toddlers. This reflects the finding that maternal care may be particularly important in the first year of life, both because of breastfeeding, and because this is the period of formation of infant

attachments. The preceding discussion suggests that we have no clear view a priori of whether, on average, children benefit from, or are harmed by, shared parental childcare in the early years. Paternal care may be of inferior quality to maternal care, either because of lower paternal human capital in this area, or because of biological and/or cultural differences. Alternatively, fathers may be good substitutes for mothers, such that the child is unaffected by the gender division of parental care time. Paternal and maternal inputs may even be complementary, in which case children will benefit from experiencing care by both parents.

3. Data

3.1. The ALSPAC cohort

ALSPAC is a cohort study that began by recruiting pregnant women who were resident in the Avon area of England, and whose expected date of delivery fell between 1st April 1991 and 31st December 1992. The enrolment sample consisted of 14 541 women, thought to be around 80 to 90 percent of all those meeting the eligibility criteria. Of these women, 13 801 (95%) went on to become the mothers of surviving offspring at 12 months, with multiple births leading to a total of 13 971 children in the study at that age. The Avon area has a population of 1 million and includes the city of Bristol (population 0.5 million), and a mixture of rural areas, inner city deprivation, leafy suburbs and moderate sized towns. The 1991 census was used to compare the population of mothers with infants under 1 year of age resident in Avon with those in the whole of Britain. The sample is broadly representative of the national population although the mothers of infants in Avon were slightly more likely to be affluent, on average, than those in the rest of Britain (as measured by, for example, living in owner occupied accommodation, having a car available to the household and having one or more persons per room). The ALSPAC sample is not entirely representative of all eligible mothers in the area, with a slight shortfall again in less affluent, and also non-white mothers⁴. Study families were surveyed with high frequency from the time of pregnancy onwards, with mothers completing 4 postal

⁴ See www.alspac.bris.ac.uk for further details on the representative nature of the sample, enrolment rates and response rates.

questionnaires prior to the birth, plus a further 5 on family characteristics and a further 8 focusing on the study child in the first 4 years after the birth alone. The study also contains data from a number of other sources, such as hands-on examination of the children, school and medical records and biological samples. A number of questionnaires were also sent directly to the mother's partner for completion, although non-response rates for these questionnaires were high (see below).

Variables available in ALSPAC relate not only to childcare arrangements and school readiness outcomes, but also to a rich variety of other measures of parental inputs and environmental factors. This richness allows us to explore not only how child outcomes differ with the extent of shared parenting, but also how other aspects of the child's environment are affected by less traditional parental roles. The ALSPAC data therefore provide us with a relatively unique opportunity to study both the behaviours of a large sample of fathers with children under the age of three, as well as the impact of these behaviours on children's development. Surveys with sampling designs that aim to reflect the composition of the population as a whole, such as the Labour Force Survey, the Family Expenditure Survey and UK Time Use Survey, result in only a very small sample of fathers (and mothers) of young children. For example, we found only around 400 such observations in the UKTUS. It is only with data in which the unit of observation is the child rather than the household that we can develop a consistent picture of the determinants and consequences of fathers' involvement in the care of infants and toddlers.

3.2. Sample selection

Of the 13 971 children in the sample, we begin by selecting those with full childcare histories between the ages of 2 and 38 months. As shown in Table 1, this criterion alone leads us to drop 5753 children, or some 41 percent of the initial sample, leaving a working sample of 8218. We then further restrict our sample to families in which the mother lived with the father of the cohort child continuously in the first 4 years life. We do this to avoid confounding fathers who are in stable relationships but who do not provide regular childcare with fathers who are not resident in the child's home for all or part of his or her early years. The experiences of children in this latter group

are likely to differ systematically from those of children in intact families, and so they do not provide a good comparison group for fathers who are involved in childcare regularly on a weekly basis. Due to the way data were collected in ALSPAC, mothers were asked questions relating to their ‘partner’, where the mother defined at any given moment who that partner was. In order to rule out changes in the identity of the partner over time (which we cannot track), we restrict our sample to children who we can confirm were living with the biological father throughout the first 4 years of life. Table 1 shows that this type of family accounts for around three-quarters of the potential sample of 8218, although we lose more observations (16%) due to missing information on paternal residency than we lose due to the fact that mothers do not live with the biological fathers (11%). Our working sample thus relates to 6010 children who are the biological offspring of two parents who lived together at least until 4 years after the birth of the child. Estimating samples are somewhat smaller, due to missing data on child outcomes. This issue is explored further below.

3.3. *Childcare measures*

Our childcare data is derived from mothers’ responses to the question ‘Apart from yourself, who regularly looks after your son/daughter when you are not there? (Please answer for each person regularly involved).’ Mothers were given a list consisting of the father and 7 other potential types of carer and recorded whether or not each one was used at that date, and also the number of hours per week that the carer looked after the child. Hence our measure of paternal childcare relates to whether or not the father *regularly* supplied *primary* childcare (i.e. without the mother present) in the period in question. Responses for each type of care were top-coded at 40 hours per week, so we can only put a lower bound on the total hours of each type of care that the child experienced. This means that we make the assumption that in all cases the mother is the parent with the majority of the responsibility for looking after the child. This does not seem to be a problem, given the tiny number of observations in which paternal childcare exceeds 30 hours per week (see Figure 1). The effects of paternal childcare estimated in this paper relate to cases in which a proportion of primary childcare time is transferred away from the default choice of the mother and towards the father. It does not imply that the parents have equal responsibility for childcare,

but rather that the mother *does not* have sole responsibility. Further, the measure does not include father involvement that takes place when the mother is present, which may be substantial, nor should it include temporary childcare that takes place irregularly due to unforeseen circumstances.

The childcare question was completed by the mother at 2, 8, 15, 24 and 38 months. We use these data to construct dummy variables that capture hours of paternal childcare in an average week as follows. We calculate the hours that the child was in paternal care in an average week in two different periods – from birth to 1st birthday (Year 1) and from 1st birthday to 3rd birthday (Years 2&3). The Year 1 measure is the average of hours at 2 and 8 months; the Years 2&3 measure is a weighted average of hours at 15, 24 and 38 months, with weights 2/6, 3/6 and 1/6 respectively. Where the mother recorded that paternal care was used, but not for how many hours per week, we set weekly hours to 2. Because of the top-coding problem, and because of the need to average over multiple data points, our data on childcare hours in an average week can only be thought of as an approximation. We choose to transform the continuous hours variables into discrete variables that capture whether the child had little or no experience of paternal care (less than 5 hours in an average week); experience of medium hours of care (between 5 and 15 hours in an average week); or experience of long hours of care (more than 15 hours a week). The 15 hour cut-off corresponds to care that is sufficient to cover half a full-time job, and is the threshold used currently in calculating entitlement to state benefits and help with childcare.

Figure 1 shows the incidence of paternal childcare in each of the two periods for the full sample of 6010 intact households. 35 percent of the fathers in our sample supplied 5 or more weekly hours of childcare in Year 1, rising to 61 percent in Years 2&3. The figure also shows that relatively few fathers provide absolutely no regular care at all – 14 percent in Year 1 and only 5 percent in Years 2&3. We choose to group such fathers with those who provide less than 5 hours a week so that our comparison category does not consist of a narrow and unrepresentative group of households. Of those who do provide care in excess of 5 hours, around a third have childcare responsibilities of 15 or more hours a week (13 % of all fathers in Year 1 and 20% in

Years 2&3). The numbers whose care exceeds 30 hours are very few – just 1% in Year 1 and 4% in Years 2&3. The patterns shown in Figure 1 show that our grouping of fathers results in 3 categories that are large enough to each include a substantial fraction of fathers, but that also discriminate between paternal childcare of lesser and greater intensity.

3.4. Child outcome measures

Our interest in this paper lies in the effects of paternal childcare on children's school readiness at age 4. We examine two dimensions of school readiness – cognitive ability as captured by scores on Entry Assessment tests administered by teachers in the first year of schooling, and behavioural outcomes as measured by the Strengths and Difficulties Questionnaire (SDQ) completed by mothers when the child is 47 months old.

The Entry Assessment results comprise teachers' ratings of the child's ability in four areas – language, reading, writing and mathematics. Ratings range from 2 to 7, and here we sum the four scores and obtain an overall measure of cognitive ability that is normalised on the full sample of all children for whom the data are available to mean 100, standard deviation 10. In addition, we standardise the score on the child's month of birth. Because children are of different ages when they take the Entry Assessment there are large age-related differences in their developmental abilities. Examination of the scores before they are standardised shows average differences of 10 points, or one standard deviation, between children who are the youngest and the oldest in their year group. The sample with valid Entry Assessment scores is substantially smaller than our working sample because of the need to obtain permissions from parents before the data could be released, and because the assessment was not compulsory in all schools at this time. Scores are available for just over half of our working sample, or 3121 cases out of 6010. Appendix Table A1 shows that the composition of this restricted sample is highly similar to that of the full working sample in terms of a number of key variables. The relationship between Entry Assessment scores in ALSPAC and maternal employment is explored in detail in Gregg et al. (2005).

The SDQ is derived from 20 questions completed by the mother that form four sub-scores: hyperactivity, emotional symptoms, conduct problems and peer problems. As with Entry Assessment, the SDQ scores are summed and normalised to mean 100, standard deviation 10 on the maximum sample. Higher scores on this measure indicate greater behavioural problems in children. There is some suggestion in the literature (e.g. Fergusson et al., 1993) that mother reports of children's behaviour reflect the mother's own mental state as well as the behaviour of the child in question. Our regression estimates include several controls for maternal depression and attitudes towards motherhood that may help to correct for any biases of this nature (see Table 4 for details).

Our focus in this paper is on the effects of greater gender equality in parental childcare time on children's school readiness. In order to identify this effect, it is necessary to control for differences in non-parental childcare, so that the coefficients on the paternal childcare dummies measure the effect of that care, relative to the base category of parental care that is provided by the mother alone. Our basic specification, which we refer to as the unconditional specification, conditions on the use of other family care and the use of paid carers in both Year 1 and Years 2&3 (8 dummies in total), plus controls for the types of childcare used between the ages of 3 and school entry (see Section 6.2 for details). Table 2 shows the coefficients on paternal care in these baseline regressions. We show results for both our school readiness measures, and also for two slightly later outcomes measured at age 6 to 7. The reasons for our focus on school readiness are discussed in Section 2.1, but we present results using these later results here for comparison.

Table 2 shows that we find a range of effects of paternal childcare on children's outcomes that depend on the gender of the child and the intensity of paternal childcare. Boys who experience long hours of paternal care in Years 2&3 score significantly worse on the Entry Assessment, and the magnitude of this coefficient is non-trivial at around 2 points, or one-fifth of a standard deviation. We find no corresponding effect of this type of care on girls' Entry Assessments, however. With

regard to behaviour at age 4, we find some indication that paternal care in the first year of life is associated with increased behavioural problems in boys, but this is offset by reduced behavioural problems in boys who experience moderate hours of shared care in Years 2&3. Effects for girls' behaviour at this age are of similar sign but smaller and less precise than the boys' coefficients.

The results for the later outcomes shown in Table 2 can give us some idea of whether the effects on school readiness observed at age 4 persist even after several years of schooling. The Key Stage 1 score is derived from standard national tests on reading, writing, mathematics and spelling administered in the third year of schooling at age 6 to 7. Behaviour at age 7 is again taken from a mother-completed SDQ. Both are standardised on the full sample for whom data is available. The results show that we find no significant effects of early paternal care on boys' cognitive or behavioural outcomes at age 7. For girls, we find only that girls who experienced long hours of shared parental care in Year 1 score slightly lower on Key Stage 1.

The results shown in Table 2 are unconditional and do not correct for selection in the type of households that use paternal childcare in the early years. The impact of controlling for various household characteristics on the school readiness estimates is explored in Section 6. The differences in the effects at age 4 and age 7 may reflect a number of different factors that we are not able to explore fully using the currently-released ALSPAC data. The role of schools in bringing up children who begin with cognitive and behavioural deficits is potentially an important one, for example. However, this brief look at the raw data suggests that the effects of shared childcare in the early years may diminish in some cases, such as the negative effect found on boys' cognitive development, but may also only emerge after several years, such as the impact on girls' Key Stage 1 scores.

3.5. Explanatory variables

With the exception of the Entry Assessment score and some medical data taken at the time of the birth, all the variables used in this paper are taken from parent-completed postal questionnaires. As noted above, most questionnaires were directed specifically

at the mother, but we also have data from questionnaires sent separately to the father (2 prior to the birth, and 3 post-birth at 2, 8 and 21 months). Whilst in some sense it would be desirable to use partners' responses rather than the second-hand reports of mothers, the poor overall response rates to these questionnaires, plus the fact that non-response is differential according to the paternal childcare status means that conclusions based on these data are potentially biased. Appendix Table A2 shows how response rates to the partner questionnaires varies with paternal childcare status. 57 percent of all children in the sample have fathers who answered all 5 questionnaires, whilst 8 percent have fathers who did not answer a single questionnaire. Fathers who provided care in Years 2 & 3 in particular were more likely to have completed questionnaires than fathers who provided little or no care in that period. If fathers who are more involved with their children, or who have relatively positively characteristics in general, are more likely to complete questionnaires then we will understate differences between fathers who provided regular childcare and those who did not. Where it is practical to do so, we use data from the mothers' questionnaires, which have close to a 100% response rate for our selected sample. In some cases, we do use father-reported information, for example on areas such as mental health and paternal attitudes. Where we do so, we mark such variables 'self-report' and try to validate the findings against mother-reported information. In our multivariate analysis we include missing indicators for all variables with item non-response.

The richness of the ALSPAC data means that we are able to explore a wide variety of hypotheses concerning the processes that underlie shared parental care in the early years. We make the distinction between variables that capture parental and child endowments, which are fixed for any given household, and variables that reflect the choices and trade-offs made by parents, subject to their endowments. Endowment controls are broken down into three groups – socio-economic resources, parents' personal characteristics such as mental and physical health, and innate child characteristics – and are listed in Tables 4 and 5 and discussed fully in Appendix B. Variables that reflect parental choices include realised household income, parenting behaviours and the home environment and potentially less tangible aspects like parental happiness and the quality of the parental relationship. These measures are

listed in Table 13 and discussed in Appendix C. The extent to which the estimated effects of shared parental care reflect differences in these more direct measures of the home environment is explored in Section 8. This section also includes a ‘value-added’ specification that conditions on earlier measures of child ability in Years 2 and 3.

4. Paternal childcare, parental employment and non-parental forms of care

It is likely that paternal childcare is intimately related to parental employment patterns. Whilst we explore the extent to which this is the case descriptively, we do not include controls for parental employment in the regressions for children’s school readiness. This is because parents’ hours of market work are not direct inputs into the production of child outcomes, but rather can be used as a proxy in the absence of more direct data on parental inputs. Our specifications condition on the total time the mother is absent from the child, or more specifically on total time with the father and total time with non-parental carers. They also condition other potential routes through which maternal employment may affect children indirectly, such as through its effect on household income or maternal well-being and mental health. The inclusion of employment variables can only confuse the interpretation of the coefficients on the paternal childcare dummies because they are likely to be highly correlated. As employment and childcare decisions are made simultaneously they do not vary independently from one another, and it does not make sense to ask how shared parenting affects children whilst holding work hours fixed, as this is not an effect that would be observed in the real world. This idea is discussed further in Section 5.1.

Only 3 percent of the fathers in our sample were unemployed continuously throughout the first three years of the child’s life. However, some 17 percent were unemployed on at least one of the four dates in this period for which employment data are available (2, 8, 21 and 33 months). We therefore distinguish fathers who were ever out of work in the period in question, and mothers who were ever *in* work during the relevant period. We do not have full data on fathers’ hours of market work, and only have data for mothers’ hours in Years 2&3. Part-time work is so rare amongst men that a working assumption that all men work full-time is reasonable. For mothers of

infants and toddlers, however, part-time work is substantially more common than full-time work. We classify a mother as working full-time in Year 1 if she was employed during that period and also worked in excess of 30 hours per week in Years 2&3, whilst recognising that we are likely to misclassify some women. Only 15 percent of the mothers in our sample were ever observed to work full-time in Years 2&3, while 30 percent did not participate in the labour market at all in the first three years.

Figure 2 shows how our sample is split between households with different types of employment arrangements (the percentages along the bottom). In Year 1, the traditional household in which the father is the breadwinner and the mother doesn't work is the most common type of arrangement, accounting for 39% of households, closely followed by two-earner households in which the mother works part-time (37%). Two-earner households in which the mother works full-time account for a sizeable minority at 12%, with small numbers of no-earner households (7%) and non-traditional households in which the mother is the breadwinner (6%). By Years 2&3, traditional households are outnumbered by two-earner households in which the mother works part-time (28% vs. 47%). The proportion of other types of household is roughly unchanged. These numbers suggest that the image of the traditional household in which the father is the breadwinner and the mother specialises in home production was already becoming out-dated in the early 1990s. In neither period do these types of household form a majority. However, a full reversal of the gender roles of mother and father was still very rare with only 6-7% of households in which the mother was the primary earner. The picture that emerges is one in which mothers still have primary responsibility for childcare, and fathers for earning family income, but where both spouses play a supplemental role by contributing some labour to the alternative sphere.

Figure 2 also shows how the incidence of paternal childcare varies with parents' employment arrangements. Paternal childcare is least common in traditional households, as we would expect. However, it is notable that there are still substantial numbers of fathers who assume childcare responsibilities even when the mother is not in work. We find some evidence that fathers are more likely to provide care, and for

longer hours, when their wives work full- rather than part-time, particularly in Years 2&3. One point of interest that paternal childcare is substantially more common in households in which the father is out of work, but only if the mother is employed herself. Where both parents are out of work, fathers are only slightly more likely to assume childcare responsibilities than fathers who are the sole earners. The patterns in Figure 2 show strongly that paternal childcare is not used solely by working mothers, and also that even full-time maternal employment is not necessarily associated with greater father involvement in childcare. There is substantial variation here in childcare arrangements across all six types of household. This suggests that a narrow focus on paternal childcare as cover for maternal employment misses the experiences of many parents in more traditional households.

The finding that paternal care is more common in households in which mothers work raises the question of the extent to which paternal childcare is a complement or a substitute for other types of non-maternal care. We use the childcare data described above to construct comparable measures of the use of childcare by another family member or friend, and by a paid carer such as a nanny, childminder or nursery. Figure 3 shows how different types of care are distributed across household type. In general, paternal care is roughly evenly split between fathers who are the sole non-maternal carer, and fathers who share non-maternal childcare responsibilities with either another family member or a paid carer. Shared care of this type is particularly common when the mother works full-time, and rarer when the mother does not work at all. The variation in arrangements shown in Figure 3 suggests that some fathers act as substitutes for non-parental types of care, such that mothers do not need to look for other arrangements outside the household. In other cases, fathers provide some care that is topped up by care from other sources. We explore whether the effects of paternal care on children's school readiness differ according to whether the father is the sole non-maternal carer in Section 7.

Although the focus in this paper is on the effects of greater gender equality in parental childcare on children's school readiness, in Section 6.3 we do present a comparison of the effects of paternal care, care by other family members or friends and care

provided by a paid carer, all relative to the base category of maternal care only. Figure 4 presents a comparison of the incidence of these different types of care in the sample as a whole. Figure 4 makes it clear that fathers are the most common form of non-maternal carer in the first three years, both in terms of moderate and longer hours of regular care. In Years 2&3 in particular, fathers are more likely to provide moderate hours of care while other types of care are more commonly used either for long hours or not at all.

As a final piece of descriptive evidence on the nature of paternal care we look at the question of continuity over time. Other research (e.g. Tran and Weinraub, 2006) has suggested that the stability of childcare is an important dimension of quality, and that children may suffer when they are not able to form a long-term relationship with the person looking after them. Table 3 shows the degree of continuity between paternal care in Year 1 and paternal care in Years 2&3. As with other dimensions of paternal care, we find a wide variety of arrangements represented in the data. 32 percent of fathers do not provide any significant amount of childcare at all in the first three years, 25 percent provide moderate hours beginning in Years 2&3 and 11 percent provide moderate hours throughout the three-year period. The remaining 32 percent are split between a number of different patterns, although it is rare that fathers who provided care in Year 1 do not go on to provide care in Years 2&3.

5. Framework

5.1. Choice of specification

Conceptually, our organising framework is based in the household production model of Gary Becker (1991). This model specifies that family utility is a function of a number of unobserved non-market ‘commodities’ that are produced within the home using inputs of parental time and purchased goods and services. Parents act to maximise utility, subject to a set of constraints. This process results in realised demands for time in different activities and for different consumption goods, which are combined according to a production function in order to produce the non-market commodities that are the source of utility. Application of the model gives a clear

distinction between parental and child endowments of human capital, which define the constraints under which families operate, and parental choices, which are the outcome of the household decision-making process. Endowments consist not only of market capital, like wage rates and non-labour income, but also of non-market capital, or skills and abilities that determine the productivity with which a given set of inputs can be combined to produce output. Appendix B gives further details of the household production model along with its predictions regarding the determinants of paternal childcare and the support for those propositions found in the raw data.

We characterise children's school readiness as one of the non-market commodities that are produced by parents within the home. Observed outcomes are the output of a production function that depends on parental input choices, and on the innate characteristics of the child. (The 'child quality production function' is a concept commonly invoked in the economics literature on child outcomes, e.g. Todd and Wolpin, 2003). However, it is not our aim here to estimate the parameters of this technological relationship. With full data on all the relevant inputs, and on child endowments, one could in principle do just this. The parameter on any given input would then reflect the average productivity of that input, holding constant all other inputs, or a *ceteris paribus* effect. Our object of interest in this paper is the average impact of a shift from maternal-only to shared parental childcare in the first three years of life. A change in arrangements of this nature is likely to be associated with many other differences in the allocation of resources within the household. Indeed, given the time constraints faced by all people, it is impossible to hold all else constant when time in one particular activity changes.

The idea that the *ceteris paribus* effect of a change in some input might not be the primary object of interest has been acknowledged by a number of authors. Todd and Wolpin (2003) use the example of the effect of a change in class sizes. They argue that the parameter of interest for policy purposes is the 'total effect' of the change, that is, the direct effect on the child's learning plus the indirect effect that follows because parents modify their own inputs in response to the greater resources invested in the child by the school. An effect estimated holding parental inputs constant is not

one that would be experienced by real children. As Newcombe (2003) argues in a paper on precisely this issue, researchers who ‘over-control’ “run the risk of studying situations that do not occur in the real world, missing mediational links, and drawing incorrect policy conclusions”. Several authors who have investigated the links between maternal employment and child outcomes have also made the point that controlling for household income and other parental inputs is inappropriate because these are mechanisms through which the maternal employment effect operates (e.g. Harvey, 1999, Ruhm, 2004).

Our estimation strategy, then, distinguishes explicitly between exogenous endowments and potentially endogenous input choices. It is important to control fully for the first type of variables because selection into paternal childcare households is non-random. Failure to control for the parental endowments, and for the child’s innate characteristics, would confound our estimates of the effects of shared parenting with exogenous differences in the opportunity sets available to households. If parents who share childcare responsibilities tend to be less ‘wealthy’ in terms of endowments than other parents, or if they tend to have innately less able children, then our estimates will be biased downwards, and conversely if they have relatively positive endowments.

Thus, the first step of our estimation conditions not on observed inputs at all, but only on parental and child endowments. This method holds constant the feasible choice set of the parents and gives the parameter on paternal childcare the interpretation of the relative impact of the full input history chosen by parents in paternal childcare households relative to that chosen by non-paternal childcare households with the same set of endowments. In effect, this specification makes the assumption that the entire history of child inputs is completely endogenous with respect to the paternal childcare decision, so that no inputs can be considered fixed when paternal childcare status changes. As such this estimate corresponds to an ‘average total effect’ and is the object of interest in Section 6. The analysis in Section 7 introduces interaction terms to explore whether this average effect disguises important differences between different sub-groups of the population

The specification that conditions on exogenous characteristics alone represents an extreme assumption as parents' decisions regarding the allocation of resources are multi-dimensional, and children's attainment is not the sole source of household utility. Some input choices may be made largely independently of the early childcare decision. Where this is the case, we do not want to confound the estimated impact of paternal childcare with the impact of other independently chosen inputs. Of course, in practice it is impossible to know the degree to which any observed input is exogenously chosen with respect to early childcare, although common sense and intuition may provide us with some guide. For this reason, our analysis in Section 8 explores how our estimate is modified when we introduce groups of controls for other types of inputs. The change in the coefficient on paternal childcare when a group of controls is included measures how much of the total effect is explained by the correlation between paternal childcare and the included inputs (this idea is made precise below). If the coefficient changes dramatically then this suggests that paternal childcare is strongly associated with other parental choices of inputs that matter for children's development. What we cannot do, however, is claim that the modified effect is closer to or further away from an estimate of causality than the total effect. Rather, our analysis in Section 8 provides us with a range of estimates that reveal the sensitivity of the estimated effect of paternal childcare to different assumptions about the endogeneity of other input choices.

Our model specification relies heavily on the rich, high frequency nature of the ALSPAC data. Todd and Wolpin (2003) provide a full description of the techniques available to researchers in the estimation of child outcome production functions, covering fixed effect, instrumental variable and value-added specifications. The nature of our question rules out the use of child fixed effects because our treatment of interest begins at birth, and hence we cannot observe outcomes prior to the experience of paternal childcare. Neither can we use sibling fixed effects as ALSPAC is a cohort survey that collects information only on the study child. A valid instrumental variable would have to fulfil the criteria that it determines paternal childcare but has no independent effect on children's development. It is our view that no such instrument

is available for paternal childcare because the household production framework makes it clear that all parental choices about the allocation of resources are determined simultaneously as a function of the same underlying set of endowments. We have no time variation in our cohort of children that would allow us to use policy changes that create a natural experiment, nor do we have geographical variation that could be exploited as a source of exogenous variation. Besides, Todd and Wolpin argue strongly that although studies using more sophisticated econometric techniques tend to be regarded as providing ‘better’ evidence, all such estimates will be inconsistent if there are unobserved influences on child development that are correlated with observed inputs. Some techniques will even be biased if there are omitted inputs that are *uncorrelated* with observed inputs, which is not the case with OLS. More generally, attempts to control for unobserved factors can introduce biases in ways that are difficult to conceptualise or quantify. We choose to use OLS with an exceptionally rich set of explanatory variables because we believe that a) the technique minimises the problem of omitted inputs as far as it is possible to do so, and b) the potential biases are easier to conceptualise as they depend on the linear association between the omitted input and the observed treatment variable.

5.2. The role of innate child endowments

The idea that parental investments in children respond to inherited endowments of health and ability in children is one that has received much attention in the literature. For example, Ermisch and Francesconi (2002) outline a conceptual model to assess the impact of parental behaviours on children’s educational attainments that explicitly allows for endowment heterogeneity. They argue that most research into the determinants of child outcomes ignore the potential endogeneity of parental inputs, and so implicitly assume that “young people do not differ in terms of their endowments relevant to educational attainment, or that parents do not respond to these endowments”. Their model highlights the fact that parents may act to reinforce the effects of innate endowments if they invest more in children where the expected return is higher, or alternatively they may act to compensate for endowments by investing more in children who suffer from health or developmental problems. In the first case, estimates of the impact of parental investment choices on child outcomes

will be biased upwards, and in the second case they will be biased downwards. The strategy used by Ermisch and Francesconi is to use a sibling difference estimator, which differences out the effect of the common inherited component of siblings' endowments. As Ruhm (2004) points out, this strategy may lead to severely biased estimates if unobserved sibling-specific factors are a key determinant of sibling differences in the parental behaviour of interest, such as parental employment.

ALSPAC is a cohort study that focuses on the study child in question, and hence does not contain data on siblings from which we could construct a sibling difference estimate. However, ALSPAC does contain exceptionally rich data on children's health, temperament and developmental ability over time that we can use to explore the extent of selection bias arising from this source. The problem with such measurements is that they potentially capture the effects of parental inputs and the child's environment as well as innate ability and characteristics. At one end of the scale we have measures taken at the time of the birth, such as birth weight, gestation at delivery and immediate post-birth health⁵. Although these are likely to in part reflect decisions by the mother made in pregnancy, such as smoking behaviour, we can assume that they are exogenous with respect to our variable of interest, paternal childcare. At the other end of the scale we have measures of children's verbal ability and cognitive development at 30 months, which are highly likely to be influenced by parental childcare decisions.

Our strategy is to distinguish between measures of health, temperament and ability at 6 months or younger and those measured between 15 and 30 months. We include the former group as a selection control, whilst the latter group falls into the set of endogenous variables discussed in Section 8. We argue that outcomes observed very early in the child's life are more likely to reflect innate characteristics than later ones because the time period of exposure to environmental influences is shorter. However, we recognize that these measures cannot be treated as truly exogenous. If our estimates of the impact of paternal care are highly sensitive to the inclusion of these

⁵ Paneth (1995) discusses the importance of birth weight for a number of health and developmental outcomes later in life.

early child controls, then we can interpret this either as evidence that parents' childcare choices respond to the innate characteristics of the child (the exogenous view), or as evidence that childcare choices causally affect outcomes in this early period (the endogenous view). We have no way, statistically, of distinguishing between the two alternatives, and the reality is likely to be a mixture of the two. If however, our estimates are not sensitive to the inclusion of these controls, it must be the case that either parental childcare is not strongly determined by the characteristics of the child, or that the impact of paternal childcare exactly compensates for differences in innate child endowments. Since child school readiness is likely to depend on a diverse set of determinants applied over the life of the child, we view the latter explanation as unlikely. Hence robustness of our results to the inclusion of child controls suggests that the estimated impact of paternal childcare is not severely biased by the fact that fathers are more likely to care for certain types of children than others.

Our controls for child endowments include three types of measure. Full details of the early measures of child endowments are given in Table 5, while descriptive statistics on their association with paternal childcare are given in Appendix B. The first set of measures relate to health at birth and immediately after. The second set relates to the nine dimensions of temperament captured by the Infant Temperament Questionnaire, (Carey and McDevitt, 1977) administered at 6 months. Temperament is a particularly useful concept for our purposes because it is highly likely to reflect inherent biological differences between children. Temperament can be thought of as a concept that is distinct from intelligence, and one that is a subset of personality and sociability. In an attempt to synthesize different approaches to the study of temperament, McCall defines the concept thus:

Temperament consists of relatively consistent, basic dispositions inherent in the person that underlie and modulate the expression of activity, reactivity, emotionality and sociability. Major elements of temperament are present early in life, and those elements are likely to be strongly influenced by biological factors. As development proceeds, the expression of temperament increasingly becomes more influenced by experience and context.

[Robert B. McCall, taken from Goldsmith et al (1987), pp. 524]

More generally, temperament can be thought of as a set of behavioral characteristics that seem to be inborn and that generally persist throughout life. Research suggests that temperament traits tend to be grouped into one of three patterns or constellations: the ‘easy child’, the ‘difficult child’ and the ‘slow to warm up child’, although around a third of children cannot be classified as any one of these three⁶. Caspi and Silva (1995) show that temperament measured at age 3 predicts a number of personality traits at age 18, such as danger seeking, aggression and interpersonal alienation. Our final set of measures are taken from the Denver Developmental Test (Frankenburg and Dodds, 1967) and measure ability in gross motor skills, fine motor skills, communication skills and social skills at 6 months.

5.3. Estimating equations

Our estimation strategy is to run OLS regressions with school readiness as the dependent variable and measures of paternal and other non-maternal childcare as the independent variables. We then introduce controls sequentially, first to explore the extent of selection bias in the unconditional estimates, and secondly to explore whether a number of observed aspects of the child’s environment can contribute to our understanding of the reasons behind the estimated average effects.

Specifically, we begin with the OLS specification

$$S_i = \hat{\beta}P_i + \hat{\gamma}N_i + \hat{\alpha}X_{1i} + \hat{u}_i \quad (1)$$

where S_i is the school readiness score of child i , P_i is the vector of paternal childcare dummies, N_i is a vector of controls for non-parental childcare, X_{1i} is a vector of controls for some exogenous characteristics of the child’s household, and $\hat{u}_i$ is an orthogonal error term. The estimated parameter vector $\hat{\beta}$ is an estimate of the average effect of paternal childcare, relative to maternal-only parental care, on school readiness. Now suppose that we introduce another variable, X_{2i} , into the regression equation.

⁶ This classification, as well as the definitions of the dimensions of temperament in Table 4.5, draws on information provided in Rothenberg (1992).

$$S_i = (\hat{\beta} + \Delta\hat{\beta})P_i + (\hat{\gamma} + \Delta\hat{\gamma})N_i + (\hat{\alpha} + \Delta\hat{\alpha})X_{1i} + \hat{\pi}X_{2i} + \hat{u}_i \quad (2)$$

It is straightforward to show that the change in the coefficient of interest when X_{2i} is included in the regression is

$$\Delta\hat{\beta} = -\hat{\omega}\hat{\pi} \quad (3)$$

where $\hat{\pi}$ is the independent effect of X_{2i} on S_i in equation (2) and $\hat{\omega}$ is the parameter on X_{2i} from a linear projection of P_i :

$$P_i = \hat{\lambda}_N N_i + \hat{\lambda}_{X1} X_{1i} + \hat{\omega}X_{2i} + \hat{v}_i \quad (4)$$

This shows that the addition of X_{2i} to equation (1) removes from the estimate of interest the component caused by the fact that a) X_{2i} has an independent effect on S_i and b) P_i is correlated with X_{2i} .

Where X_{2i} is an exogenous characteristic or family endowment, the quantity $(-\Delta\hat{\beta})$ can be thought of all the selection bias that results from the omission of that particular characteristic. Where X_{2i} is an endogenous input that is affected by P_i , however, the quantity $(-\Delta\hat{\beta})$ is the part of the total effect, $\hat{\beta}$, that operates via the mechanism of influence of X_{2i} . The difference in interpretation is not something that can be established statistically, but must come from a priori conjectures about the nature of the relationships between the variables in the model.

It is common practice to introduce controls in equations such as (1) sequentially in order to explore the how the estimated effect of the factor of interest is affected by removing either a particular type of selection bias or a potential mediating factor (e.g. Ruhm, 2004, Gregg et al, 2005). This procedure produces estimates of $\hat{\beta} + \Delta\hat{\beta}$ (the with-controls estimate) and of $\hat{\beta}$ (the without-controls estimate) but not of $\Delta\hat{\beta}$ that is, of the bias itself. Given the random element of any parameter estimated on a sample of data, it is often not clear whether the change in the coefficient is statistically significant, that is, whether a significant part of the raw association is due to correlation with the included factor. Researchers generally compare the magnitudes of $\hat{\beta} + \Delta\hat{\beta}$ and $\hat{\beta}$ and if the difference is ‘large’ they conclude that selection along that

dimension is important. This is largely due to the fact that, as $\beta + \Delta\beta$ and β are estimated in separate regressions, the covariance between the two point estimates is not estimated, and so the change in the estimate cannot be tested formally.

This paper uses a bootstrap technique that allows us to test formally how far raw differences in the school readiness of children in paternal care and non-paternal care households a) reflect selection bias along a particular dimension of endowments and b) are mediated by a number of parental input choices. To our knowledge, this is the first application of this technique in the estimation of the determinants of child outcomes. In this case our results may be of particular interest because they quantify the potential biases that researchers might face when using datasets with more limited information on endowments than ALSPAC. If we find that certain types of personal parental characteristics are a strong source of selection bias, for example, then this has implications for the results of other studies that are not able to condition on these characteristics. The bootstrap produces 200 estimates of β , $\beta + \Delta\beta$ and $\Delta\beta$ by re-sampling from the estimation sample. The significance of the estimate is calculated by deriving a z-score (the mean value of the parameter estimates divided by the standard deviation) and comparing this with the standard normal distribution in a two-tailed test.

The analysis in Section 7 introduces interactions between P_i and a number of discrete parental and child characteristics. Given that the cell sizes of paternal care households are reduced by splitting on child gender, age of child when care took place and hours of care, we carry out each interaction in a separate regression. We also try where possible to choose interactions that give two sub-groups of roughly equal size. The bootstrap is not necessary here as our specification allows us to use standard F-tests to test whether the effects of a particular type of paternal care differ between two sub-groups. Specifically, estimates in this section make use of the specification

$$S_i = \hat{\beta}^A(P_i \cdot D_i^A) + \hat{\beta}^B(P_i \cdot D_i^B) + \hat{\gamma}N_i + \hat{\alpha}X_i + \hat{u}_i \quad (5)$$

where D_i^A is a dummy equal to one if the household falls into sub-group A, D_i^B is a dummy equal to one if the household falls into sub-group B, and $D_i^A = 1 \Leftrightarrow D_i^B = 0$.

Hence the estimated impact of paternal care, $\partial S_i / \partial P_i$, is equal to $\hat{\beta}^A$ for children in sub-group *A*, and equal to $\hat{\beta}^B$ for children in sub-group *B*. We test the null hypothesis that effects are equal between the two groups, $H_0 : \beta^A = \beta^B$.

6. Results with controls for family endowments at birth

6.1. Measures of family endowments

Table 4 lists the construction of all the variables used to control for parental endowments in our multiple regression analysis, while Table 5 repeats the exercise for the child endowment measures. Summary statistics of these measures and their association with early years paternal childcare are discussed fully in Appendix B. Here we summarise the main findings of that section as a prelude to our estimates of the effects of paternal childcare. This part of the analysis is concerned with the potential selection biases that arise because paternal care and non-paternal care households differ systematically in their human capital endowments. We make the assumption that the variables in this section are not affected by choices on the part of parents about the allocation of resources, but rather are treated as fixed in the post-birth household decision-making problem. The validity of this assumption is less questionable in some cases than in others, so we pay careful attention to the implications for our findings were the assumption not to hold.

We do find that children who are cared for by their fathers are a select sample in terms of family socio-economic resources. They are less likely to have degree-educated parent and tend to have younger parents and fewer siblings. Children who experience long hours of paternal care in particular are drawn from households with fewer resources. They are more likely to have mothers aged under 25, fathers in low skilled occupations and to live in deprived neighbourhoods, and are less likely to live in owner-occupied housing. Lack of access to alternative forms of childcare, particularly low cost or free childcare may also predict the use of paternal care, given our finding that paternal care is more common in deprived neighbourhoods. However, we do not find any evidence that paternal childcare is associated with more limited

maternal social networks. Finally, we feel it is important to emphasise that despite the differences detailed above, paternal childcare is not concentrated in any one narrowly defined type of household. The statistics in Appendix B show that there are substantial numbers of paternal carers in all types of household, including affluent households in which parents have degrees and professional careers, and those located in better neighbourhoods.

We find no evidence that fathers are significantly more likely to care for sons or daughters, although the figures suggest that fathers are perhaps slightly more likely to provide long hours of care for sons rather than daughters in Year 1. In terms of birth order and family size, children cared for by their fathers are more likely to be first-born and to have fewer siblings by their 4th birthday. This is the case for all types of paternal care, regardless of the hours of care or the age of the child. Finally, we find no substantial differences in the ethnic composition of children cared for by their fathers although non-white children only make up a small 3 percent of our sample.

The only socio-economic measures that are measured after the birth of the child are housing tenure and the number of children in the household at age 4. These variables are certainly subject to choices made by parents in the post-birth period. However, because these factors represent large and lumpy investment decisions, we argue that it is appropriate to think of them as parental endowments, rather than choices that are determined endogenously with respect to childcare.

Socio-economic variables generally capture endowments that are commonly observed by researchers. Less commonly observed are the personal endowments of individuals such as physical and mental health and innate attitudes or behaviours. These types of endowments can be thought of as determinants of an individual's productivity in non-market production, in a similar way that endowments of market human capital determine productivity in paid work. Failure to control for these types of variables would result in selection bias in the estimated impact of paternal care on children's outcomes if they predict both paternal childcare and other influences on children's development. ALSPAC contains a number of measures of these types of resources

that can be used to control for heterogeneity in parental attributes. However, there is a risk here that some measures, such as mental and physical health, are causally affected by decisions concerning childcare and other time uses. For example, Newcombe (2003) argues that maternal mental health is affected by labour market participation and should be considered a mediating factor between maternal employment and child outcomes. To the extent that this is the case, the association between paternal childcare and parental health will partly reflect reverse causation. Whilst recognising that this is the case we argue that ill health, and in particular post-natal depression, is likely to largely reflect factors that are beyond the control of the individual. We consider that the risk of removing mediating mechanisms via these types of measure is outweighed by the risk of failure to control for differences in factors that occur independently of paternal childcare. For this reason, we include post-birth measures of parental physical and mental health in our groups of controls for parents' personal attributes. We also include a number of attitudinal variables, but restrict these to measures that were collected prior to the birth of the child in order to rule out the possibility that they reflect attitudes acquired during the experience of parenting the study child.

Overall, descriptive statistics give a mixed picture of the relative attributes of fathers who provide early years childcare. On one hand, they are, on average, equally as healthy as other fathers both physically and mentally and seem to be more oriented towards an active parenting role. In addition, fathers who provide long hours of care are less likely to drink alcohol on frequent occasions. On the other hand, they are slightly more likely to smoke and have more negative attitudes both towards schooling and towards the degree to which their own actions can influence their environment (a more external locus of control).

The possibility that some fathers assume childcare responsibilities because mothers are affected by post-natal depression is an intuitively appealing one. The Royal College of Psychiatrists estimates that around 1 in 10 women suffer post-natal depression following a birth and that the causes of post-natal depression are little understood and likely to be complex. For this reason we pay careful attention to the

wealth of psychological instruments in ALSPAC designed to measure maternal depression and other mental health problems, and explore the time-varying dimension of maternal mental health. Overall we find little support for the hypothesis that post-natal depression is an important factor in explaining the incidence of paternal childcare in the first 3 years. Where we do find differences, the timing of the mental health and paternal care measures suggests that we are picking up selection rather than a causal influence of maternal depression on paternal childcare responsibilities. In particular, we do not find any association between contemporaneous mental health and paternal care. Our results do imply, however, that the wives of paternal carers tend to have slightly poorer mental health than other mothers.

Unlike the case for fathers, we find no evidence of differences in mother's feelings in pregnancy about the impending birth of the child, nor in locus of control or pre-birth alcohol consumption. However, in a similar way to fathers, mothers in some types of paternal care households are more likely to attend antenatal classes, but also more likely to smoke in pregnancy and to have relatively negative attitudes towards their schooling. Overall the descriptive statistics suggest that the wives of paternal carers are not a highly selected group in terms of their personal attributes. With the exception of antenatal class attendance, the mothers in paternal care households tend to have slightly more negative characteristics than other mothers, but these differences are not large.

We explored differences in child endowments separately for boys and girls, both because the innate characteristics of boys and girls are likely to differ, and because parents may respond differently to a given attribute depending on the gender of the child. We find no evidence that fathers are more or less likely to care for children who began life with health deficits as measured health characteristics at birth. We also find few differences in mother-reported general child health in the first 6 months, although it seems that children who were cared for by the father for long hours in Years 2&3 did tend to be slightly unhealthier in this early period, and this is the case for both boys and girls.

One striking feature of the temperament data is that we generally only find differences in the types of children who are cared for by their fathers in Years 2&3, despite the fact that temperament is measured at the age of 6 months. Children experiencing paternal care in the first year of life differ little in terms of temperament from other children. We do find some evidence that fathers who provide care after the first year of life are more likely to do so for ‘easy’ rather than ‘difficult’ children. Many of these effects are restricted to the differential temperaments of sons rather than daughters. The fact that we do not find a strong relationship between temperament and childcare arrangements that occur contemporaneously is evidence against a reverse causation interpretation and in favour of the hypothesis that parental decisions respond to the innate tendencies of their children. If it is the case that fathers care preferentially for easier children, or equivalently, that mothers care more for more difficult children, failure to control for these differences would bias the estimated effect of paternal care upwards. However, the associations between child temperament and paternal childcare that we find are not large, and we would not expect them to drive the unconditional relationships between paternal childcare and school readiness.

Boys who are in the care of their fathers for long hours in Year 1 score uniformly higher on all four sub-scores of developmental ability at 6 months than boys experiencing less paternal care. Boys cared for by their fathers for long hours later on, when they are toddlers, also tended to have better gross and fine motor skills in infancy. We find no difference in the developmental abilities of boys at 6 months between those who experienced medium hours of care and those who experienced little or no paternal care, and virtually no differences in the abilities of girls with any type of parental care. The direction of association between long hours of paternal care and boys’ development scores is unclear, and as these measures are likely to reflect environmental influences to a greater degree than the temperament measures we do not emphasise these findings. However, we conclude that there is no evidence at all that fathers care preferentially for children with health or developmental difficulties, or for children who are less sociable or who do not respond well to non-parental carers. In fact, the balance of the evidence suggests that, if anything, fathers may be entrusted with the care of better-adjusted, more able children. This is more true for sons than for

daughters, in whom we find fewer differences in infancy according to paternal care status.

6.2. Regression results

Table 2 detailed the associations between paternal childcare and children's school readiness, whilst Appendix B and the previous section provided evidence on other factors that may be correlated with both paternal childcare use and child outcomes. We now go on to explore the implications of this selection for estimates of the impact of paternal childcare on children's school readiness. Appendix D gives full details of the estimates for each of our four samples (Entry Assessment and behavioural outcomes for boys and girls respectively) with details of z-statistics for all the estimates. Tables 6 and 7 summarise the key findings from these regressions.

We begin with the estimate from Table 2 that conditions only on non-parental childcare use in the first 3 years and childcare between the ages of 3 and school entry⁷. We hold constant non-parental time because our object of interest is the effect on children of a gender re-allocation of total parental childcare away from the mother and towards the father in the first 3 years. The coefficients on the paternal care dummies then have the interpretation of the effect of that type of care relative to parental care that is performed solely by the mother. Specifically, we control for whether the child experienced medium or long hours of care by a family member or friend in Year 1, or in Years 2&3, and the equivalent for care by a paid carer such as a childminder, nanny or nursery. Data on childcare for the period between the child's third birthday and school entry are not collected in the same way as in earlier periods and our choice of variables reflect this. For example, childcare information for this period was collected retrospectively when the child was aged 4½, rather than contemporaneously as is the case for the earlier measures. In addition, childcare in this period is qualitatively different from that in earlier periods, in that many children enter center-based care after the age of 3. Whilst only 27 percent of children were looked after by a paid carer for at

⁷ Slight discrepancies in the coefficients are due to the differences in estimation procedure. Estimates in Table 4.2 are from OLS estimation, estimates in Tables 4.6 and 4.7 use the bootstrap technique. See Section 4.5.3 for details.

least 5 hours a week in the first 3 years, after this age 72 percent attended a setting outside the home, including nurseries, playgroups and childminders. The nature of the data allow us to control for whether the child was cared for in a nursery (47%), playgroup (40%), and by a childminder or nanny (14%). (Childcare types are not mutually exclusive, so children may experience more than one of these settings.) In addition, mothers were asked about childcare provided by the father and other family or friends after the age of 3. However, the phrasing of the question means these responses are not comparable with the earlier childcare data. By this measure only 4% percent of children experienced paternal care and 18% experienced care by another relative or friend. It is impossible to tell how far this reflects a shift away from family care towards center-based care and how far it reflects differences in the concept of childcare mothers used when answering the question. We include dummies for the use of both father and family care in the post-birth period, and also a dummy for ‘other arrangements’ used in only 2% of cases.

Our initial estimates, then, capture the unconditional effect of paternal childcare, relative to parental care provided solely by the mother in the first three years. We then introduce four groups of controls for parental socio-economic endowments, fathers’ personal characteristics, mothers’ personal characteristics and child characteristics measured in the first 6 months of life (variables correspond exactly to those shown in Tables 4 and 5). We use missing indicators to control for item non-response in order to maximize the available sample sizes.

The change in the coefficients on paternal childcare when a group of controls is added to the unconditional specification ($-\Delta\beta$ from Section 5.3) shows the extent to which the unconditional coefficient reflects selection bias along the dimension in question. We introduce the groups of controls separately, that is one at a time, in order to explore the selection bias arising from different types of endowment, and then include all the selection controls simultaneously. This last estimate provides our preferred estimate of the total effect of paternal, relative to maternal, childcare on children’s school readiness.

Table 6 shows the results of applying this procedure to the Entry Assessment scores of boys and girls in our sample. As with all the child outcomes in this paper, scores were normalized to mean 100, standard deviation 10 using the full sample of all children for whom the outcome is available. Looking first at the results for boys, the unconditional results in the first column reveal no significant effects of medium hours of paternal care at either age, nor of long hours of paternal care provided in Year 1. We do find, however, a significantly negative effect of long hours of paternal care in Years 2&3. The magnitude of this effect is relatively large at around one-fifth of a standard deviation. So boys who were cared for by their fathers for more than 16 hours a week (around 20 percent of all boys in intact families) entered school with, on average, a significant deficit in cognitive ability. The subsequent columns introduce each grouping of endowment variables to the specification in the far left column.

Looking first at the diagnostics at the bottom of the tables, we find that each group is a significant predictor of boys' Entry Assessment scores. The F-tests shown here relate to a test of the joint significance of the additional controls, first in the specification that conditions on childcare history alone and second in the specification that conditions simultaneously on all four groups of endowments. We find that socio-economic, maternal and child endowments are each strongly associated with boys' test scores even when the other controls are included in the regression. Father's personal characteristics are significant when included alone, but lost significance when the other controls are added. This indicates that they are collinear with the other groups of controls and do not have an independent effect in their own right. In terms of the increase in the adjusted R^2 of the regressions, the socio-economic controls explain the greatest part of the variation in test scores of the four groups. Maternal, paternal and child endowments can explain roughly equal amounts of the variance when included singly. When all the controls are included together the adjusted R^2 is substantially higher than in any of the earlier specifications, confirming the findings of the F-tests that, with the exception of paternal characteristics, each group of endowments has an independent association with boys' outcomes.

Our finding that paternal care in Year 1 and care of medium hours in Years 2&3 have no effects on boys' Entry Assessment is not modified in any way by the inclusion of selection controls. The estimates never become significantly positive or negative, nor do they change significantly after removing each source of bias. Perhaps surprisingly, we find that the negative unconditional effect of long hours of paternal care in Years 2&3 does not primarily reflect a selection effect. In each case the inclusion of controls for family endowments do reduce the magnitude of the negative effect slightly, suggesting that there is some weak negative selection into this type of paternal childcare. The part of the estimate in the far left column that can be accounted for by selection ranges from 0.26 in the case of the socio-economic controls to 0.05 in the case of maternal personal endowments. However, in no case does the component of the overall effect that can be accounted for by selection reach statistical significance. This is the case even when all the controls are included simultaneously, and the coefficient drops from -2.04 to -1.74 . Hence we conclude that long hours of paternal, relative to solely maternal, childcare in Years 2&3 are associated with poorer quality parental investments in boys that lead to lower educational attainment when they begin school. This finding does not seem to reflect differences in the opportunities available to parents who use this type of childcare, as captured by their endowments, nor in the innate characteristics of the boys who receive such care themselves.

The bottom panel of Table 6 repeats the exercise for girls' Entry Assessment scores. Results on the importance of different types of endowments for girls' test scores in general are highly similar to those for boys, with the exception that the controls for father's personal characteristics retain their significance even when the other controls are included. However, here we find no evidence that girls are either harmed by or benefit from any of the types of paternal care. In particular, the estimated effects of long hours of paternal care in Years 2&3 are positive in sign and insignificant. This finding is intriguing and implies that the negative effect of this type of care is restricted to boys alone. Again, selection does not play an important role in any of the unconditional effects. The effect of medium hours of paternal care in Year 1 becomes significantly more positive when differences in socio-economic endowments are removed from the estimate, and the effect of long hours of care in Years 2&3 also

becomes slightly more positive when we control for the relative characteristics of fathers providing such care. However, in neither case does the effect of paternal care become significantly different from zero.

To summarise, we find evidence of negative effects of one type of paternal care - long hours in Years 2&3 – on the Entry Assessment scores of boys but not girls. This implies that, for daughters, maternal and paternal childcare are good substitutes for one another in the production of cognitive ability, or in other words, that the quality of care provided by each parent is, on average, equal. This is also the case for the care provided to boys by parents in the first year of life, and for moderate reallocations from the father to the mother in Years 2&3. Hence we find no evidence that maternal care in the first year is uniquely important for children's cognitive development, as has been implied by much of the maternal employment literature. The quality of care provided to boys by fathers who assume substantial caring responsibilities between the 1st and 3rd birthday, however, appears poorer than that provided by mothers and the magnitude of this effect is non-trivial. This finding cannot be explained by differences in parental education, occupational class, mental and physical health or early child characteristics.

Table 7 explores the effects of paternal care on our other measure of school readiness, children's behaviour. The adjusted R²'s and F-tests at the bottom of the table show that, again, each group of controls is a significant predictor of boys' behaviour problems at age 4. In this case, mothers' personal endowments, rather than family socio-economic resources, can account for the largest proportion of the variance in boys' outcomes. However, each grouping of endowments has an independent association with behaviour. The pattern of the effects of paternal childcare here is strikingly different to that for boys' Entry Assessment results. Firstly, we find no evidence that the boys who received long hours of paternal care when they were toddlers differ in their behaviour from boys who received only parental care from the mother. This rules out the possibility that their poorer cognitive attainment on school entry results from behavioural problems like hyperactivity that interfere with the acquisition of cognitive skills.

In contrast to our results for Entry Assessment, the effects of shared parenting relative to maternal specialization are concentrated in cases in which fathers provided only moderate hours of care in an average week. Medium hours of shared parenting in Year 1 are associated with slightly greater behavioural problems in boys. Controlling for socio-economic endowments and maternal characteristics raises the estimate slightly, indicating that this type of paternal care is associated with endowments that are relatively beneficial for boys' behaviour. On the other hand, controlling for child endowments reduces it slightly, indicating that boys receiving this type of care may have slightly more innate tendencies towards behavioural difficulties. However, in no case does the removal of selection bias significantly alter our initial finding. In contrast, medium of hours of shared parenting in Years 2&3 are associated with significantly fewer behavioural problems in boys. This effect is larger in magnitude and more precisely estimated than the effect of equivalent care in Year 1 and again, selection controls have little impact on the estimated effect. Only 4% of all fathers provided medium hours of care in Year 1 but not in Years 2&3; 11% provided medium hours of care in both periods and 25% provided medium hours of care starting in Years 2&3. Together, these results suggest that moderate hours of shared parenting are associated with improved behavioural outcomes in boys, but only if begun after the child's first birthday. Moderate hours of shared parenting begun in infancy, or longer hours at any age, are not associated with any beneficial or harmful effects on boys' behaviour.

The results for girls' behaviour shown in the bottom panel indicate that these conclusions about the effects of moderate hours of shared parenting apply to girls as well as boys, although the magnitude of the effects are somewhat smaller in this case. Unlike the case for boys, these effects are not apparent in the unconditional estimates, but only emerge after the inclusion of selection controls. A comparison of the contribution of each group of controls in explaining girls' behaviour shows a very similar pattern to that for boys, with parental and child endowments each exerting strong and independent effects.

The results of our multivariate analysis suggest that the impact of shared parental childcare on school readiness depends crucially on the timing and intensity of paternal care, and on the gender of the child. In general, paternal childcare has no impact on cognitive attainment at school entry. The exception to this is boys who are cared for by their fathers for long hours – upwards of 15 hours per week – during their toddler years. These boys enter school with, on average, lower ability than other boys. In contrast, shared care is associated with improved behavioural outcomes in boys, and to a lesser extent in girls, but only if this care is begun after the first year of life and is of moderate intensity. We find no evidence that the poorer cognitive attainment of boys who experience long hours of paternal care in Years 2&3 is associated with concurrent differences in behavioural outcomes. Nor do we find that long hours of paternal care have the same beneficial effects on behaviour as more moderate hours of care.

6.3. Comparing the effects of paternal childcare with other non-maternal forms of care

The results shown in Tables 6 and 7 all condition on hours of non-parental care or, more specifically, on care by family or friends and care supplied by a paid carer. It is of interest to see how the effects of paternal care compare with the effects of care from these other sources, where each is measured relative to traditional, solely maternal care. We compare these estimates first in terms of the unconditional effects that are the output of the far left column in Tables 6 and 7, and then in terms of the selection-corrected effects from the far right of the respective tables.

Table 8 shows the results of this comparison for Entry Assessment results. For boys who experience non-maternal care for moderate hours in Year 1, we find that the use of paid carers is associated with poorer outcomes than the use of any other type of maternal or non-maternal care. This finding only emerges after controlling for selection, indicating that the endowments of families using this type of care are relatively beneficial for boys' Entry Assessment. For longer hours of non-maternal care in Year 1, we find that both types of non-maternal care, paid and unpaid, are associated with poorer outcomes among boys than for the use of parental care alone. Again, the negative effect of paid care at this age only becomes apparent after including controls for parent and child endowments. In contrast, childcare by a paid

professional for moderate hours in Years 2&3 is associated with better Entry Assessment scores in boys than for any other type of childcare, but this finding is entirely explained by selection in the type of parents and children who use this care. Selection bias on this estimate is strongly significant and when removed, reduces the estimated impact to one that is non-significant. Finally, the poorer outcomes of boys experiencing long hours of paternal care in Years 2&3 are contrasted with the beneficial effects of long hours of paid care at this age. Even though selection can account for over half of this positive effect, it remains substantial and significant.

The bottom panel of Table 8 shows the equivalent results for girls' Entry Assessment. In contrast to boys, girls do not seem to be harmed by exposure to paid care in infancy. In addition, whereas boys seem to suffer cognitively from long hours of care by a family member or friend at this age, girls actually seem to benefit, and this finding only emerges after controlling for selection. It is shorter, rather than longer hours of care by unpaid relatives that are associated with poorer cognitive attainment in girls. Like boys, girls who receive moderate hours of paid care in Years 2&3 score higher on the Entry Assessment test, but again this association entirely reflects the differential composition of the sample using this type of care. The results for long hours in paid care in Years 2&3 are also similar to those for boys, in that a large positive association is substantially reduced when we condition on family endowments.

Table 9 shows that for behavioural outcomes, we find fewer differences between parental care only and other types of non-parental care. The only exception is that girls who experience long hours of family care in Years 2&3 have significantly more behavioural problems than girls in other types of care. To summarise, we find that in Year 1 paternal care is to be preferred to paid care or long hours of family care for the production of boys' cognitive attainment, but that it is inferior to all other types of care in terms of boys' behavioural outcomes. For girls in Year 1, paternal care is preferable to medium hours of family care but inferior to long hours of family care in terms of cognitive outcomes, and inferior to all other types of care in terms of behaviour. For boys in Years 2&3, paternal care is preferable to other types of care in terms of behaviour, but inferior to other types of care, and in particular to long hours of paid

care in terms of cognitive attainment. For girls in Years 2&3 paternal care is preferable to other types of care, and in particular long hours of family care because of its positive association with behaviour.

7. Sub-group analysis

So far, our analysis has been concerned with estimating the average effect of shared parenting relative to maternal-only parental care. But it may be the case that the effects we have identified are restricted only to certain types of children, and that the average obscures this heterogeneity. In this section we explore whether the estimated impact of shared parenting varies with a number of parental characteristics and features of the care provided. We might expect that where the mother's human capital endowments are poorer, the replacement of maternal with paternal childcare would have less harmful (more beneficial) effects than when the quality of the mother being replaced is higher. However, the opposite might be the case if the mother's superior market capital entails a boost to family earnings when market time is reallocated from the mother to father, and this increase in income has positive effects on the child's environment. Symmetrically, shared parenting may be relatively beneficial when the father's human capital is greater, but not if the higher opportunity cost of father's time results in a substantial reduction in household income when his time is allocated away from the market and towards the domestic sphere.

Tables 10 and 11 show the results of this analysis for children's Entry Assessment and behaviour respectively. Given that our sample has already been split by the gender of the child, to split it further along various characteristics would result in cell sizes that are too small for valid inference. For this reason we conduct each analysis on the full sample of boys and girls and interact the paternal care dummies with the characteristic in question. Each interaction is taken from a separate regression that conditions on the same set of non-parental childcare and parent and child endowments used in Section 6. Hence the coefficients can be interpreted as the selection-corrected impact of paternal care for children in the particular sub-group, relative to maternal-only

parental care. The F-tests shown relate to a test of the null hypotheses that the total effect of parental care is equal across the two sub-groups that define the interaction.

The first four interactions in Table 10 test whether the effects of paternal care on Entry Assessment vary with a number of characteristics of the father. The non-significant F-tests on virtually all these interactions suggest that it is not the case that childcare provided by some fathers but not others is either beneficial or harmful. We find little variation in the effects by father's educational attainment for either boys or girls. The impact of long hours of shared parenting in Years 2&3 on boys' Entry Assessment is significantly negative when the father has qualifications of an A-level or higher and also when he has qualifications of an O-level or below. We find some evidence that shared parenting in Years 2&3 is associated with greater negative effects on boys if the father is in a highly skilled occupation, but cannot reject the hypothesis that the effects are the same regardless of occupation. This may reflect the greater opportunity cost of fathers' lost earnings, and also perhaps that fathers in more demanding occupations have less energy to provide high-quality interactions for their sons. We also find little variation between the effects of paternal childcare that is combined with continuous paternal employment and that which is carried out by fathers who were out of work at some point during the period in question. Again the negative effects on boys' outcomes are significant for both groups, although of larger magnitude when the father had some periods of unemployment.

Finally, we explore whether differences in the quality of involvement across paternal carers are associated with differences in the estimated effects. The variables used to capture the quality of interactions are discussed more fully in Section 8. We use data on the frequency with which each parent: reads to the child; sings to the child; plays with toys with the child; plays physically with the child; and takes the child for walks. Items scored from 0 to 2 and summed to create an overall parent-child interactions score for each parent. Data are available at 6 and 38 months. The sub-groups used here split each paternal childcare group according to whether the contemporaneous father-child interaction score was above or below the median for that particular group. The results suggest that poorer quality paternal care in Years 2&3 is associated with

worse cognitive outcomes in boys than maternal care alone. The effect of medium hours of poorer quality paternal care are here significantly negative, contrasting with zero effects of medium hours of better quality care. For longer hours, the negative effect of poorer quality care is more than double that of better quality care, although both estimates are still negative in sign and not significantly different from one another. It is notable that we find no effects of either poorer quality or higher quality paternal childcare on girls' Entry Assessment.

The next set of interactions explores whether the effects of paternal childcare vary with the quality of the mother whose time is being replaced. We find no significant differences in the effects by either mother's educational qualifications or mother's occupational class. There is some suggestion from the magnitude of the coefficients that long hours of shared parental care in Years 2&3 are less harmful for boys' outcomes when the mother has high education, perhaps because the quality of mother-child interactions serves to offset the negative effects of paternal care to a greater degree in these cases. We also find that medium hours of shared care in Year 1 can be beneficial for girls' cognitive outcomes, but only if the mother has few qualifications. The interactions with maternal employment status suggest that the effects of paternal care on boys do depend to some degree on whether the mother is employed in the labour market. Long hours of paternal care in Year 1 are beneficial, but only if the mother is not in work at the time, and this difference is highly statistically significant. This group accounts for only 4% of all intact households, compared with 8% that use long hours of shared care because the mother is in work. In contrast, the negative effect of long hours of shared care in Years 2&3 is more than twice as large when the mother is not in work during the period, although here we cannot reject the null of no difference in the effects by maternal employment status. This group is a very select sample, reflecting the arrangements of only 4% of households, compared with 16% of households that use long hours of shared care in this period to cover maternal work hours. We also explored whether paternal care that is combined with full-time maternal employment has any differential effects, but this does not appear to be the case. We find no variation in the effects of paternal care on girls' outcomes by maternal employment status. Our final two maternal measures relate to the quality of

her interactions with the child, and to whether she was at risk from suffering post-natal depression. In general we find few significant differences in the effects, although the negative effects of some types of shared parenting are smaller when the mother's interaction score is relatively high, or when she suffered post-natal depression. In the first case this may be a compensating effect for the relatively poorer quality of paternal inputs, in the second case it may reflect the fact that maternal care is no better than paternal care when the mother is mentally ill.

The final two interactions in Table 10 explore whether the effects of shared parenting depend on whether the child also experiences some non-parental care and on whether the child has older siblings. We find the impacts of shared parenting on boys are sensitive to whether the father is the only non-maternal carer. Medium hours of paternal care in Year 1 are associated with significantly better outcomes when the child also experiences some non-parental care (13% of all households, compared with 9% where paternal care is the only non-maternal source of childcare). In addition, the negative effects of long hours in Years 2&3 are restricted only to cases where no non-parental care is used (8% vs. 13% of the total sample). However, paternal care used for medium hours in Years 2&3 is significantly more beneficial if the father is the only non-maternal carer. None of these differences are apparent in the effects of paternal childcare on girls. However, whether or not a girl is first-born does have a bearing on the relationship between shared parenting and her cognitive development, whereas this is not the case for the effects on boys. First-born girls benefit from medium hours of shared care in Year 1, whilst this is not the case for girls with older siblings. However, first-born girls experience more harm from paternal childcare in Years 2&3 than do girls who are born second or more.

To summarise, we find that the effects of shared parental care on children's cognitive outcomes identified in Section 6 are robust across a number of different types of household. The negative effect of long hours of paternal care in Years 2&3 on boys' scores is somewhat less when: the father is not in a highly skilled occupation; the father is in continuous employment during the period care is provided; the quality of the father's interaction with the child is high; the mother is relatively highly educated;

the mother is employed when the care takes place; the quality of maternal interactions are high; the mother suffered post-natal depression; and the father shares childcare with other non-parental carers. None of these differences is significant, with the exception of the beneficial effects of combining paternal care with other forms of childcare. However, with the exception of the depression interaction, together they amount to a picture of households in which both parents have good parenting skills but in which the mother has a comparative advantage in market work compared with the father. Households that are non-traditional in the relative endowments of the husband and wife seem to be able to use long hours of shared parenting in Years 2&3 with only minor negative impacts on sons' development. Boys in households in which either parent's parenting skills are poorer, or in which the father's opportunity cost of time is substantially higher than the mother's, however, seem to suffer more from non-traditional parenting arrangements.

Table 11 explores the same interactions in the effects of paternal childcare on children's behavioural outcomes. Here our interest is in particular in whether there is variation in the harmful effects of medium hours of paternal care in Year1, which are offset by beneficial effects of care of similar intensity in Years 2&3. We find significant beneficial effects of the latter form of paternal care on the sons of all the different groups of fathers we examine, including low or high educated fathers, fathers in skilled or less skilled occupation, fathers who are employed or unemployed and fathers who have high or low quality interactions with their children. Effects are slightly smaller for fathers in less skilled occupations and who provide lower quality interactions, but also smaller among more educated fathers and those who are in work. The pattern for girls' outcomes is highly similar, although the smaller size of the effects of shared parenting in general means that effects from some of the sub-groups are insignificant. With regard to the harmful effects of early paternal care, we find that the effects are slightly larger for boys if the father is less educated or in less skilled work, but slightly smaller for girls for girls in the same types of household. For both genders, lower quality paternal interactions are associated with slightly greater negative effects in the first year. However, none of these interaction effects are significantly different from one another.

We also find little evidence that the effects are restricted to the children of certain kinds of mother. Boys seem to suffer more from paternal care in Year 1 if the mother is not in work during the period, and also if her interactions are of below average frequency or she suffers from post-natal depression. The beneficial effects of moderate hours of shared parenting in Years 2&3 are greater for the daughters of higher quality mothers who participate in the labour market. In contrast to our finding that paternal care combined with other non-parent forms of childcare is relatively beneficial for boys' cognitive outcomes, here we find that the beneficial effects of shared parenting on behaviour are larger in families that do not use non-parental childcare, and this difference is larger for girls than for boys. Birth order has little implication for the effects of paternal care, with the exception that it is children with older siblings who seem to suffer more from shared parenting in Year 1.

To summarise, the harmful effects of moderate hours in shared parenting in Year 1 on boys' behaviour are focused in households in which the mother suffered post-natal depression, was not employed and provided relatively infrequent interactions, and where the parents already had a child prior to the birth of the study child. These differences also apply to a lesser degree to girls's behavioural outcomes, although only the differential effect by birth order is statistically significant. The beneficial effects of shared parenting in Years 2&3 are more uniform, although they are reduced slightly if paternal care is shared with other non-parental care or if the mother's interactions are of lower quality. Overall, we find effects of shared parental childcare of similar sign and magnitude in many different sub-groups of the population. This is compelling evidence against the proposition that what we are measuring is not the effect of shared care, but rather the effects of unobserved differences between paternal and non-paternal care households. It also suggests that the average effects identified in Section 6 do not in general obscure important differences between different types of families.

8. Results with controls for contemporaneous child's environment

8.1. Measures of contemporaneous child's environment

So far, our results have been aimed at identifying the total effects of paternal childcare on children's school readiness. This section explores a number of factors that may mediate the relationships found in Section 6. The variables used in this section are conceptually distinct from the endowment controls used thus far in that there is a significant possibility of reverse causation running from paternal childcare to these potentially endogenous regressors. Tables 12 and 13 give details of the additional variables used in this section. In Appendix C we explore descriptively how a number of dimensions of the child's environment differ with the use of paternal childcare, and as before, we give only a brief summary of those findings here. We again organize our variables into groups that are then introduced one at a time into our multivariate analysis. We take as a starting point the final selection-corrected estimates from Section 6, and explore how they are modified when a number of potential mediating mechanisms are removed from the estimates. Since each of the resulting estimates can be thought of as a 'partial' effect none of them represent a better or more 'true' estimate than the ones so far described. However, this process may help us to understand some of the reasons for the effects of shared parental childcare on children's school readiness.

The first of our dimensions of the child's environment is disposable household income. We characterize household income as potentially endogenous because it reflects employment decisions that are made simultaneously with childcare decisions. Its association with paternal childcare is not clear a priori – the positive association of income with the greater maternal supply in paternal childcare households is balanced by the negative association of income with lower paternal labour supply. We find no strong unconditional relationship between paternal care and household income. Income tends to be slightly lower, on average, the greater the hours of paternal care, but this relationship is only significant for households in which fathers provide long hours of care in Years 2&3. This is perhaps not surprising as parents choose the allocation of time optimally and are unlikely to choose options that have serious deleterious consequences for household income.

Another potential explanatory factor is the quality of the parental relationship, or alternatively, the degree of family conflict. Parental childcare may be a marker for a more harmonious parental relationship, which has been shown to be associated with beneficial outcomes in children (e.g. Cummings and O'Reilly, 1997). We find that, somewhat surprisingly, family conflict is more common in households in which the father assumed primary childcare responsibilities in the first year of life. We find no relationship between parental conflict and the use of paternal childcare in the later period that is concurrent with the conflict measure. We find that paternal care in Years 2&3 is associated with greater maternal satisfaction with the relationship, but find no association between care in infancy and maternal satisfaction. Paternal childcare is strongly associated with greater shared parental activities outside the home. That we find this for paternal care in Year 1, as well as in Years 2&3 suggests that this may reflect a selection effect, rather than a causal influence of paternal childcare on the parents' relationship. Our final measure of relationship quality relates to the degree of communication between the spouses. We find that in general paternal childcare is associated with better communication between parents, the exception being paternal care for medium hours in Year 1, which is not associated with better communication in the following period than little or no paternal care.

The finding that medium hours of paternal care in Year 1 is associated with greater parental conflict and no improvement in parental communication or maternal satisfaction may help to explain the poorer behavioural outcomes of children experiencing this type of paternal care. However, children in long hours of paternal care in Years 2&3 tend to have parents with higher quality relationships, so this mechanism is unlikely to explain boys' poorer cognitive outcomes. It must be noted that the relationships described are unconditional, and may alter when controls for other types of heterogeneity between paternal and non-paternal care households are included.

The warmth of parental interactions with children is one aspect of parenting that is difficult to capture using questionnaire methods, yet may be crucially important for children's development. It is possible that paternal carers are, by their nature, warmer,

more nurturing fathers and it is also possible that primary childcare responsibilities themselves promote a more positive relationship between father and child. On the other hand, paternal childcare may be an indicator that the mother-child relationship is less close, or may affect mother-child bonding because of the mother's regular and prolonged absence. To explore this we use a number of items completed by the parents about the feelings towards the child and parenthood in general. The hope is that responses to these questions are related to the manner in which each parent interacts with the child in practice. Our descriptive analysis shows few differences in maternal attitudes depending on the childcare responsibilities of the father, so it does not appear that, on average, mothers who are less bonded with their children rely on fathers for childcare to a greater degree. We also find a strong positive association between paternal childcare and father's enjoyment of parenthood. The relationship with paternal enjoyment in Year 1 is similar whether we look at paternal care in Year 1, or in Years 2&3, which suggests that fathers who go on to assume childcare responsibilities already had relatively positive attitudes prior to that care taking place.

Our next set of measures covers a diverse set of variables relating to parenting behaviours and the home environment. These provide us with some evidence on the differential conditions experienced by children in paternal childcare. Such children tend to be breastfed for shorter periods, but it does not appear to be the case that they experience poorer quality maternal interactions along other dimensions, at least those captured by our variables. As the frequency of father-child interactions is increasing in the amount of paternal-only childcare, such children appear to receive greater parent-child interactions overall than other children. This may help to account for the positive association we find between some types of paternal care and children's social development. Children in some paternal care households do spend more time than other children in activities with little cognitive component, such as playing outside, watching television, spending time in the car and on outings to shops. However, they also receive, if anything, more cognitively stimulating interactions like being read to, being taught and talked to by the mother and visiting libraries. One finding of interest is that even though fathers who provide childcare do engage in more frequent interactions with their children than other fathers, on average their interaction scores

still fall short of those provided by the mother. This may simply reflect the fact that mothers spend a greater amount of time in total with the child. But if fathers do not provide as much cognitive stimulation as mothers when they are the parent with primary responsibility, for example because they view their caring role as fulfilled simply by being present and watching over the child, then this may help to account for the poorer cognitive outcomes of some boys who receive paternal care. Finally, we address the idea that children in paternal care may be disadvantaged because fathers are excluded from mother-child support networks by examining the amount of time the child spends with other children at age 3. This measure provides no evidence to support the view that such children are deprived of the beneficial effects of group environments like playgroups.

Our final group of potentially endogenous controls has a different interpretation to that of possible mediators. This is a set of measures of child health, temperament and developmental ability measured between the ages of 15 and 30 months, summarized in Table 13. In contrast to the early child endowment controls used in Section 6, it is clear that these measures are highly likely to reflect environmental influences. However, including them as controls can throw light on the extent to which the effects of paternal childcare on school readiness identified in Section 6 have already emerged by age 2. In effect their inclusion leads to a ‘value-added’ specification that reflects the change in developmental outcomes between age 2 and school entry. To the extent that these early outcomes are the outcome of processes independent of childcare arrangements, such as the manifestation of innate endowments that are not apparent in infancy, their inclusion will purge our estimates of other influences that are correlated with paternal childcare. Our discussion of the results using these controls in Section 8.2 reflects the uncertainty in their interpretation.

8.2. Regression results

We take as a starting point the final selection-corrected estimates from Section 6, and explore how they are modified when a number of potential mediating mechanisms are removed from the estimates. Since each of the resulting estimates can be thought of as a ‘partial’ effect none of them represent a better or more ‘true’ estimate than the ones

so far described. However, this process can help us to understand some of the reasons for the effects of shared parenting on children's school readiness.

Tables 14 and 15 show the results of introducing each of our groups of potentially endogenous controls on the estimated impact of shared parenting (full details of the estimates with z-statistics are given in Appendix D). In each table, the far right column reproduces our selection-corrected estimates from Section 6, the subsequent columns add each group of controls individually to the first specification and the final column shows the result of including all the potentially endogenous controls simultaneously. Hence all the regressions in these tables include the socio-economic, personal and early child endowment controls explored above. F-tests again relate to a test of joint significance, first on the control group when included individually and second on the control group when all other variables are included.

Table 14 begins with the results for Entry Assessment. The second column of the table for boys shows that our household income measure has virtually no association with Entry Assessment scores when family endowments are held constant, as revealed by the insignificant F-tests and unchanged R^2 . It is unsurprising therefore, that differences in household income cannot account for any of the negative effect of long hours of paternal care in Years 2&3 on boys' cognitive outcomes. The third and fourth introduce controls of parental relationship quality and parental enjoyment and confidence. Again, we find little association between these measures and boys' Entry Assessment scores in general. The inclusion of the latter group does reduce the magnitude of the negative coefficient slightly, indicating that when we hold constant parental attitudes a small amount of the negative effect is explained, but the change in the coefficient is not significant.

The next column introduces controls for parenting behaviours and the home environment. These controls do have some significant predictive power for Entry Assessment scores, even holding constant differential parental endowments. The effect on the paternal care coefficient is negative, indicating that the differential experiences of boys in paternal care are associated with better, rather than worse,

cognitive outcomes. This result illustrates to some degree the risk of ‘overcontrolling’ in child attainment regressions. Including this group as a selection control would have led us to overstate the negative impact of paternal care, because it removes from the estimate the effects of other behaviours that may be intrinsically associated with paternal care. The resulting estimate is a partial effect and not one that corresponds to something that would be observed in reality.

The sixth column gives our value-added specification that conditions of children’s developmental outcomes measured between 15 and 30 months. These measures are strongly predictive of Entry Assessment scores, causing the R^2 of the regression to rise from 0.23 to 0.33. Interestingly, their inclusion leaves the coefficient on long hours of paternal care in Years 2&3 unchanged. This means that the adverse effects of this type of care do not operate in any way through outcomes observed prior to age 2½. There are a number of potential explanations for this finding. It may simply reflect delayed effects of paternal care that only emerge as the child becomes older. It may also reflect the fact that Entry Assessment scores capture reading and writing skills that are distinct from the verbal ability and general development measures that make up our control variables. Another possibility is that the poorer Entry Assessment scores of this group reflect something other than cognitive ability. This possibility is discussed further in our concluding comments.

In general, the results for boys’ Entry Assessment leaves the question of why boys who experience substantial hours of paternal childcare when they are toddlers have poorer outcomes something of a mystery. The inclusion of none of our potentially endogenous control groups significantly affects the negative effect established in Section 6 (nor the estimated effects of any other types of paternal care). The finding that the effect does not operate through earlier measures of ability implies that the explanation lies in something relating to the school environment. We conclude that although we can offer only suggestions as to the reason for this finding, it is robust to a wide variety of different specifications, including the sub-group analyses explored in the preceding section.

The bottom panel of Table 14 shows our results for girls' Entry Assessment scores. The tests at the bottom of the table show a similar association between the variable groups and Entry Assessment scores to that seen for boys. Household income, parental relationship quality and parental attitudes again have little explanatory power, the controls for parenting behaviours are moderately significant and the controls for earlier ability are highly significant. In general, we find few differences in the estimates when additional controls are included. The insignificant positive effect of medium hours of paternal care in Year 1 becomes marginally significant when we control for parental attitudes and also for parenting behaviours and the home environment. This implies that we have removed a negative influence from the estimate that operates through poorer parenting behaviours experienced by girls in this group. In neither case, however, is this mediating relationship large or significant. A similar finding is that the positive effect of long hours of paternal care in Years 2&3 becomes marginally significant when the correlation between paternal care and relationship quality is removed. Given the marginal significance and small magnitudes of the change in the coefficients, we do not emphasize these results.

Table 15 shows our results for behavioural problems at age 4. Again we find no significant association between household income and child outcomes. The relationship quality variables are significant when included individually, but lose significance when we control for parenting behaviours and attitudes and earlier child characteristics. Here, however, we find a strongly significant relationship between parental attitudes and behavioural outcomes. It is possible that this reflects the fact that maternal attitudes towards parenting may influence their perceptions of children's behaviour. It is worth emphasizing, however, that these specifications condition on parental mental health variables and remain significant even when we control for mother-assessments of child temperament at earlier ages. In addition, there is a gap of at least a year between the latest measure of parental attitudes and the assessment of behavioural outcomes. Our measures of parenting behaviours and the home environment are also significant predictors of behaviour, but to a lesser extent than the attitudinal measures. As with the Entry Assessment results, the inclusion of earlier

measures of development and temperament increases the R^2 dramatically by over 10 percentage points.

In general the inclusion of additional variables does little to modify our conclusions as to the negative effects of medium hours of paternal care in Year 1, offset by the beneficial effects of care of a similar duration in Years 2&3. In some cases, we find that a significant proportion of the effects of paternal care on behaviour reflects the relatively beneficial attitudes to parenthood of parents using these types of care. When we remove this source of correlation from the estimates, they move in the direction of fewer benefits (or greater adverse effects). The magnitudes of the proportion of the paternal effects explained via this mechanism are around 0.25 in the case of moderate hours in Years 2&3, and although they are statistically significant, they do not explain the effects sufficiently to change the significance of the partial estimates. The other finding of interest in Table 15 is that the effects of paternal care do seem to operate partially through their impact on earlier development as captured by our additional child controls. The harmful effect of medium hours of care in infancy becomes insignificant when earlier measures of temperament are included. The beneficial effect on boys' behaviour of medium hours of care in Years 2&3 remains significant in the value-added specification, but its magnitude is reduced significantly and by around a third. To the extent that these controls capture innate characteristics that are not fully measured by our age 6 months variables, this finding suggests that there may be a residual component of selection in the total effects estimated in the far left column. It seems more likely, however, that the effects of paternal care manifest themselves in observable differences in behaviour at the time that the paternal care occurs. Our results do suggest however, that these differences widen over time as the effects still persist even after conditioning on earlier measures.

9. Conclusions

This study uses a unique dataset to describe the degree of paternal involvement in the primary childcare of children under the age of 3, and to explore the implications of paternal childcare for children's development. One key finding of this research is that

primary paternal childcare is widespread, and is used by parents in a diverse range of family circumstances. That 60 percent of fathers regularly care for toddlers without the mother present for at least 5 hours a week suggests that the focus in much of the literature on mothers' time with children may fruitfully be widened to a focus on the time inputs of both parents. Our data also show that many children regularly spend time away from the mother in the early years even when she does not participate in the labour market. Research into the effects of the changing care environments in which young children are raised may benefit from a recognition that market work hours are not a sufficient statistic for the time that a child spends in the care of either mothers or fathers.

In many cases we find no effects, either positive or negative, of a reallocation of some primary care time away from the mother towards the father. In particular, paternal care in the first year of life is associated with little difference in child outcomes, on average, than traditional maternal-only parental care. This finding is of interest because the biological fact of breastfeeding and psychological theories of mother-child attachment both imply that the first year might be a period in which the mother has a uniquely important role to play. Our findings suggest that if the introduction of paternity rights encourages the replacement of some maternal time with paternal time in the first year, this should not have any adverse consequences for the children themselves. The one exception to this general finding is that children who experience moderate hours of paternal care in the first year of life that is not continued into Years 2&3 appear to suffer slightly in socio-emotional terms. Only 4 percent of the children in our sample experienced this arrangement, and findings from our sub-group analysis that the adverse effects are concentrated in cases in which the mother suffered post-natal depression, did not work in the labour market and had lower frequency qualitative interactions with the child suggests that these effects are not typical.

The results of our analysis on the effects of paternal childcare in Years 2&3 on children's school readiness, however, do suggest that mothers and fathers cannot always be treated interchangeably in terms of their impact on children's development. On one hand, children who experience moderate hours of paternal care in this period

appear to have fewer behavioural problems at age 4 than children who experienced either maternal-only parental care, or who experienced a more substantial gender division of childcare responsibilities. We find evidence of this effect for children in a wide variety of sub-groups, and also when we include a wide variety of controls, which suggests strongly that paternal care itself has some causal effect, rather than proxying some unobserved aspect on family life. Lamb (1997) argues that because mothers and fathers represent different types of interaction to children, children are likely to develop different expectations of them, which should in turn increase their awareness of different social styles and perhaps contribute to the development of social competence. Our results are supportive of this view. The introduction of controls for child temperament and other developmental abilities prior to the age of 3 reduces the estimated positive effects on children's behaviour at age 4. This suggests that the beneficial effects are already apparent to some degree at earlier ages, but the fact that the coefficient remains significant implies that the social benefits of early paternal care accumulate over time. We find that controlling for mothers' and fathers' attitudes to parenting reduces the estimated positive effect somewhat, implying that parents who make use of paternal childcare have attitudes that are relatively beneficial for children's socio-emotional development. Since these attitudes, particularly on the part of fathers, may be intrinsically associated with why fathers assume care responsibilities in the first place, it would be misleading to partial out this component of the overall effect of paternal care. This illustrates the idea that 'over-controlling' can lead to estimates that are devoid of meaning in a real world context.

The one note of caution regarding trends towards gender equality in childcare responsibilities sounded by this study relates to the academic skills of boys who experience more than 15 hours a week of paternal care when they are toddlers. Boys experiencing this type of paternal care score significantly worse on tests at entry to school, and the magnitude of this effect is non-trivial. Boys in this group make up 20 percent of our overall sample and so cannot be regarded as a narrow, unrepresentative group. A number of features of our analysis point to a causal influence of paternal childcare, rather than simply the effect of some common unobserved heterogeneity. Our exploration of the possible selection bias in the estimate shows that the parents of

these boys are drawn from all social classes and types of family – indeed, the only common link between them in terms of observable endowments appears to be that they experienced long hours of paternal care. Sub-group analysis shows that this result is robust across virtually all divisions of the data, the one exception being that it is limited to boys for whom the father was the only non-maternal carer. Controls for household income and a diverse set of other aspects of the home environment cannot drive the effect away. We find no evidence that boys in this type of care have poorer outcomes on our other, socio-emotional, dimension of school readiness. Most intriguingly, we find no evidence at all of similar effects for girls who experienced this type of paternal care, which we would expect if paternal care is proxying some unobserved family characteristic.

Our analysis points strongly towards the idea that fathers do not, on average, provide the same degree of cognitive stimulation to sons that mothers provide. We find some evidence that fathers do parent boys differently to girls, an idea that has received attention in the developmental psychology literature. Data in Appendix C shows that girls in our sample tend to be read to, sang to and cuddled by their fathers more frequently than boys, whilst boys tend to play with their fathers more frequently than girls, both physical play and play with toys, and also to be taken for walks by their fathers more often. However, the fact that the negative effect is restricted only to boys may only reflect that girls are less affected by the paternal care environment. Our data on qualitative parenting behaviours like reading and playing with children also finds that fathers score lower on these measures, on average, than mothers, even though paternal involvement is positively associated with childcare responsibilities. This may simply result from the fact that mothers spend more time in total in the company of the child than fathers. But it is possible that fathers do not provide the same quality of interactions when they are in charge, perhaps because culturally they are less adapted to the needs of young children, and are more likely to see their responsibilities as fulfilled by supervising the child and seeing to physical needs like feeding and changing nappies.

One finding of note is that we find no evidence of negative effects of paternal care on the outcomes of boys prior to school entry, nor on Key Stage 1 scores at age 6 to 7. The lack of finding at later ages may be due to a number of factors that we are unable to explore in our data. However, the lack of findings at earlier ages raises the possibility that the Entry Assessment scores of this group of boys reflect something other than cognitive ability. One candidate is that they reflect how well the child adjusts to the classroom environment, or how effectively the child is able to translate his ability into performance on a school-administered test. Other researchers have suggested that fathers may be excluded from mother-child support networks, particularly when they care for babies and toddlers, and as a result children in paternal care receive less exposure to settings like playgroups. We have one measure with which we can address this hypothesis – weekly hours the child spends with other children at age 3 – and we do not find differences in this measure that support the hypothesis. The fact that we find no evidence of greater behavioural problems at age 4 of boys in this group is also suggestive that problems in adapting to the school environment are an unlikely explanation for the poorer test scores. As Entry Assessment is teacher-assessed, there remains the possibility that there is heterogeneity in either the types of schools attended by boys in this group, or that there is systematic bias in teachers’ perceptions of these boys’ abilities⁸. In the first case, we would require that boys experiencing long hours of care in Years 2&3 attend schools where teacher standards are higher, perhaps because of a positively-selected intake. In the second case, we require that teachers observe some marker for paternal care that biases their assessments downwards. Given the high degree of variation in the socio-economic circumstances of boys who experience this type of paternal care shown in Appendix Table B1, neither of these explanations is very attractive.

Overall, our research highlights the fact that trends towards greater gender equality in family life, as well as in the marketplace, may have consequences for child as well as for adult well being. This paper has focused on one aspect of changing gender roles within the family, namely cases in which the father regularly cares for the child

⁸ Feinstein et al. (2004) summarise the evidence that teachers tend to underrate the ability of working class children and overestimate that of middle class children.

without the mother present. Whilst other research has found positive associations between qualitative forms of father involvement and child outcomes, our research highlights that other forms of father involvement are worthy of study, and may not always have beneficial effects. It is possible, however, that as active fathering becomes more widespread, fathers will become better adapted to providing for the needs of their children.

Figure 1

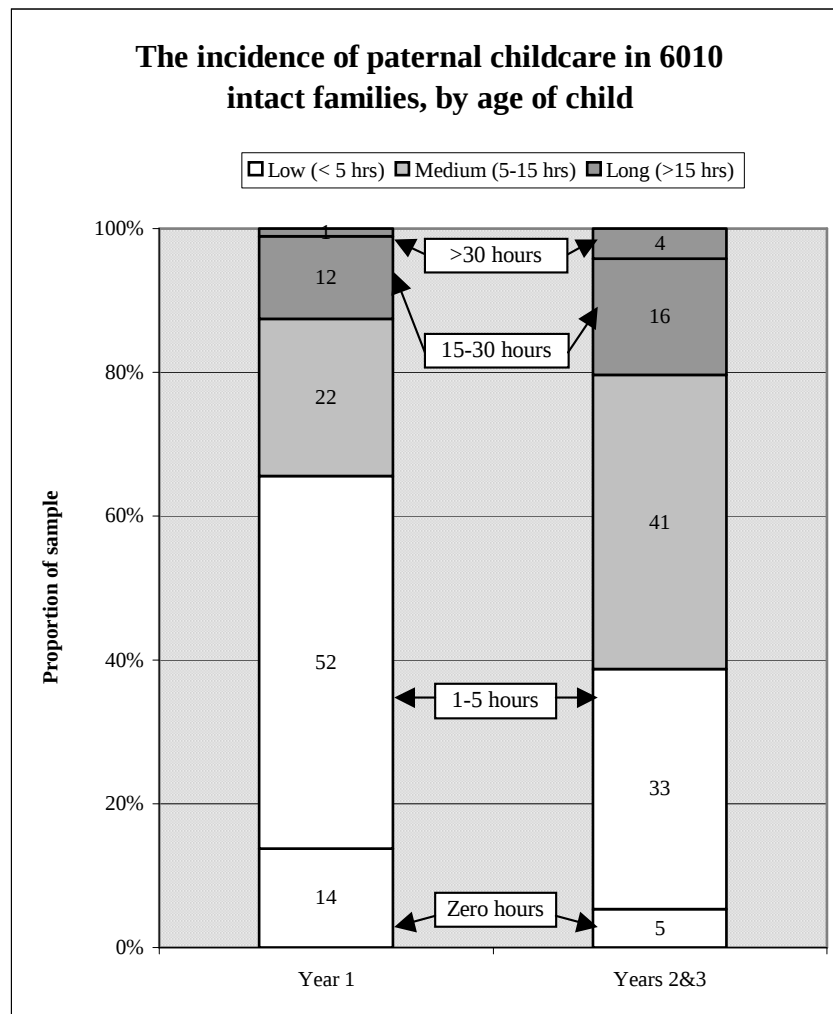
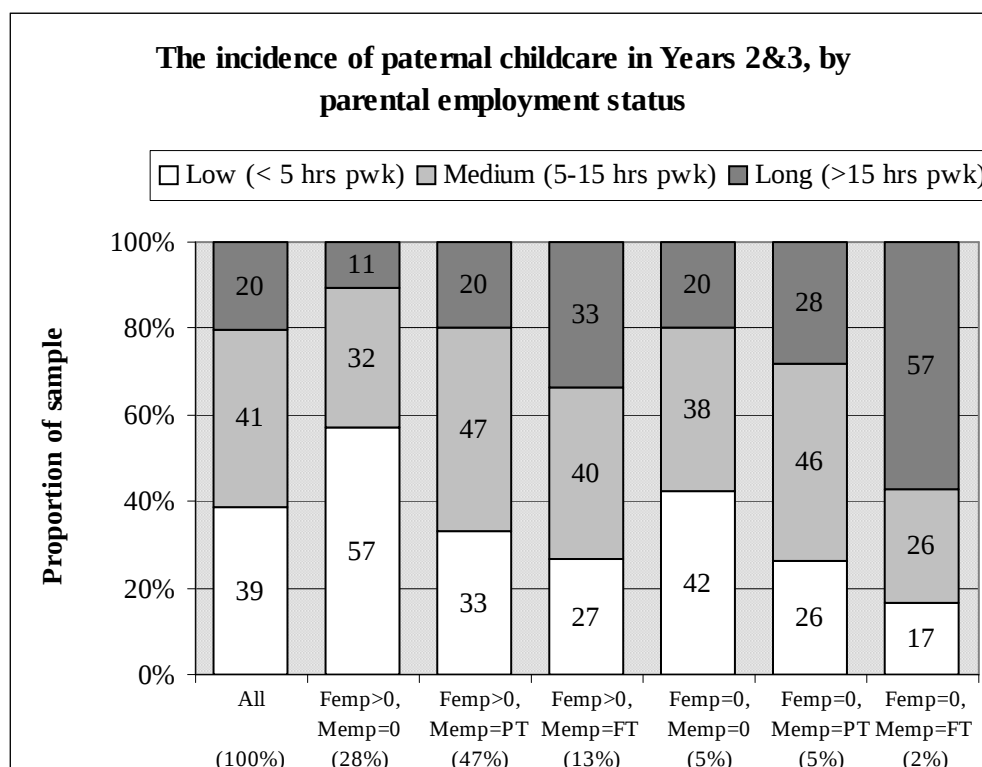
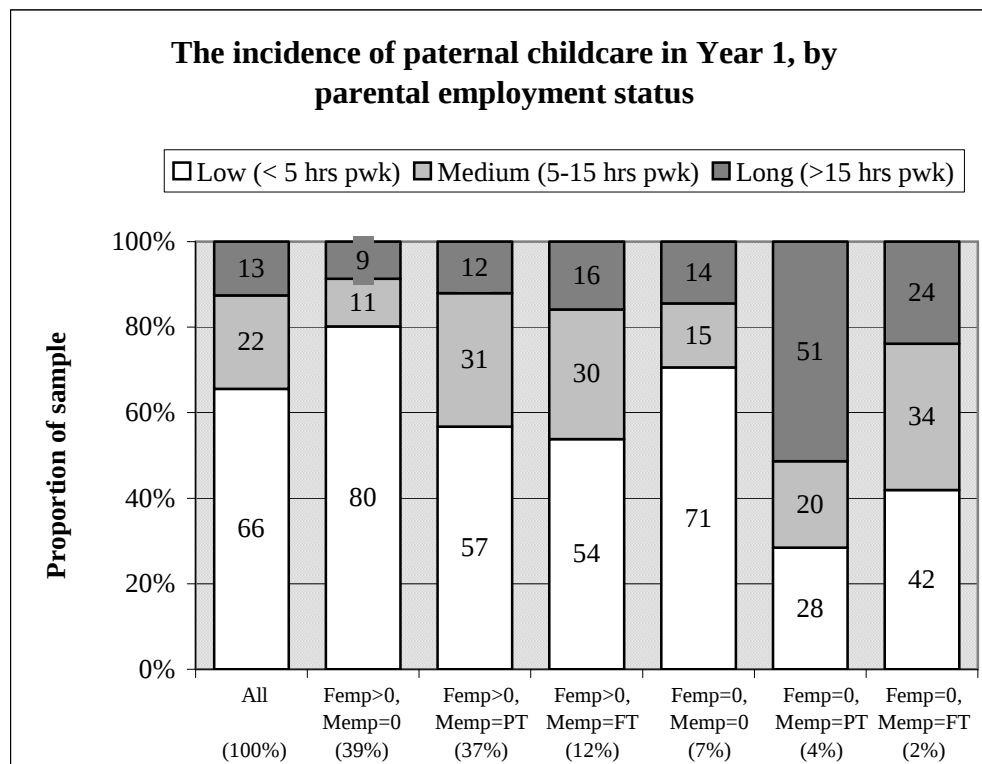
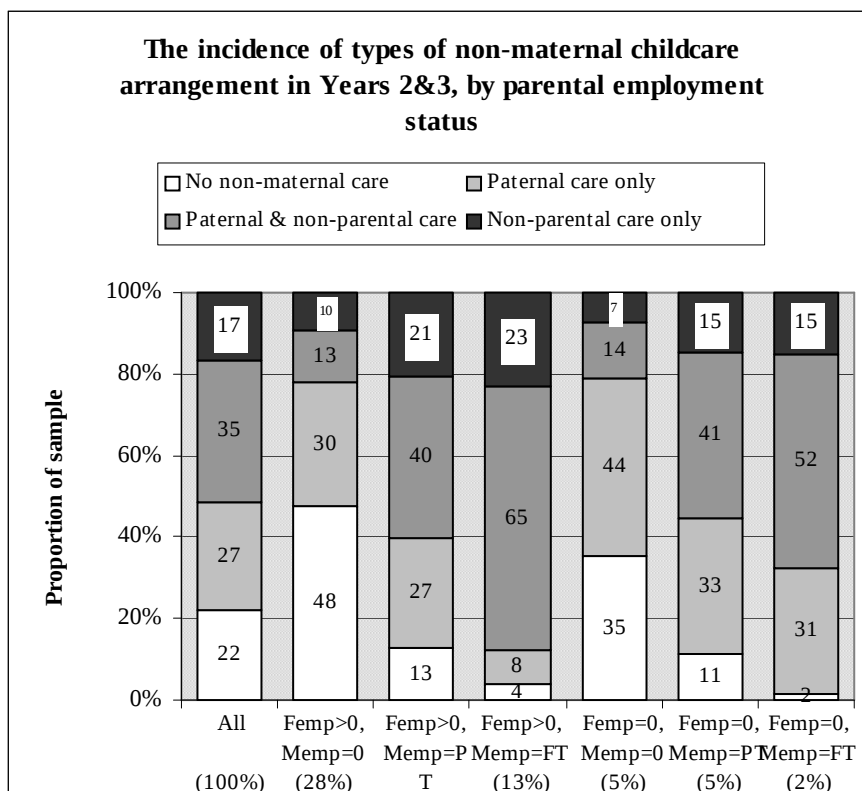
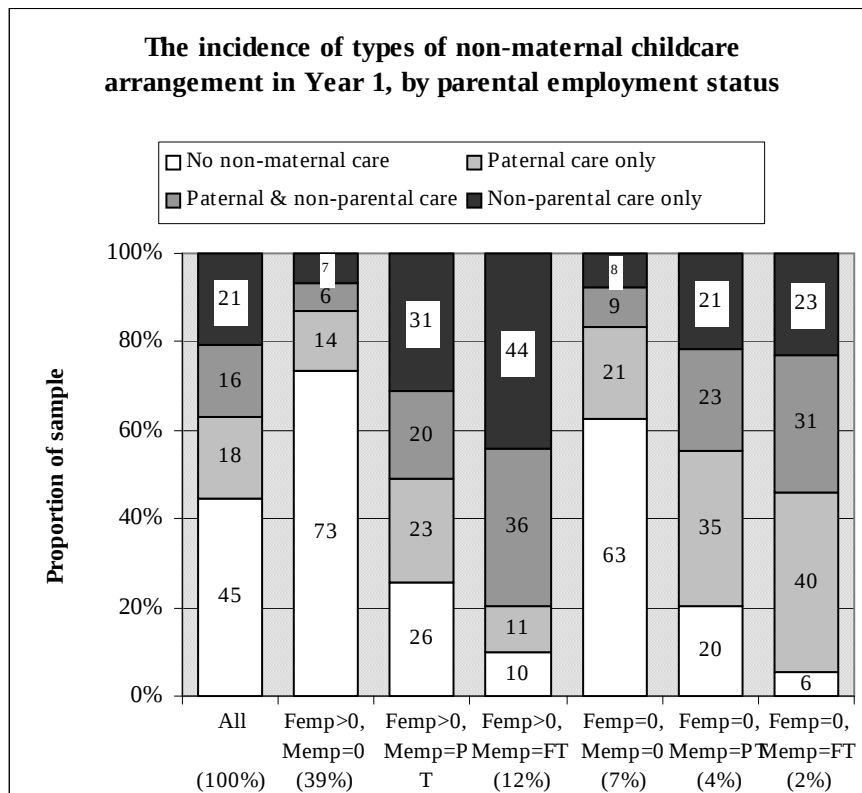


Figure 2



Femp > 0: Father in employment throughout period; Femp = 0: Father out of work at some point in period
Memp = PT/FT: Mother worked part-time or full-time in period; Memp = 0: Mother did not work in period

Figure 3



Femp > 0: Father in employment throughout period; Femp = 0: Father out of work at some point in period
Memp = PT/FT: Mother worked part-time or full-time in period; Memp = 0: Mother did not work in period

Figure 4

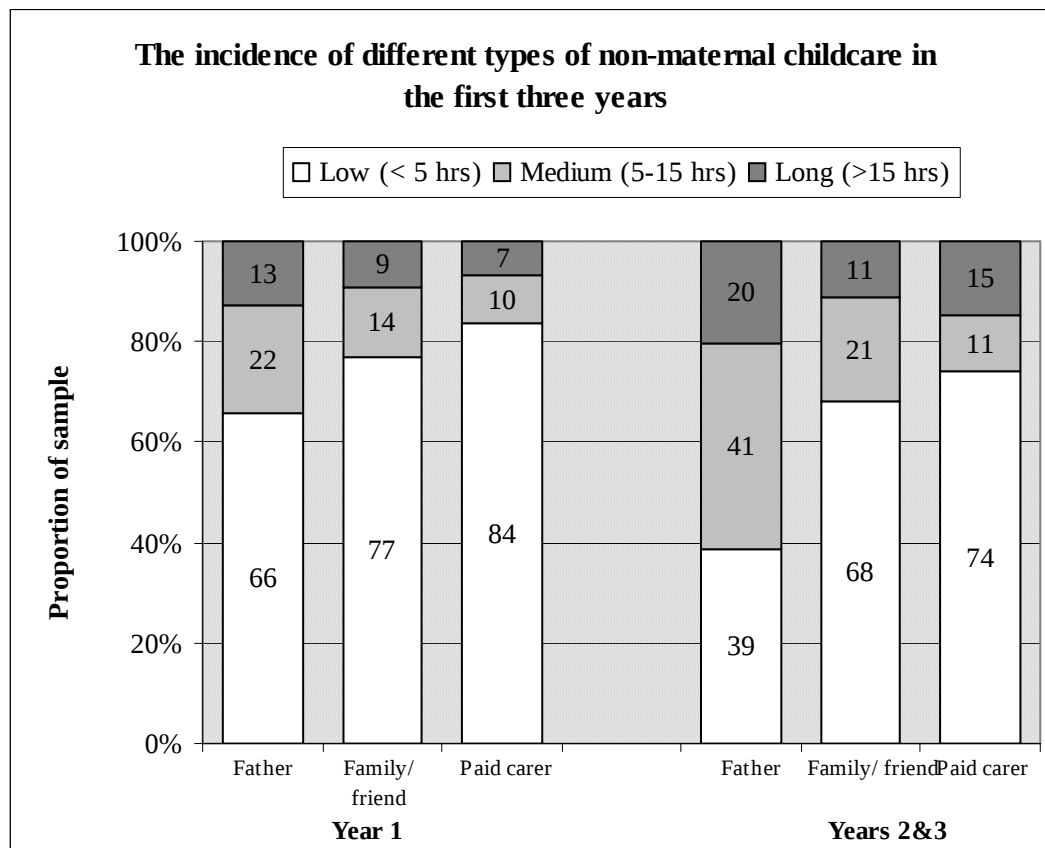


Table 1: Sample selection

Criteria: full childcare history	Number remaining after selection	Number observations dropped	Number dropped as % initial sample
Children in sample at 12 months	13 971		
No missing childcare data at 2 months	11 852	2119	0.15
No missing childcare data at 8 months	10 553	1299	0.09
No missing childcare data at 15 months	9716	837	0.06
No missing childcare data at 24 months	8835	881	0.06
No missing childcare data at 38 months	8218	617	0.04
Total dropped due to missing childcare data	8218	5753	0.41
Criteria: intact families with two biological parents	Number remaining after selection	Number observations dropped	Number dropped as % potential sample
Full childcare data	8218		
Mother lives with biological father pre-birth: missing info	7905	313	0.04
Mother lives with biological father pre-birth: no	7541	364	0.04
Live-in father figure at 21 months is biological father of study child: missing info	7278	263	0.03
Live-in father figure at 21 months is biological father of study child: no/no live-in father figure	7038	240	0.03
Live-in father figure at 33 months is biological father of study child: missing info	6703	335	0.04
Live-in father figure at 33 months is biological father of study child: no/no live-in father figure	6543	160	0.02
Live-in father figure at 47 months is biological father of study child: missing info	6172	371	0.05
Live-in father figure at 47 months is biological father of study child: no/no live-in father figure	6010	162	0.02
Total dropped due to missing info	6936	1282	0.16
Total dropped due to non-intact status	7292	926	0.11
Total dropped	6010	2208	0.27

Table 2: Unconditional effects of paternal childcare on child outcomes

	Dependent variable							
	BOYS				GIRLS			
Paternal childcare	Entry Assessment	Behaviour age 4	Key Stage 1 (age 6/7)	Behaviour age 7	Entry Assessment	Behaviour age 4	Key Stage 1 (age 6/7)	Behaviour age 7
Year 1: 5-15 hours	0.04 [0.07]	0.92 [1.92]*	-0.41 [0.71]	0.56 [1.04]	0.30 [0.54]	0.75 [1.65]*	-0.76 [1.51]	0.52 [1.06]
Year 1: >15 hours	0.01 [0.02]	0.48 [0.78]	-0.80 [1.08]	0.39 [0.56]	-0.22 [0.28]	0.11 [0.18]	-1.40 [1.97]**	-0.41 [0.60]
Years 2&3: 5-15 hours	-0.58 [1.08]	-1.31 [3.09]***	-0.23 [0.44]	-0.71 [1.49]	-0.17 [0.32]	-0.57 [1.39]	-0.09 [0.20]	-0.28 [0.64]
Years 2&3: > 15 hours	-2.03 [2.93]***	-0.27 [0.51]	0.14 [0.21]	-0.86 [1.41]	0.45 [0.71]	-0.25 [0.47]	0.46 [0.79]	-0.63 [1.13]
N	1609	2964	1930	2389	1512	2834	1836	2341

Notes

Each column presents results from a separate OLS regression.

All measures standardised to mean 100, s.d. 10 on the full sample with the outcome measure.

Higher behavioural scores indicate greater behavioural problems.

Conditioning variables: Childcare by family/friend and by paid carer Y1 & Y23 (8 dummies), childcare arrangements age 3 to school entry (6 dummies). See Section 6.1 for details.

Table 3: Continuity of paternal care in the first three years

Paternal care history	N	%
Never above 5 hours in 1 st 3 years	1,945	32
Began care of 5-15 hours in Years 2&3	1,484	25
Began care of 15+ hours in Years 2&3	512	9
Decreased hours to 5-15 in Years 2&3	297	5
Cared 5-15 hours throughout 1 st 3 years	679	11
Increased hours to 15+ in Years 2&3	402	7
Cared 15+ hours throughout 1 st 3 years	308	5
Ended care of 5-15 hours after Year 1	231	4
Ended care of 15+ hours after Year 1	152	3
Total	6,010	100
Never above 5 hours in 1 st 3 years	1,945	32
Total ended care after Year 1 (5+ hrs per week)	383	6
Total began care in Years 2&3 (5+ hrs per week)	1,996	33
Total provided care in both periods1 (5+ hrs per week)	1686	28
Total	6,010	100

Table 4: Controls for parental endowments used in multiple regression analysis

Socio-economic endowments

<u>Variables</u>	<u>Notes</u>
Mother's and father's education	4 categories: CSE/none, Vocational/O-level, A-level, Degree
Mother's and father's occupational class	Mothers were asked about the occupation of both spouses in their current or last main jobs prior to the birth. This information was used to code parents' occupational class on the basis of the National Statistics Socio-economic Classification into 4 categories: I. Professional, etc. occupations; II. Managerial and technical occupations; III. Skilled occupations – manual and non-manual; IV. Partly skilled and unskilled occupations.
Mother's age at birth	5 categories: <20, 20-24, 25-29, 30-34, 35+
Father's age at birth	The older average age of fathers leads us to use slightly different age bands than for mothers. 5 categories: <25, 25-29, 30-34, 35-39, 40+
Index of Multiple Deprivation (IMD) for ward of residence at birth	The IMD provides a measure of the quality of the local environment and the family's access to services. The IMD is derived from 33 indicators across the 6 domains of income, employment, health, education, housing and geographical access to services. The IMD score for each ward in England is ranked and we distinguish households with an IMD in the four quartiles of this national ranking in order to provide an objective basis for comparison.
Financial difficulties pre-birth	During pregnancy the mother was asked to rate how difficult she currently found it to afford food, clothing, heating, rent or mortgage and things for the baby. We distinguish mothers with a financial difficulties score in the highest 10 percent of all mothers who answered the question.
Housing tenure in Year 2	3 categories: Owner occupied, social housing, other
Mother's social networks score	We use the mother's social networks score as a proxy for the availability of other family members who could potentially provide childcare Prior to the birth, mothers answered 10 questions on their social networks, including questions on the number of times in the last month the mother got together with one of her own or her partner's relatives, how many of her family or friends would provide help in times of trouble, how many friends she has and how many people she is able to discuss personal problems with. Each item is scored from 0 to 3 and summed to give a total networks score of between 0 and 30.
Birth order	Firstborn = 0; top-coded at 3
Number of under 16s in household at age 4	
Child is non-white	

Table 4 continued

Parents' personal endowments

<u>Variables</u>	<u>Notes</u>
Mother's and father's health in Year 1 and Year 3	Two variables for each parent, both derived from mother reports of general health, responses are coded from 1 (hardly ever well) to 4 (always well).
Father's mean CCEI pre-birth to Year 2	From fathers' own responses to 23 questions from the Crown-Crisp Experiential Index (CCEI) relating to free-floating anxiety, depression or somaticism. Fathers completed the questionnaire at 4 dates ranging from prior to the birth to Year 2. We compute the average CCEI score over all available dates in order to generate a measure that captures longer-term mental health, but exploratory analysis showed that our findings are not sensitive to this averaging procedure. Score ranges from 0 to 46
Father suffered anxiety/depression	Concern about the non-random response to the father-completed questionnaires (see Section 3.5) lead us to derive a variable from mother-completed questions on whether the father had suffered from anxiety or depression in any of the first 3 years of the child's life.
Mother's mean CCEI in pregnancy, Year 1 and Year 2	See father's CCEI. We allow for time variation in maternal mental health due to our interest in post-natal depression. The pregnancy score is the mean of two observations in early and late pregnancy. Year 1 is the mean of scores at 2 and 8 months, Year 2 a single measure recorded at 21 months.
Mother's Edinburgh Post-natal Depression score (EPDS) in pregnancy and Year 1	As administered in ALSPAC, the EPDS is composed of the sum of responses to 10 items, each scored between 0 and 3. Validation of the scale during pregnancy, the post-partum period and early parenthood has been examined using standardized psychiatric interviews as the validating measures and shown to have high sensitivity and specificity. Validation studies have utilized various threshold scores in determining which women were positive and in need of referral, with cut-offs ranging from 9 to 13 points. We choose a cut-off of 12 with the aim of identifying those mothers most at risk of suffering from a depressive illness, and construct two dummy variables. The first is equal to one if the mother's EPDS score was 12 or more in either of the scales administered in pregnancy, and the second if her score fell into the high-risk category in measurements taken at either 2 or 8 months post-birth. The EPDS is a useful way of testing for pre- or post-natal depression because it does not include somatic items, or those relating to physical symptoms, which may be confounded with normal physiological symptoms at this time. The CCEI does contain a somatic sub-scale, and can be thought of as capturing a broader, more continuous definition of mental health.

Table 4 continued

<u>Variables</u>	<u>Notes</u>
Father attended birth	
Mother ever felt unattached to child	Dummy variable, from mother report in Year 4
Mother's and father's feelings about the impending birth	Both from mother reports in pregnancy. Scored from 0 (mixed feelings/unhappy/indifferent) to 2 (overjoyed)
Mother and father attended antenatal classes	One dummy variable for each parent.
Mother and father smoked during pregnancy.	One dummy variable for each parent.
Mother's and father's alcohol consumption	Mother's consumption for pre-pregnancy period, father's consumption during pregnancy. 3 categories: less than once a week, around once a week, nearly every day
Mother's and father's locus of control	Self-completed by each parent in pregnancy. Sum of responses to 12 questions, each scored 0/1. Locus of control is a psychological concept related to the idea that people tend to ascribe their chances of future successes or failures either to internal or external causes. Persons with an internal locus of control see themselves as responsible for the outcomes of their own actions. Someone with an external locus of control sees environmental causes and situational factors as being more important than internal ones.
Mother and father found school a valuable experience	Self-completed by each parent. Scored from 1 (no, of no value) to 5 (yes, very)

Table 5: Controls for child endowments uses in multiple regression analysis (variables measured between birth and 6 months only)

Health

<u>Variables</u>	<u>Notes</u>
Gestation < 37 weeks	Dummy variable
Birth weight < 2.5kg and child not pre-term (gestation $\geq$ 37 weeks)	Dummy variable
Birth weight	Continuous variable, in kg
Child placed in Special Care Unit after delivery	Dummy variable
Child's general health in 1 st 6 months	Derived from mother reports, responses are coded from 1 (hardly ever well) to 4 (always well).

Temperament at 6 months

Nine dimensions of temperament are derived from mothers' responses to 88 questions from the Infant Temperament Questionnaire (Carey and McDevitt, 1977) administered 6 months after the birth. All measures are standardised to mean 100, s.d. 10 on the full sample with available data. Higher scores on all measures are associated with more 'difficult' temperaments (see Section 5.2).

<u>Variables</u>	<u>Notes</u>
Activity	Definition: Motor activity and the proportion of active and inactive periods in the child's day. For example, an infant may kick and squirm a lot or may be very quiet. As a preschooler, a child may prefer using his gross motor skills predominately, such as in running, or use his fine motor skills predominately, such as in doing puzzles. Example question: <i>He moves about a lot (kicks, grabs, squirms) during nappy change and dressing</i>
Rhythmicity	Definition: The degree of predictability of the timing of the child's biological functions such as hunger, sleep-wake cycles, and elimination. As an infant, a child may have a bowel movement every day after breakfast or only a few times a week. As a preschooler, she may prefer a big meal at lunch each day or there may be no predicting when she will be hungry. Example question: <i>He wants daytime naps at differing times (over 1 hour difference) from day to day</i>
Approach	Definition: A child's response to new people, new toys, new settings; it may be positive or negative. For example, an infant may smile at strangers and like new foods, or he/she may have a more sober reaction to novelty. As a preschooler, he/she may join right in or may be initially shy. Example question: <i>He is shy (turns away or clings to you) on meeting another child for the first time</i>

continued overleaf

Table 5 continued

<u>Variables</u>	<u>Notes</u>
Adaptability	Definition: The long-term reaction or adjustment to change in such areas as foods, moving, or going to a new school. Babies and children may take a long time to adjust to changes or may seem to take nearly no time at all. Example question: <i>He objects to being bathed in a different place or by a different person even after 2 or 3 tries</i>
Intensity	Definition: The energy level of a response — whether it is positive or negative. An infant may express his/her displeasure by mild fussing, or by loud wails. As a preschooler, a child may smile quietly with pleasure or jump around and yell. Example question: <i>He vigorously resists additional food or milk when full (spits out, clamps mouth closed, pushes spoon away etc)</i>
Mood	Definition: The quality of the child's mood — pleasant and friendly versus unpleasant, unhappy, and crying. An infant may generally smile and coo, or may be irritable and cry. As a preschooler, the child may tend to be generally content or discontent about many issues and people. Example question: <i>He is fussy or cries during a physical examination by a doctor</i>
Persistence	Definition: The child's ability to continue an activity despite frustration and the length of time spent on the activity without interruption. An infant may give up easily or may continue trying to reach something for a long time. A preschooler may lose interest quickly in toys or games or dressing himself, or may continue trying to make a toy do what he wants or trying to pull on his sock. Example question: <i>He pays attention to a game with a parent for only a minute or so</i>
Distractability	Definition: How easily outside stimuli interfere with a child's ongoing activity. An infant may not be able to suck while nursing if his/her mother talks to her. As a child, he/she may not be able to finish one thing before she starts or joins another activity. Example question: <i>He continues to fuss when his nappy is changed despite efforts to distract him with game, toy or singing etc</i>
Threshold	Definition: The amount of stimulation necessary to evoke a response in a child. An infant or a young child may respond strongly to moderate changes in such things as noise, room temperature, pain, odours, colours, and textures, or he/she may not be affected. Example question: <i>He notices, looks carefully at changes in your appearance or dress (hairdo, unfamiliar clothing)</i>

continued overleaf

Table 5 continued

Development at 6 months

Four measures of developmental ability are derived from mother reports of whether the child was able to complete 42 tasks from the Denver Developmental Screening Test (Frankenburg and Dodds, 1967) at 6 months. All measures are standardised to mean 100, s.d. 10 on the full sample with available data.

<u>Variables</u>	<u>Notes</u>
Gross motor skills	Relates to tasks involving large muscle movement and control, such as sitting and crawling
Fine motor skills	Relates to tasks involving manual dexterity and hand-eye coordination.
Communication skills	Captures the baby's production of sounds, and his or her ability to recognize and understand language.
Social skills	Relates to the baby's interaction with adults and his or her ability in self-help skills like drinking from a cup

Table 6: Regression results with controls for family endowments at birth: Entry Assessment (summary)

Entry Assessment: Boys

Paternal childcare	Included controls:					
	A	A, B	A, C	A, D	A, E	A, B, C, D, E
Year 1: 5-15 hours	0.02	0.24	-0.08	0.07	0.09	0.12
Year 1: 16+ hours	-0.05	0.03	-0.05	0.33	-0.41	-0.08
Years 2&3: 5-15 hours	-0.62	-0.67	-0.65	-0.84	-0.64	-0.85
Years 2&3: 16+ hours	-2.04 ***	-1.78 **	-1.86 **	-1.99 ***	-1.94 ***	-1.74 **
Adj R ²	0.049	0.172	0.105	0.117	0.093	0.234
F-test (1)		7.69 ***	7.40 ***	7.28 ***	4.35 ***	
F-test (2)		4.19 ***	2.02	2.13 **	3.47 ***	

Entry Assessment: Girls

Paternal childcare	Included controls:					
	A	A, B	A, C	A, D	A, E	A, B, C, D, E
Year 1: 5-15 hours	0.34	0.75 √	0.37	0.39	0.43	0.88
Year 1: 16+ hours	-0.26	-0.23	-0.06	-0.51	-0.23	-0.15
Years 2&3: 5-15 hours	-0.19	-0.22	-0.13	-0.10	-0.04	-0.09
Years 2&3: 16+ hours	0.46	0.81	0.77 √	0.63	0.66	0.91
Adj R ²	0.043	0.175	0.093	0.109	0.103	0.251
F-test (1)		8.21 ***	6.41 ***	7.48 ***	5.60 ***	
F-test (2)		4.75 ***	2.62 **	3.39 ***	4.15 ***	

Notes

Control groups

- A. Childcare history (see pp. 172)
- B. Socio-economic endowments (see Table 4)
- C. Father's personal endowments (see Table 4)
- D. Mother's personal endowments (see Table 4)
- E. Child's endowments (see Table 5)

Each column within a table relates to a separate regression.

Standard errors (not shown) derived from bootstrap with 200 repetitions.

***, **, and * indicate significance at the 1, 5 and 10% levels respectively.

√ indicates rejection of the null hypothesis that the coefficient value is unchanged compared with that in the far left column ($p < 0.1$).

F-test (1) is the joint test of the significance of the additional control group when childcare history is the only other set of conditioning variables (i.e. the specification in the same column as the F-test).

F-test (2) is the joint test of the significance of the additional control group when all endowment controls are included in the regression (i.e. the specification in the far right column).

Table 7: Regression results with controls for family endowments at birth: Behaviour problems (summary)

Behaviour problems: Boys

Paternal childcare	Included controls:					
	A	A, B	A, C	A, D	A, E	A, B, C, D, E
Year 1: 5-15 hours	0.88 *	1.04 **	0.90 *	0.99 **	0.71	0.87**
Year 1: 16+ hours	0.48	0.61	0.49	0.31	0.66	0.51
Years 2&3: 5-15 hours	-1.36 ***	-1.50 ***	-1.28 ***	-1.40 ***	-1.19 ***	-1.30***
Years 2&3: 16+ hours	-0.27	-0.48	-0.27	-0.40	-0.06	-0.09
Adj R ²	0.020	0.085	0.068	0.150	0.100	0.233
F-test (1)		6.80 ***	12.59 ***	30.02 ***	14.52 ***	
F-test (2)		3.37 ***	2.92 **	14.71 ***	8.83 ***	

Behaviour problems: Girls

Paternal childcare	Included controls:					
	A	A, B	A, C	A, D	A, E	A, B, C, D, E
Year 1: 5-15 hours	0.77	0.93 *	0.78 *	0.74 *	0.89 *	0.92 *
Year 1: 16+ hours	0.11	-0.23	0.06	-0.11	0.04	-0.14
Years 2&3: 5-15 hours	-0.55	-0.72 *	-0.50	-0.81 **	-0.64 *	-0.82 *
Years 2&3: 16+ hours	-0.21	-0.34	-0.23	-0.43	-0.26	-0.40
Adj R ²	0.016	0.090	0.059	0.150	0.080	0.231
F-test (1)		7.62 ***	10.00 ***	29.09 ***	11.53 ***	
F-test (2)		4.30 ***	2.66 **	12.92 ***	8.10 ***	

Notes

Control groups

- A. Childcare history (see pp. 172)
- B. Socio-economic endowments (see Table 4)
- C. Father's personal endowments (see Table 4)
- D. Mother's personal endowments (see Table 4)
- E. Child's endowments (see Table 5)

Each column within a table relates to a separate regression.

Standard errors (not shown) derived from bootstrap with 200 repetitions.

***, **, and * indicate significance at the 1, 5 and 10% levels respectively.

√ indicates rejection of the null hypothesis that the coefficient value is unchanged compared with that in the far left column ($p < 0.1$).

F-test (1) is the joint test of the significance of the additional control group when childcare history is the only other set of conditioning variables (i.e. the specification in the same column as the F-test).

F-test (2) is the joint test of the significance of the additional control group when all endowment controls are included in the regression (i.e. the specification in the far right column).

Table 8: Comparison of the effects of paternal with other types of childcare, with and without selection controls: Entry Assessment (summary)

Entry Assessment: Boys

Childcare hours	<u>Childcare history controls only</u>			<u>With full controls of parent and child endowments</u>		
	Father	Family/ friends	Paid carer	Father	Family/ friends	Paid carer
Year 1: 5-15 hours	0.02	-0.84	-1.43	0.12	-0.68	-2.04 **
Year 1: 16+ hours	-0.05	-2.27 **	-0.72	-0.08	-2.28 **	-1.87 *
Years 2&3: 5-15 hours	-0.62	0.83	2.84 ***	-0.85	0.78	0.96 √
Years 2&3: 16+ hours	-2.04 ***	0.69	5.05 ***	-1.74 **	0.57	2.38 ** √
Adj R ²		0.049			0.234	

Entry Assessment: Girls

Childcare hours	<u>Childcare history controls only</u>			<u>With full controls of parent and child endowments</u>		
	Father	Family/ friends	Paid carer	Father	Family/ friends	Paid carer
Year 1: 5-15 hours	0.34	-1.20 *	-0.18	0.88	-1.30 *	-1.09
Year 1: 16+ hours	-0.26	0.79	1.43	-0.15	1.70 ** √	0.31
Years 2&3: 5-15 hours	-0.19	-0.22	1.57 *	-0.09	0.28	0.54 √
Years 2&3: 16+ hours	0.46	-0.24	2.59 **	0.91	-0.49	1.16 √
Adj R ²		0.043			0.251	

Notes

Left panel and right panel of each table relates to a single regression each.

For details of controls see Section 6.2 and Tables 4 and 5.

Standard errors (not shown) derived from bootstrap with 200 repetitions.

***, **, and * indicate significance at the 1, 5 and 10% levels respectively.

√ indicates rejection of the null hypothesis that the coefficient value is unchanged compared with that in the left panel (p<0.1).

Table 9: Comparison of the effects of paternal with other types of childcare, with and without selection controls: Behavioural problems (summary)

Behavioural problems: Boys

Childcare hours	<u>Childcare history controls only</u>			<u>With full controls of parent and child endowments</u>		
	Father	Family/ friends	Paid carer	Father	Family/ friends	Paid carer
Year 1: 5-15 hours	0.88 *	-0.11	-1.12	0.87 **	0.08	-0.27 √
Year 1: 16+ hours	0.48	-0.26	-1.44	0.51	-0.06	-0.64
Years 2&3: 5-15 hours	-1.36 ***	-0.17	-0.05	-1.30 ***	-0.04	0.09
Years 2&3: 16+ hours	-0.27	1.15	-1.09	-0.09	0.88	-0.61
Adj R ²		0.020			0.233	

Behavioural problems: Girls

Childcare hours	<u>Childcare history controls only</u>			<u>With full controls of parent and child endowments</u>		
	Father	Family/ friends	Paid carer	Father	Family/ friends	Paid carer
Year 1: 5-15 hours	0.77	0.04	0.42	0.92 *	-0.04	0.95
Year 1: 16+ hours	0.11	-0.14	-1.01	-0.14	-0.11	-0.08 √
Years 2&3: 5-15 hours	-0.55	0.83	-0.60	-0.82 **	0.64	0.16 √
Years 2&3: 16+ hours	-0.21	2.02 ***	-1.20	-0.40	1.96 ***	0.00 √
Adj R ²		0.016			0.231	

Notes

Left panel and right panel of each table relates to a single regression each.

For details of controls see Section 6.2 and Tables 4 and 5.

Standard errors (not shown) derived from bootstrap with 200 repetitions.

***, **, and * indicate significance at the 1, 5 and 10% levels respectively.

√ indicates rejection of the null hypothesis that the coefficient value is unchanged compared with that in the left panel ($p < 0.1$).

Table 10: Interactions in the effects of paternal childcare on Entry Assessment

PATERNAL CHILDCARE	BOYS				GIRLS			
	Year 1		Years 2&3		Year 1		Years 2&3	
	5-15 hrs	15+ hrs	5-15 hrs	15+ hrs	5-15 hrs	15+ hrs	5-15 hrs	15+ hrs
INTERACTION								
Father's education								
O-level or below	-0.45 [0.55]	0.28 [0.28]	-0.95 [1.26]	-1.60 [1.72] *	1.09 [1.45]	0.12 [0.12]	0.11 [0.15]	0.84 [0.96]
A-level or higher	0.77 [0.89]	-0.63 [0.59]	-0.74 [1.00]	-1.91 [1.94] *	0.49 [0.64]	-0.60 [0.57]	-0.21 [0.31]	1.08 [1.27]
F-test	1.06	0.41	0.04	0.05	0.33	0.26	0.10	0.04
Father's occupational class								
Prof/managerial/tech	0.81 [0.89]	0.16 [0.14]	-1.32 [1.73] *	-2.67 [2.50] **	0.14 [0.17]	-1.18 [1.11]	-0.29 [0.41]	1.18 [1.32]
Skilled/unskilled	-0.15 [0.19]	0.24 [0.24]	-0.96 [1.25]	-1.39 [1.52]	1.39 [1.88] *	0.42 [0.40]	-0.12 [0.17]	0.72 [0.84]
F-test	0.62	0.00	0.11	0.84	1.31	1.22	0.03	0.14
Father's employment								
In work in period	-0.01 [0.02]	0.09 [0.11]	-0.84 [1.55]	-1.28 [1.77] *	0.84 [1.50]	-0.85 [1.00]	-0.30 [0.58]	0.70 [1.09]
Not in work in period	1.66 [1.13]	-0.73 [0.45]	0.69 [0.53]	-3.18 [2.21] **	-0.64 [0.46]	1.09 [0.78]	-1.52 [1.40]	1.50 [1.11]
F-test	1.17	0.23	1.34	1.63	1.09	1.55	1.25	0.33
Father's interaction score								
> median for group	-0.06 [0.07]	-0.34 [0.30]	0.03 [0.04]	-1.06 [1.15]	1.08 [1.52]	-0.63 [0.55]	-0.28 [0.47]	1.04 [1.28]
<= median for group	0.40 [0.55]	0.00 [0.00]	-1.71 [2.64] ***	-2.29 [2.80] ***	0.58 [0.84]	0.02 [0.02]	0.20 [0.34]	0.83 [1.15]
F-test	0.20	0.07	5.62 **	1.35	0.31	0.24	0.50	0.05
Mother's education								
O-level or below	-0.08 [0.11]	-0.07 [0.07]	-0.67 [0.98]	-2.17 [2.49] **	1.43 [1.99] **	0.64 [0.67]	-0.36 [0.55]	1.00 [1.25]
A-level or higher	0.49 [0.52]	-0.16 [0.14]	-1.02 [1.21]	-1.30 [1.21]	0.05 [0.07]	-1.34 [1.19]	0.37 [0.49]	0.90 [0.98]
F-test	0.23	0.00	0.10	0.41	1.71	1.89	0.53	0.01
Mother's occupational class								
Prof/managerial/tech	1.01 [0.99]	-1.38 [1.18]	-0.95 [1.03]	-1.85 [1.63]	0.24 [0.28]	0.13 [0.11]	0.54 [0.63]	1.67 [1.69] *
Skilled/unskilled	-0.13 [0.16]	0.46 [0.45]	-0.52 [0.72]	-1.33 [1.44]	1.17 [1.63]	-0.02 [0.02]	-0.35 [0.52]	0.36 [0.43]
F-test	0.77	1.50	0.13	0.13	0.70	0.01	0.66	1.03

continued overleaf

Table 10 continued

PATERNAL CHILDCARE	BOYS				GIRLS			
	Year 1		Years 2&3		Year 1		Years 2&3	
	5-15 hrs	15+ hrs	5-15 hrs	15+ hrs	5-15 hrs	15+ hrs	5-15 hrs	15+ hrs
INTERACTION								
Mother's employment								
In work in period	0.21 [0.31]	-1.36 [1.57]	-0.99 [1.68] *	-1.26 [1.75] *	0.83 [1.34]	-0.05 [0.06]	0.27 [0.49]	0.99 [1.49]
Not in work in period	-0.06 [0.06]	2.72 [2.20] **	-0.31 [0.37]	-3.95 [2.52] **	0.56 [0.61]	-0.71 [0.56]	-0.71 [0.92]	1.09 [0.93]
F-test	0.05	8.42 ***	0.57	2.67	0.07	0.22	1.39	0.01
Mother's employment								
FT in 1 st 3 years	-0.22 [0.15]	-1.48 [0.93]	0.47 [0.36]	-1.38 [1.08]	1.91 [1.48]	1.73 [1.11]	0.08 [0.07]	0.15 [0.12]
Never FT in 1 st 3 years	0.21 [0.32]	0.36 [0.42]	-1.02 [1.84] *	-1.78 [2.31] **	0.60 [1.02]	-0.76 [0.90]	-0.04 [0.08]	1.02 [1.54]
F-test	0.07	1.09	1.22	0.08	0.87	2.02	0.01	0.42
Mother's interaction score								
> median for group	0.40 [0.39]	-0.10 [0.08]	-0.51 [0.76]	-1.30 [1.50]	0.50 [0.59]	1.31 [1.16]	-0.45 [0.73]	0.77 [1.02]
<= median for group	0.13 [0.19]	-0.08 [0.09]	-1.08 [1.75] *	-2.21 [2.62] ***	1.00 [1.63]	-1.11 [1.24]	0.31 [0.54]	1.04 [1.34]
F-test	0.06	0.00	0.59	0.77	0.27	3.32 *	1.30	0.09
Post-natal depression								
EPDS <12 in Year 1	0.37 [0.57]	0.00 [0.01]	-0.86 [1.51]	-1.95 [2.64] ***	0.82 [1.41]	-0.60 [0.74]	0.18 [0.34]	0.80 [1.23]
EPDS >=12 in Year 1	-1.06 [0.68]	-0.54 [0.29]	-0.65 [0.46]	-0.82 [0.49]	0.85 [0.63]	1.84 [1.04]	-1.34 [0.99]	1.44 [0.88]
F-test	0.71	0.07	0.02	0.38	0.00	1.61	1.10	0.13
Non-parental childcare								
None	-0.56 [0.80]	0.08 [0.09]	-0.13 [0.22]	-2.68 [3.38] ***	0.81 [1.30]	0.18 [0.19]	0.16 [0.28]	0.62 [0.88]
5 hours or more pwk	2.19 [2.12] **	-0.60 [0.43]	-2.36 [2.75] ***	0.16 [0.14]	0.99 [1.05]	-0.94 [0.76]	-0.49 [0.60]	1.41 [1.41]
F-test	5.13 **	0.17	5.21 **	4.75 **	0.03	0.55	0.49	0.47
Birth order								
First born	0.37 [0.43]	-0.39 [0.37]	-1.07 [1.43]	-1.76 [1.80] *	1.79 [2.43] **	1.05 [0.97]	-2.09 [3.06] ***	0.30 [0.35]
Second or more	-0.02 [0.03]	0.18 [0.18]	-0.63 [0.92]	-1.74 [1.94] *	-0.25 [0.33]	-1.27 [1.32]	1.86 [2.86] ***	1.70 [2.08] **
F-test	0.11	0.17	0.21	0.00	3.89 **	2.76 *	18.93 ***	1.50

Each interaction relates to a separate regression. Coefficients have the interpretation of the effect of that type of paternal care for the given sub-group, relative to maternal-only parental care.

All regressions include full controls for childcare history and parent and child endowments (see Tables 4 and 5 and Section 6.2).

***, **, * indicate significance at the 1, 5 and 10% levels respectively.

F-test is a test of the null hypothesis that the interacted effects are equal.

Table 11: Interactions in the effects of paternal childcare on behavioural problems

PATERNAL CHILDCARE	BOYS				GIRLS			
	Year 1		Years 2&3		Year 1		Years 2&3	
	5-15 hrs	15+ hrs	5-15 hrs	15+ hrs	5-15 hrs	15+ hrs	5-15 hrs	15+ hrs
INTERACTION								
Father's education								
O-level or below	1.30 [2.09] **	0.34 [0.44]	-1.54 [2.64] ***	-0.34 [0.48]	0.74 [1.19]	-0.74 [0.92]	-1.17 [2.03] **	-0.83 [1.17]
A-level or higher	0.46 [0.73]	0.44 [0.57]	-0.90 [1.70] *	0.15 [0.21]	0.99 [1.72] *	0.57 [0.72]	-0.66 [1.32]	-0.13 [0.19]
F-test	0.90	0.01	0.65	0.25	0.08	1.42	0.44	0.54
Father's occupational class								
Prof/managerial/tech	0.46 [0.70]	-1.12 [1.37]	-1.77 [3.21] ***	0.62 [0.83]	1.30 [2.14] **	0.47 [0.57]	-1.25 [2.35] **	0.25 [0.37]
Skilled/unskilled	1.52 [2.46] **	1.83 [2.36] **	-1.09 [1.87] *	-0.65 [0.92]	0.61 [1.00]	-1.18 [1.44]	-0.50 [0.87]	-0.67 [0.95]
F-test	1.39	7.27 ***	0.71	1.57	0.63	2.14	0.93	0.89
Father's employment								
In work in period	0.98 [2.09] **	0.25 [0.40]	-1.25 [3.10] ***	-0.13 [0.24]	0.88 [1.96] *	0.22 [0.34]	-0.89 [2.26] **	-0.32 [0.63]
Not in work in period	0.79 [0.71]	0.15 [0.14]	-2.26 [2.38] **	0.64 [0.65]	1.06 [0.96]	-1.60 [1.47]	-0.26 [0.30]	-0.54 [0.53]
F-test	0.03	0.01	1.13	0.55	0.02	2.32	0.54	0.04
Father's interaction score								
> median for group	0.32 [0.52]	0.09 [0.10]	-1.68 [3.51] ***	-0.32 [0.48]	0.72 [1.27]	-1.22 [1.44]	-0.99 [2.13] **	0.03 [0.04]
<= median for group	1.27 [2.33] **	0.67 [1.00]	-0.85 [1.79] *	0.18 [0.29]	1.02 [1.87] *	0.58 [0.82]	-0.68 [1.48]	-0.73 [1.25]
F-test	1.58	0.35	2.36	0.42	0.17	3.14 *	0.36	1.03
Mother's education								
O-level or below	0.83 [1.43]	0.36 [0.48]	-0.96 [1.86] *	0.66 [1.00]	0.97 [1.66] *	-0.58 [0.76]	-0.93 [1.82] *	-0.99 [1.52]
A-level or higher	1.15 [1.67] *	0.80 [0.98]	-1.61 [2.68] ***	-1.15 [1.47]	0.84 [1.38]	0.37 [0.44]	-0.71 [1.27]	0.20 [0.28]
F-test	0.13	0.17	0.69	3.23 *	0.02	0.73	0.08	1.54
Mother's occupational class								
Prof/managerial/tech	0.58 [0.80]	1.89 [2.20] **	-1.43 [2.19] **	-0.47 [0.57]	0.35 [0.55]	-0.28 [0.32]	-0.85 [1.34]	0.22 [0.29]
Skilled/unskilled	1.37 [2.26] **	-0.19 [0.24]	-1.41 [2.59] **	0.30 [0.43]	1.39 [2.29] **	-0.39 [0.48]	-0.98 [1.82] *	-0.79 [1.12]
F-test	0.70	3.31 *	0.00	0.52	1.38	0.01	0.02	0.95

Continued overleaf

Table 11 continued

PATERNAL CHILDCARE	BOYS				GIRLS			
	Year 1		Years 2&3		Year 1		Years 2&3	
	5-15 hrs	15+ hrs	5-15 hrs	15+ hrs	5-15 hrs	15+ hrs	5-15 hrs	15+ hrs
INTERACTION								
Mother's employment								
In work in period	0.26 [0.50]	1.25 [1.88] *	-1.06 [2.43] **	-0.27 [0.48]	0.90 [1.84] *	-0.04 [0.05]	-1.14 [2.70] ***	-0.74 [1.39]
Not in work in period	2.81 [3.62] ***	-1.21 [1.37]	-1.36 [2.28] **	0.83 [0.90]	1.24 [1.65] *	-0.27 [0.30]	-0.22 [0.37]	0.18 [0.20]
F-test	8.30 ***	5.65 **	0.21	1.20	0.16	0.05	2.15	0.89
Mother's employment								
FT in 1 st 3 years	-0.92 [0.85]	-0.92 [0.75]	-0.68 [0.78]	0.86 [0.83]	1.86 [1.77] *	0.18 [0.15]	-1.14 [1.26]	-1.18 [1.17]
Never FT in 1 st 3 years	1.25 [2.59] **	0.75 [1.20]	-1.36 [3.30] ***	-0.23 [0.40]	0.72 [1.56]	-0.13 [0.19]	-0.81 [2.03] **	-0.29 [0.54]
F-test	3.42 *	1.51	0.56	0.93	1.00	0.05	0.13	0.68
Mother's interaction score								
> median for group	-1.02 [1.39]	-0.15 [0.17]	-1.70 [3.38] ***	0.18 [0.28]	0.49 [0.72]	-0.32 [0.35]	-1.53 [3.28] ***	-1.53 [2.51] **
<= median for group	1.64 [3.28] ***	0.70 [1.10]	-0.94 [2.06] **	-0.34 [0.55]	1.08 [2.24] **	-0.06 [0.09]	-0.22 [0.49]	0.62 [1.02]
F-test	10.57 ***	0.69	1.95	0.48	0.59	0.06	6.40 **	8.55 ***
Post-natal depression								
EPDS >=12 in Year 1	2.58 [2.33] **	-1.23 [0.92]	-0.31 [0.31]	-0.45 [0.37]	1.18 [1.11]	-1.16 [0.87]	0.04 [0.04]	0.17 [0.13]
EPDS <12 in Year 1	0.58 [1.20]	0.82 [1.34]	-1.43 [3.37] ***	-0.05 [0.08]	0.85 [1.84] *	0.07 [0.11]	-0.97 [2.36] **	-0.52 [1.00]
F-test	2.74 *	1.99	1.07	0.09	0.08	0.72	0.88	0.26
Non-parental childcare								
None	0.98 [1.91] *	0.29 [0.45]	-1.37 [3.07] ***	0.52 [0.90]	1.04 [2.10] **	0.11 [0.16]	-1.22 [2.81] ***	-0.20 [0.35]
5 hours or more pwk	0.60 [0.75]	1.03 [0.97]	-0.97 [1.48]	-1.68 [1.97] **	0.46 [0.61]	-0.62 [0.63]	0.11 [0.17]	-0.80 [1.01]
F-test	0.17	0.37	0.29	5.29 **	0.43	0.38	3.39 *	0.44
Birth order								
First born	0.62 [0.97]	0.83 [1.07]	-1.64 [2.91] ***	-0.49 [0.68]	-0.04 [0.07]	-0.97 [1.14]	-0.77 [1.43]	-0.59 [0.86]
Second or more	1.14 [1.90] *	0.09 [0.12]	-0.98 [1.96] *	0.13 [0.20]	1.76 [2.99] ***	0.50 [0.67]	-0.99 [2.01] **	-0.40 [0.61]
F-test	0.36	0.49	0.85	0.44	4.69 **	1.80	0.09	0.05

See notes to Table 10.

Table 12: Controls for child's environment used in multiple regression analysis

<u>Variables</u>	<u>Notes</u>
Household income	Our measure is constructed from banded information on weekly disposable household income taken from two questionnaires in Years 3 and 4. We impute median values for the bands using data on a comparable sample from the Family Expenditure Survey, convert the income variables to real values using the 1995 RPI as a base and equalise using the OECD modified scale. We also impute the value of housing benefit for families who do not directly receive housing payments. Finally we average over the two measures to reduce measurement error and (in our multivariate analysis) take the log of the variable.
Parental relationship quality	
Rows with partner score	Derived from 6 questions about the frequency that rows occur between the mother and her spouse. Five questions relate to the frequency (over the previous 3 months) that a parent shouts or calls the other parent names, walks out of the house, hits or slaps the other parent, throws or breaks things deliberately and doesn't speak to the other parent for more than half an hour. Each of these is scored 0 for never and 2 if either or both parents did the behaviour in question. A sixth question relates specifically to the number of arguments or disagreements between the parents in the previous 3 months, scored 0 for no arguments at all to 4 for more than 13 arguments. These six items are then summed to create an overall score scaled from 0 to 14. We take an average of the score measured at 21 and 33 months in order to approximate a longer-term measure of the degree of family conflict.
Mother's satisfaction with partner score	Derived from 7 questions on how the mother rates her satisfaction with various aspects of the parental relationship: handling family finances, demonstrations of affection, sex, amount of time spent together, making major decisions, household tasks and leisure time interests and activities. Responses were scored from 0 (very dissatisfied) to 3 (very satisfied) and summed and averaged as before (scale 0 to 21).
Going out score	Mothers were asked how often in the previous three months she and her spouse had: gone out for a meal, gone out for a drink, visited family, visited friends and gone to the cinema or theatre. Responses were scored from 0 (never) to 3 (more than once a week) and summed and averaged as before (scale 0 to 15).
Parental communication score	Mothers were asked how often in an average week she and her partner: discussed work or how the day had gone, laughed together, calmly talked over something such as the news or a hobby or interest, kissed or hugged, made plans and talked over feelings or worries. Responses were scored from 0 (never) to 3 (most days) and summed and averaged as before (scale 0 to 18).

Continued overleaf

Table 12 continued

<u>Variables</u>	<u>Notes</u>
Attitudes to parenthood	
Mother's enjoyment of parenthood at 8 and 33 months	Each measured by mothers' responses to how accurately 5 statements describe their feelings: 'I really enjoy this child'; 'It is a great pleasure to watch my child develop'; 'Having this child has made me feel more fulfilled'; 'Children are fun'; and 'I feel I should be enjoying my child but am not' (reverse coded). Responses are scored from 0 to 3 and summed.
Mother's confidence in parenting at 8 and 33 months	Two variables. Parental confidence is measured similarly by 6 statements: 'I feel confident with my child'; 'I would have preferred that we had not had this child when we did'; 'I dislike the mess that surrounds my child'; 'I really cannot bear it when the child cries'; 'I feel constantly unsure if I am doing the right thing for my child'; and 'I feel I have no time to myself'. Responses are scored from 0 for the most negative response to 3 for the most positive and summed.
Father's enjoyment of parenthood at 8 months	From fathers' own responses to identical questions as mothers' enjoyment variables. Fathers' own reports available at 8 months only.
Father's confidence in parenting at 8 months	From fathers' own responses to identical questions as mothers' confidence variables. Fathers' own reports available at 8 months only.
Father's attitude to parenthood at 8 and 33 months	Two variables. From mother reports. Items are highly similar to those used in the construction of the enjoyment and confidence variables above.
Parenting behaviours and the home environment	
Mother-child interaction score at 6 and 38 months	Two variables. Derived from questions on the frequency the mother engages in 5 activities with the child: reading to the child or showing pictures in books; singing to the child; playing with toys with the child; playing physically with the child; and taking the child for walks. Each item is scored from 0 (hardly ever/never) to 2 (often) and summed.
Father-child interaction score at 6 and 38 months	Two variables. From mother reports (father reports not available). Derived as for mother-child interaction score.
Frequency mother puts child to bed at 38 months	Scored from 0 (hardly ever/never) to 2 (often).
Frequency father puts child to bed at 38 months	From mother report. Scored as above.
Mother initiated breastfeeding	Dummy variable
Duration of breastfeeding in months	

continued overleaf

Table 12 continued

<u>Variables</u>	<u>Notes</u>
Frequency mother talks to child when occupied at 6 and 38 months	Two variables. How often the mother talks to the child whilst she is engaged in other activities such as housework, scored from 0 (never) to 4 (always). Mother report.
Frequency of outings to shops at 6 and 38 months	Two variables. Outings scores are composed of the sum of a number of individual items, each scored from 0 (never) to 4 (more than once a week). Outings to shops relates to 3 items – local shops, department stores and supermarkets.
Frequency of outings to park/playground and family/friends at 6 and 38 months	Two variables. Outings to a park or playground is one item and grouped with outings to friends or family, also one item. Scored as above.
Frequency of outings to library/places on interest/places of entertainment at 38 months	Outings to the library, places of interest and places of entertainment comprise one item each. Not asked at 6 months. Scored as above.
Weekly hours child spends outdoors at 38 months	From mother report. Top-coded at 14.
Weekly hours child spends in car at 38 months	As above
Weekly hours child watches TV at 38 months	As above
Weekly hours spent with other children at 38 months	As above
Toy score at 24 months	Derived from the number of 12 different types of toy that the child owns. Responses are scored from 0 to 3 and summed.
Number of books child owns at 6 and 30 months	Two variables. Top-coded at 12.

See Appendix C for summary statistics on all variables.

Table 13: Controls for child outcomes between 15 and 30 months used in ‘value-added’ specifications

<u>Variables</u>	<u>Notes</u>
Child’s general health – 6-18 months, 18-30 months, 30-42 months	Derived from mother reports, responses are coded from 1 (hardly ever well) to 4 (always well).
Temperament at 24 months	Scores for the nine dimensions of temperament described in Table 5. Derived from mothers’ responses to questions from the Toddler Temperament Questionnaire, an age-appropriate version of the questions from the Infant Temperament Questionnaire administered at 6 months. All measures are standardised to mean 100, s.d. 10 on the full sample with available data. Higher scores on all measures are associated with more ‘difficult’ temperaments
Developmental ability at 18 and 30 months	Gross motor, fine motor and social skills at 18 and 30 months. Communication skills at 18 months only. From the Denver Developmental Screening Test, equivalent to that administered at 6 months (see Table 5). All measures standardised as for temperament.
Verbal and communication ability at 15 and 24 months	from the MacArthur Toddler Communication questionnaire (Fenson et al., 1991), and consist of vocabulary, non-verbal communication and social development scores recorded at 15 months, plus and vocabulary and grammar scores at 24 months. Variables are standardized as above.

See Appendix Table C5 for descriptive statistics on these variables.

**Table 14: Regression results with controls for contemporaneous child environment:
Entry Assessment (summary)**

Boys	Included controls:						F, G, H, I, J, K
	F	F,G	F,H	F,I	F,J	F,K	
Paternal childcare							
Year 1: 5-15 hours	0.12	0.08	0.13	0.15	0.01	0.14	-0.02
Year 1: 16+ hours	-0.08	-0.04	-0.03	-0.16	-0.07	-0.07	0.01
Years 2&3: 5-15 hours	-0.85	-0.78	-0.79	-0.66	-0.87	-0.58	-0.33
Years 2&3: 16+ hours	-1.74**	-1.74**	-1.68**	-1.60 *	-1.87**	-1.71**	-1.63*
Adj R ²	0.234	0.236	0.241	0.242	0.283	0.334	0.380
F-test (1)		5.51	1.89	2.16	4.10***	8.15***	
F-test (2)		5.96	2.93	2.15	2.16**	6.30***	
Girls	Included controls:						F, G, H, I, J, K
	F	F,G	F,H	F,I	F,J	F,K	
Paternal childcare							
Year 1: 5-15 hours	0.88	0.83	0.85	1.04 *	1.08 *	0.67	0.90
Year 1: 16+ hours	-0.15	-0.12	-0.25	-0.16	0.13	0.18	0.14
Years 2&3: 5-15 hours	-0.09	-0.04	-0.10	-0.10	-0.25	0.02	-0.02
Years 2&3: 16+ hours	0.91	0.92	0.95 *	0.96	0.54	0.63	0.50
Adj R ²	0.251	0.253	0.255	0.259	0.295	0.323	0.372
F-test (1)		4.36	2.00	1.65	3.92***	5.59***	
F-test (2)		2.90	2.52	1.34	2.86***	5.30***	

Notes

Control groups

- F. Childcare history and full parent and child endowment controls (see Tables 4 and 5 and Section 6.2)
- G. Household income (see Table 12)
- H. Parental relationship quality (see Table 12)
- I. Attitudes to parenthood (see Table 12)
- J. Parenting behaviours and the home environment (see Table 12)
- K. Child outcomes between 15 and 30 months (see Table 13)

Each column within a table relates to a separate regression.

Standard errors (not shown) derived from bootstrap with 200 repetitions.

***, **, and * indicate significance at the 1, 5 and 10% levels respectively.

√ indicates rejection of the null hypothesis that the coefficient value is unchanged compared with that in the far left column ($p < 0.1$).

F-test (1) is the joint test of the significance of the additional control group when childcare history is the only other set of conditioning variables (i.e. the specification in the same column as the F-test).

F-test (2) is the joint test of the significance of the additional control group when all endowment controls are included in the regression (i.e. the specification in the far right column).

Table 15: Regression results with controls for contemporaneous child environment: Behavioural problems (summary)

Boys	Included controls:						F, G, H, I, J, K
	F	F,G	F,H	F,I	F,J	F,K	
Paternal childcare							
Year 1: 5-15 hours	0.87 **	0.86 **	0.88 **	0.84 **	0.88 **	0.60	0.61
Year 1: 16+ hours	0.51	0.49	0.55	0.89 √	0.38	0.08 √	0.25
Years 2&3: 5-15 hours	-1.30 ***	-1.35 ***	-1.23 ***	-1.03 *** √	-1.20 ***	-1.05 ***	-0.82 ** √
Years 2&3: 16+ hours	-0.09	-0.16	-0.07	0.18 √	0.20	0.38 √	0.45 √
Adj R ²	0.233	0.235	0.240	0.279	0.258	0.348	0.389
F-test (1)		3.91	5.89 ***	23.43 ***	4.39 ***	20.33 ***	
F-test (2)		5.21	2.52	12.80 ***	2.45 **	15.28 ***	
Girls	Included controls:						F, G, H, I, J, K
	F	F,G	F,H	F,I	F,J	F,K	
Paternal childcare							
Year 1: 5-15 hours	0.92 *	0.91 *	0.89 *	0.96 **	0.88 *	0.56 √	0.52 √
Year 1: 16+ hours	-0.14	-0.17	-0.15	-0.22	0.00	-0.10	0.07
Years 2&3: 5-15 hours	-0.82 **	-0.83 **	-0.73 *	-0.58 √	-0.71 *	-0.72 *	-0.46 √
Years 2&3: 16+ hours	-0.40	-0.36	-0.37	-0.10 √	-0.16	-0.32	-0.01
Adj R ²	0.231	0.232	0.236	0.272	0.256	0.329	0.376
F-test (1)		3.86	5.45 ***	18.08 ***	3.88 ***	16.05 ***	
F-test (2)		1.69	2.04	11.13 ***	3.04 ***	13.17 ***	

Notes

Control groups

- F. Childcare history and full parent and child endowment controls (see Tables 4 and 5 and Section 6.2)
- G. Household income (see Table 12)
- H. Parental relationship quality (see Table 12)
- I. Attitudes to parenthood (see Table 12)
- J. Parenting behaviours and the home environment (see Table 12)
- K. Child outcomes between 15 and 30 months (see Table 13)

Each column within a table relates to a separate regression.

Standard errors (not shown) derived from bootstrap with 200 repetitions.

***, **, and * indicate significance at the 1, 5 and 10% levels respectively.

√ indicates rejection of the null hypothesis that the coefficient value is unchanged compared with that in the far left column ($p < 0.1$).

F-test (1) is the joint test of the significance of the additional control group when childcare history is the only other set of conditioning variables (i.e. the specification in the same column as the F-test).

F-test (2) is the joint test of the significance of the additional control group when all endowment controls are included in the regression (i.e. the specification in the far right column).

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APPENDIX A: Sample selection issues

Appendix Table A1: Comparison of the means of key variables between the full sample and the Entry Assessment sample

	Full sample (N = 6010)	Entry Assessment sample (N = 3121)
Paternal childcare: Medium hours, Year 1	0.22	0.23
Paternal childcare: Long hours, Year 1	0.13	0.12
Paternal childcare: Medium hours, Years 2&3	0.41	0.41
Paternal childcare: Long hours, Years 2&3	0.20	0.21
Mother's education: CSE/none	0.12	0.12
Mother's education: Voc/O-level	0.43	0.46
Mother's education: A-level	0.27	0.27
Mother's education: Degree	0.18	0.15
Father's education: CSE/none	0.17	0.17
Father's education: Voc/O-level	0.30	0.32
Father's education: A-level	0.30	0.30
Father's education: Degree	0.24	0.20
Child is firstborn	0.44	0.46
Mother worked in first 3 years	0.70	0.73
Father worked continuously in first 3 years	0.83	0.84
Average household income at age 3 and 4	241.5	237.3

Appendix Table A2. Response rates to partner questionnaires

Variable	Mean value of variable in sample:			
	All	Paternal childcare LOW < 5 hours per week	Paternal childcare MEDIUM 5-15 hours per week	Paternal childcare HIGH 16 or more hours per week
Father answered all 5 questionnaires	0.57	0.56 0.53	0.59 0.59 **	0.59 0.62 **
Father answered between 1 and 4 questionnaires	0.35	0.35 0.38	0.34 0.34 **	0.34 0.32 **
Father answered no questionnaires	0.08	0.09 0.09	0.06 ** 0.07 **	0.07 0.07 ***

Notes

Numbers are the proportion of the sample with the given characteristic.

The two lines for each variable give results partitioning the sample by:

Paternal childcare in **Year 1**

Paternal childcare in **Years 2 & 3**

Stars relate to t-test that mean for group is equal to mean for low paternal childcare group (** = $p < 0.01$; * = $p < 0.05$)

Appendix B: Associations between paternal childcare and family endowments at birth

B1. Becker's household production model

Gary Becker's *A Treatise on the Family* (1991) provides the basis for economic thinking on the family. Its eleven chapters and supplemental papers cover topics as diverse as polygamy and monogamy, intergenerational mobility, the sexual division of labour and fertility. As Pollak (2002) argues, the guiding principles behind Becker's work are that rational individuals act to maximise utility and that the behaviour of different individuals is coordinated by equilibrium in implicit or explicit markets. Many of the models in this work have relevance for childcare decisions and parental investments in children more generally. We focus here on the household production model described in Chapter 1, adapted from the single adult to the two adult case. This model provides a basic static framework for thinking about how parents allocate resources of time and money between competing uses, and highlights the way in which many of the trade-offs faced by families are related to their endowments of human capital. However, we also draw on Becker's work on the division of labour within families in Chapter 2, which introduces the idea of gains to intra-household specialisation along the lines of comparative advantage.

The household production specifies that household utility is a function of K unobserved non-market 'commodities' that are self-produced by the household members.

$$U = U(Z_1, \dots, Z_K) \quad (B1)$$

According to Becker, "[t]hese commodities include children, prestige and esteem, health, altruism, envy, and pleasures of the senses, and are much smaller in number than the goods consumed" (pp. 24). The k th commodity, Z_k , is produced within the home using time inputs of the mother (t_{Mk}), time inputs of the father (t_{Fk}) and purchased goods and services (x_k).

$$Z_k = Z_k(t_{Mk}, t_{Fk}, x_k; E) \quad (B2)$$

E represents family endowments of non-market capital that determine the productivity

with which inputs can be combined to produce commodity output. If we think of children's school readiness as one of the commodities on which parental utility depends then in that case E will capture both the parents' ability in creating an environment conducive to child development, and also the child's innate characteristics.

Parents each face a time constraint, such that total time in non-market production and total hours of market work, h , sum to the total available

$$\sum_k t_{jk} + h_j = 1 \quad J = M, F \quad (B3)$$

Parents also face a budget constraint that states that the sum of expenditures on market goods must be equal to the sum of labour income and non-labour income, v .

$$\sum_k p_k x_k = w_M h_M + w_F h_F + v \quad (B4)$$

Maximisation of the utility function (B1), subject to the technological, time and spending constraints results is a set of demands for time in each activity by each parent, and for the goods used in the production of each commodity, all as a function of market and non-market endowments.

$$\begin{aligned} t_{jk}^* &= t_{jk}^*(w_M, w_F, v, E) \\ x_k^* &= x_k^*(w_M, w_F, v, E) \end{aligned} \quad (B5)$$

where w_j is the market wage rate of parent J .

The model gives a clear distinction between parental and child endowments of human capital, which define the constraints under which families operate, and parental choices, which are the outcome of the household decision-making process. Endowments consist not only of market capital, like wage rates and non-labour income, but also of non-market capital, or skills and abilities that determine the productivity with which a given set of inputs can be combined to produce output. We can define the 'full income' of the household as a function of this full set of endowments. Specifically, we can define an indirect household utility function in which the values of the commodities, Z_k , $k = 1, \dots, K$ are replaced by their equilibrium values, which are a function of exogenous endowments.

$$V = V(w_M, w_F, v, E) \quad (\text{B6})$$

Full income can be thought of as the maximum utility attainable by a household with a given set of endowments. This framework is useful for defining a number of hypotheses about the factors that would tend to be associated with paternal participation in childcare. In particular, we can assess whether paternal childcare is used more by families that are ‘wealthy’ in the sense of full income, or whether it tends to be decreasing in the full income of the household. Before we discuss the specific predictions of the model, we can say something further about the relative endowments of mothers and fathers, which in the basic model are all subsumed in E .

Becker’s theory of the division of labour argues that there are potential gains to intra-household specialisation along the lines of comparative advantage. Assuming that there are two sectors, market and domestic, an individual has a comparative advantage in market work if the ratio of their productivity in market work to their productivity in domestic work exceeds the ratio of their spouse. The potential gains to a division of labour create incentives to invest preferentially in human capital that raises productivity in the sector in which the individual anticipates they will spend the most time. Even without differences in human capital, household members may have an innate comparative advantage in one sector. For example, Becker argues that women have an innate advantage in the rearing of children, but stresses that this assumption is not necessary for the principle of comparative advantage to hold. The degree of specialisation that is optimal for the household will depend on the magnitude of comparative advantage, and also on the extent to which parental time inputs are complementary. Greater complementarities or decreasing returns in production of one individual’s time inputs will result in less specialisation in equilibrium. The key insight from this model is that the relative abilities of the mother and father will play a role in determining the optimal allocation of time, as well as the absolute levels of endowments.

B2. Hypotheses concerning the determinants of paternal childcare

The following section explores the relationship between family endowments and the

use of shared parental childcare in the early years. This gives us some insight into the kinds of factors that are associated with greater gender equality in childcare responsibilities. We can think of a number of hypotheses and common stereotypes about the type of couples who are likely to share parenting. Becker's theory suggests that the opportunity cost of an individual's time, as measured by their wage rate, will be negatively related to the amount of time allocated to non-market uses like childcare. This suggests that we are likely to see greater childcare responsibilities amongst low wage husbands, and husbands married to high wage women. The theory of the division of labour within households suggests that shared parenting will be less common where the gains to specialisation are larger. One factor affecting these gains will be the size of the husband's comparative advantage in market work. This will be smaller (and possibly negative) where the wife's relative earnings capacity in the labour market is higher, and where the wife's relative ability or productivity in childrearing is smaller. Hence we might expect that shared childcare is observed more frequently in households in which the wife has the higher wage of the two spouses, and also in households in which the wife's parenting ability is low, for example because of post-natal depression. Another factor affecting the gains to a division of labour is the size of the market. The number of dependent children in the household can be thought of as increasing the demand for total non-market production and so increasing the gains to a traditional division of labour.

Individual tastes, as well as productivity, play a role in determining the optimal allocation of spouses' time. Many fathers may gain utility directly from interacting with their children. Equally, many mothers may gain utility from engaging in other activities besides childcare such as market work, particularly if the utility of time with the child diminishes rapidly after long hours of care. In this case, we would expect the use of shared childcare to be related to attitudes towards parenthood, and also perhaps to parental education. This idea also suggests that, if time with children is a normal good, the demand for it will be increasing in the full income of the household. This speaks to one stereotype of couples who share childcare responsibilities, namely that they tend to be high-wage two-career couples who can afford to sacrifice some earnings in exchange for the pleasure generated by variety in the allocation of time.

An alternative scenario is that shared parenting is decreasing in the full income of the household. In this case, low income households may be forced to rely on the father for childcare because of the zero market cost of paternal care. If, for example, the father's attachment to the labour market is insecure and his earnings low, then shared parenting combined with maternal employment may be the optimal solution for the household, even if this option would be rejected when financial resources were greater. This speaks to the idea put forth by Averett et al (2005) that some fathers may provide care because of involuntary unemployment or unanticipated separation from the labour market, rather than because they are either good at it or enjoy it. It also suggests that the availability of other low cost childcare options such as grandparents may be negatively associated with the use of shared parental childcare.

B3. Associations between parent and child endowments and paternal childcare

The household production model in Section B1 makes clear that full income is a multi-dimensional concept. Families may be well off in terms of some endowments, like education, and simultaneously less well off in other dimensions, such as mental or physical health. In our multivariate analysis, and in this section, we distinguish between three types of parental endowments – household socio-economic resources, mother's personal characteristics and father's personal characteristics. We also explore descriptively differences in the average characteristics of children who do and do not experience paternal care. These four groups are carried forward directly into our analysis of the effects of paternal care on school readiness outcomes. We also include a fifth descriptive section on variables that are not considered determinants of children's development but that are of interest because they throw light on the circumstances in which parents adopt shared parental childcare. Tables 4 and 5 gives summaries of the construction of the variables used in regression analysis.

B3.1. Socio-economic endowments

Table B1 shows how family endowments of social and economic resources vary with the use of paternal childcare. These variables are largely ones that are available in comparable datasets and are frequently used as controls when estimating the impact of

some factor on children's development. Unless specified otherwise, the numbers in Table B1 are the proportion of each sample with the characteristic in question and stars relate to a t-test that the proportion is the same as in the low paternal childcare group. The two lines for each characteristic are the result of partitioning the sample first by paternal childcare in Year1, and then paternal childcare in Years 2&3. Differences between the two lines of results indicate that the composition of paternal care households changes with the age of the child.

First we examine how the wives of paternal carers differ in their educational attainment from other mothers. The relationship is not linear in that in general paternal carers are more likely to be married to mothers with moderately high educational attainment (equivalent to A-levels) and correspondingly less likely to be married to mothers with either lower qualifications or with a degree. It is noticeable, however, that these differences are not large, indicating that paternal care is not concentrated amongst the husbands of women with certain levels of educational capital. Turning to the father's education, we see that paternal carers are significantly less likely to have a degree than other fathers, but otherwise are not highly differentiated by educational attainment.

Data on wages are not available in ALSPAC, so we use occupational class as a proxy. Table B1 shows that the wives of paternal carers are more likely to be in managerial and technical occupations than other mothers, and correspondingly less likely to be in skilled manual or non-manual occupations. The exception is the wives of fathers who provide medium hours of care in Years 2&3. These wives are broadly similar in terms of occupation to mothers who assume full responsibility for parental childcare. It is noticeable that paternal carers are no more or less likely to be married to women in professional occupations, or in low-skilled occupations, than other fathers.

Fathers providing medium hours of care in Year 1 are less likely to be in professional, managerial or technical occupations and more likely to be in skilled manual or non-manual work, although this is less true for fathers who provide medium hours of care after the first year. Fathers who provide long of hours of care are also less likely to be

in higher-class occupations, but in this case are noticeably more likely to be in relatively unskilled, rather than skilled, occupations.

Paternal carers are generally younger than other fathers and more likely to be aged under 30. We find greater differences in paternal care by the mother's age. Fathers providing long hours of care are more likely to be married to women aged under 25 than other fathers and less likely to be married to women aged 30-34. Fathers providing medium hours of care in Year 1 are also less likely to be married to women aged 30 or above, but in this case they are drawn disproportionately from households in which the mother is aged 25-29 rather than under 25.

The Index of Multiple Deprivation (IMD) for the family's ward of residence at the time of the birth provides a measure of the quality of the local environment and the family's access to services. Overall, the households in our sample are disproportionately drawn from the least deprived quartile. However, paternal care households are substantially less likely to be located in the most affluent areas. This is particularly true of households in which fathers provide long hours of care, which are noticeably more likely to be located in the most deprived areas. Fathers who provide medium hours of care are no more likely to be in the most deprived areas than non-caring fathers, although on average they come from slightly less affluent neighbourhoods.

Mothers in our selected sample of intact families are less likely to fall into the highest 10% of those reporting financial difficulties in pregnancy than other mothers, but we find no evidence of large differences in this subjective measure of financial hardship between paternal childcare households and non-paternal childcare households. Another measure of parental resources is housing tenure in Year 2. Fathers providing long hours of care in Year 2 & 3 are less likely to live in owner-occupied housing, but this is not the case either for fathers providing care in Year 1, or for fathers who provide medium hours of care at either age.

We use the mother's social networks score to explore whether paternal childcare is

related to the availability of other family members who could potentially provide childcare. As shown in Table B1, we find no evidence that fathers are less likely to provide care when the mother has strong social networks, or conversely that they are more likely to provide care when the mother has limited social resources outside the family.

We find no evidence that fathers are significantly more likely to care for sons or daughters, although the figures suggest that fathers are perhaps slightly more likely to provide long hours of care for sons rather than daughters in Year 1. In terms of birth order and family size, children cared for by their fathers are more likely to be first-born and to have fewer siblings by their 4th birthday. This is the case for all types of paternal care, regardless of the hours of care or the age of the child. Finally, we find no substantial differences in the ethnic composition of children cared for by their fathers although non-white children only make up a small 3 percent of our sample.

To summarise our findings in this section, we do find that children who are cared for by their fathers are a select sample in terms of family socio-economic resources. They are less likely to have degree-educated parent and tend to have younger parents and fewer siblings. Children who experience long hours of paternal care in particular are drawn from households with fewer resources. They are more likely to have mothers aged under 25, fathers in low skilled occupations and to live in deprived neighbourhoods, and are less likely to live in owner-occupied housing. These findings are largely in accord with the idea that fathers for whom the opportunity cost of time is lower (i.e. who have lower wages) are more likely to devote time to caring for children. We would also expect the gains to maternal specialisation in childcare to increase with the number of children in the household, and we do indeed find that shared parenting is less common in larger size families. Lack of access to alternative forms of childcare, particularly low cost or free childcare may also predict the use of paternal care, given our finding that paternal care is more common in deprived neighbourhoods. However, we do not find any evidence that paternal childcare is associated with more limited maternal social networks. Finally, we feel it is important to emphasise that despite the differences detailed above, paternal childcare is not

concentrated in any one narrowly defined type of household. The figures in Table B1 show that there are substantial numbers of paternal carers in all types of household, including affluent households in which parents have degrees and professional careers, and those located in better neighbourhoods.

B3.2. Father's personal endowments

The characteristics explored in Table B1 capture endowments that are commonly observed by researchers. Less commonly observed are the personal endowments of individuals such as physical and mental health and innate attitudes or behaviours. We recognise the possibility (raised by e.g. Newcombe, 2003) that there may be reverse causation running from employment and childcare decisions to mental and physical health, but consider that post-natal depression in particular, but also potentially other health problems, are likely to be beyond the control of the individual. We also include a number of attitudinal variables, but restrict these to measures that were collected prior to the birth of the child in order to rule out the possibility that they reflect attitudes acquired during the experience of parenting.

Table B2 shows how the average personal attributes of fathers differ according to their assumption of childcare responsibilities. We find little evidence that paternal carers differ in their physical or mental health from other fathers, although fathers providing medium hours of care in Years 2&3 appear to have slightly better outcomes along both dimensions. This finding is of interest because Averett et al (2005) suggest that their finding of poorer cognitive outcomes among children who experience paternal care may be explained by the more unstable employment of their fathers. This could result if, for example, unemployment causes psychological strain on fathers. The effect would be compounded if childcare responsibilities further conflict with ideas about appropriate masculine gender roles. The results in Table B2 do not provide any support for this hypothesis for the fathers in our sample.

We explore whether fathers who provide paternal care do so in part because they have more interest or ability in child rearing using several variables, namely whether the father was present at the birth of the child, whether the father attended antenatal

classes, and the father's feelings about the mother's pregnancy prior to the birth. We find that fathers who provide long hours of childcare appear to have more positive parenting orientations than non-caring fathers as measured by the latter two of these variables. This is also true to a lesser extent for fathers who provide medium hours of care in Years 2&3, but not for those who provide medium hours of care in Year 1. We do not, however, find any differences in attendance at the birth of the child.

A number of other paternal attributes are shown in Table B2. Fathers who provide childcare are slightly more likely to smoke in the pre-birth period than other fathers, although this result is not uniform across all types of care. Fathers providing long hours of care are significantly more likely to drink alcohol never or only very occasionally, but this is not the case for those providing medium hours of care. We also find other differences in the attributes of caring fathers that are restricted only to those who supply long hours of childcare. These fathers tend to regard their own schooling as a less valuable experience than other fathers, and also to have a more external locus of control.

Overall, the data in Table B2 give a mixed picture of the relative attributes of fathers who provide early years childcare. On one hand, they are, on average, equally as healthy as other fathers both physically and mentally and seem to be more oriented towards an active parenting role. In addition, fathers who provide long hours of care are less likely to drink alcohol on frequent occasions. On the other hand, they are slightly more likely to smoke and have more negative attitudes both towards schooling and towards the degree to which their own actions can influence their environment.

B3.3 Mother's personal characteristics

Table B3 provides a breakdown of a similar set of maternal characteristics. Here we find that, on average, the wives of men providing care in Years 2&3 tend to be less healthy as measured in Year 3 than other mothers. The fact that we find no such health differences in Year 1 between these groups of mothers raises the possibility that later paternal care is chosen in part in response to time-varying maternal health

problems that affect the mother's ability to provide childcare. However, there is also the possibility that mothers who participate in the labour market have poorer health due to the stresses of combining work and motherhood, and it is this effect we are picking up. Note though that we find no relationship between the amount of paternal childcare in Year 1 and mother's health measured either contemporaneously, or measured two years later.

The possibility that some fathers assume childcare responsibilities because mothers are affected by post-natal depression is an intuitively appealing one. The Royal College of Psychiatrists estimates that around 1 in 10 women suffer post-natal depression following a birth and that the causes of post-natal depression are little understood and likely to be complex. For this reason we pay careful attention to the wealth of psychological instruments in ALSPAC designed to measure maternal depression and other mental health problems, and, in contrast to fathers, explore the time-varying dimension of maternal mental health. We find that on average, more women are classified as being at risk of depression in pregnancy than after the birth on the EPDS measure. The wives of men who later assumed responsibility for long hours of childcare were more likely to be at risk in pregnancy than other mothers. The timing here suggests that this reflects selection in the type of mothers who share childcare with the father, rather than a causal effect. Turning to scores for Year 1, we find no association between paternal childcare in that period and maternal EPDS, even though the wives of men providing long hours of care were more likely to be depressed prior to the birth. We do find, however, that paternal carers in Years 2&3 are more likely to have wives with high depression scores in Year 1. Again this is likely to reflect selection, for example because career-oriented mothers who postpone re-entry to the labour force until Years 2 or 3 suffer psychologically from their lack of contact with the labour market. If fathers were assuming care responsibilities because mothers were unable to care for the child themselves, then we would expect to see an association between paternal care in Year 1 and Year 1 EPDS, which is not the case.

Our results using the broader CCEI measure of mental health are in line with those using the EPDS: the wives of husbands providing long hours of care in either period

tend to have higher depression scores in pregnancy, and paternal care in Years 2&3 is associated with higher scores in Year 1. We find no association, however, between maternal CCEI scores in Year 2 and paternal childcare in that period or earlier. As a final way of tackling this issue, we explore mother responses to a question asked in Year 4 about whether she had ever felt unattached to the study child. We find no substantial differences in responses to this question by paternal childcare status in either period. Overall then, we find little support for the hypothesis that post-natal depression is an important factor in explaining the incidence of paternal childcare in the first 3 years. None of the differences in mean maternal mental health measures shown in Table B3 are large in magnitude. Where we do find differences, the timing of the mental health and paternal care measures suggests that we are picking up selection rather than a causal influence of maternal depression of paternal childcare responsibilities. In particular, we do not find any association between contemporaneous mental health and paternal care. Our results do imply, however, that the wives of paternal carers tend to have slightly poorer mental health than other mothers.

The remaining maternal attributes in Table B3 correspond to the paternal attributes detailed in Table B2. Unlike the case for fathers, we find no evidence of differences in mother's feelings in pregnancy about the impending birth of the child, nor in locus of control or pre-birth alcohol consumption. However, in a similar way to fathers, mothers in some types of paternal care households are more likely to attend antenatal classes, but also more likely to smoke in pregnancy and to have relatively negative attitudes towards their schooling. The data in Table B3 suggest overall that the wives of paternal carers are not a highly selected group in terms of their personal attributes. With the exception of antenatal class attendance, the mothers in paternal care households tend to have slightly more negative characteristics than other mothers, but these differences are not large.

B34.. Child endowments (6 months or younger)

Table B4 details the average differences in our early child controls by paternal care status. We explore these differences separately for boys and girls, both because the

innate characteristics of boys and girls are likely to differ, and because parents may respond differently to a given attribute depending on the gender of the child. The top panel shows differences in characteristics at birth such as birthweight and whether the child was pre-term. We find no evidence that fathers are more or less likely to care for children who began life with health deficits as measured by these variables. We also find few differences in mother-reported general child health in the first 6 months, although it seems that children who were cared for by the father for long hours in Years 2&3 did tend to be slightly unhealthier in this early period, and this is the case for both boys and girls.

The second panel of Table B4 shows the scores of nine dimensions of temperament, derived from the Infant Temperament Questionnaire. All scores on these, and on the development measures, were normalized to mean 100, standard deviation 10 on the full sample of all children for whom data is available. The meaning of the nine dimensions of temperament is detailed more fully in Table 5. Research suggests that temperament traits tend to be grouped into one of three patterns or constellations: the ‘easy child’, the ‘difficult child’ and the ‘slow to warm up child’, although around a third of children cannot be classified as any one of these three. In all the temperament scores shown in Table B4 higher scores indicate temperaments that are associated with more behavioral difficulties.

One striking feature of the temperament data is that we generally only find differences in the types of children who are cared for by their fathers in Years 2&3, despite the fact that temperament is measured at the age of 6 months. Children experiencing paternal care in the first year of life differ little in terms of temperament from other children. One exception is that boys who were cared for by their fathers for long hours in Year 1 had slightly higher activity scores at 6 months than other boys, indicating that they were more fidgety and less likely to be still and quiet, but this was not the case for girls in the same type of paternal care. The other exception is that children of both genders experiencing medium hours of paternal care in Year 1 tended to show slightly more regularity (rhythmicity) in bodily functions like becoming hungry and falling asleep than other children.

We do find some evidence that fathers who provide care after the first year of life are more likely to do so for ‘easy’ rather than ‘difficult’ children. Many of these effects are restricted to the differential temperaments of sons rather than daughters. For example, boys experiencing paternal care in Years 2&3 tended to respond to new people or situations in a more positive, rather than in a shy, way at 6 months compared with other boys, as captured by the approach score. They also tended to have slightly more pleasant, friendly dispositions as captured by the mood score. Boys experiencing long hours of paternal care in this period also tended to be more adaptable in infancy with regard to changed circumstances, and to be slightly more persistent, that is to continue with activities over a period of time without losing interest or becoming frustrated. The only differences for daughters are that girls experiencing medium hours of paternal care in Years 2&3 tended to express their feelings in a slightly more intense, energetic way and, like boys, to be more persistent at 6 months. Finally, higher threshold scores indicate that girls who spent long hours in the care of their fathers in Years 2&3 tended to respond more readily in infancy to changes in the environment or external stimuli.

The timing of the effects shown in Table B4 suggests that fathers may be more likely to provide care for sons with easier, rather than more difficult, dispositions. The fact that we do not find a strong relationship between temperament and childcare arrangements that occur contemporaneously is evidence against a reverse causation interpretation and in favour of the hypothesis that parental decisions respond to the innate tendencies of their children. If it the case that fathers care preferentially for easier children, or equivalently, that mothers care more for more difficult children, failure to control for these differences would bias the estimated effect of paternal care upwards. This said, the average differences in temperament shown in Table B4 are not large, and we would not expect them to drive the unconditional relationship between paternal childcare and school readiness.

The remaining variables in Table B7 are scores derived from the Denver Developmental Screening Test. Interestingly, boys who are in the care of their fathers for long hours in Year 1 score uniformly higher on all four sub-scores than boys

experiencing less paternal care. Boys cared for by their fathers for long hours later on, when they are toddlers, also tended to have better gross and fine motor skills in infancy. We find no difference in the developmental abilities of boys at 6 months between those who experienced medium hours of care and those who experienced little or no paternal care, and virtually no differences in the abilities of girls with any type of parental care.

The direction of association between long hours of paternal care and boys' development is unclear, and as these measures are likely to reflect environmental influences to a greater degree than the temperament measures we do not emphasise these findings. However, what we conclude overall from Table B4 is that there is no evidence at all that fathers care preferentially for children with health or developmental difficulties, or for children who are less sociable or who do not respond well to non-parental carers. In fact, the balance of the evidence suggests that, if anything, fathers may be entrusted with the care of better-adjusted, more able children. This is more true for sons than for daughters, in whom we find fewer differences in infancy according to paternal care status.

B3.5. Other correlates of paternal childcare

Table B5 provides a breakdown of a number of household characteristics that do not fall into one of our groupings of selection controls. They are not included in our multivariate analysis, but do throw light on several hypotheses concerning the determinants of paternal childcare.

One implication of the theory of the intra-household division of labour discussed in Section B1 is that we might expect paternal childcare to be more common in households in which the husband's traditional advantage in market earnings capacity is smaller, or even negative. As noted above, we do not observe individual's wages in ALSPAC, but an individual's educational attainment and occupational class are likely to be strong predictors of their potential earnings capacity. Table B5 details the relationship between paternal childcare and the *relative* human capital stocks of the mother and father. In accordance with the theory we find that fathers are who provide

childcare are significantly more likely to be partnered with women who have higher educational attainment and occupational class than themselves, and that these differences are really quite large. The parallel finding, that fathers providing childcare are less likely to be the higher earner of the two parents, is smaller in magnitude. This implies that a reduction in the husband's earnings advantage does not make the choice of paternal childcare substantially more likely until it becomes negative, that is, until the wife's wage exceeds that of her husband. This is consistent with the notion that women have a productivity advantage in childrearing, whether for biological or cultural reasons. At equal wage rates the mother still has an overall comparative advantage in domestic production. It is only when she has an outright advantage in market work that this comparative advantage reverses. The exception to this seems to be fathers who provide medium hours of care in Year 2&3. This type of care is not strongly linked to relative earnings capacities of the parents, and may reflect differences in tastes more than differences in productivity.

Further evidence on this issue is provided by information on the way non-childcare housework tasks are divided between spouses. If paternal childcare reflects simply tastes on the part of fathers for time with the child, we might expect that other housework tasks such as cleaning and cooking, which are traditionally strongly gender-typed, will be unaffected. If, however, paternal childcare reflects a genuine shift in the division of labour, then childcare-providing husbands may also share non-childcare tasks more equally. The data in Table B5 suggests that this latter explanation is in fact the case. In Year 2, both parents completed identical questions about which spouse was responsible for grocery shopping, cooking and cleaning the home. We coded responses from -2 for 'husband always' to 2 for 'wife always' and averaged over the three types of task. Both mother and father reports are in agreement that the gender division of these housework tasks is more equal in households in which fathers provide childcare, although on average the figure is always positive, indicating that wives have primary responsibility for these tasks. It is interesting that although both parents' responses show the same trend, in general mothers tend to attribute less responsibility for housework to their husbands than do fathers themselves. Comparison of these data on a

restricted sample showed that this finding does not solely reflect bias arising from non-random response to the fathers' questionnaire (see Section 3.5).

Table B5 also contains some information about the work schedules of parents. As discussed in Section 4, we do not include parental employment in our multivariate analysis because it is a proxy measure for other determinants of child outcomes that are directly observed in our data. We have also argued that the characterization by many researchers of parental employment patterns as exerting a causal influence on childcare responsibilities is misguided if employment and childcare decisions are made simultaneously. However, given the empirical regularity that paternal childcare is associated with shift-working and non-traditional employment schedules it is of interest to see if this feature is also found in the ALSPAC data.

Amongst working mothers, hours of paid work in both Year 2 and Year 3 are slightly longer where the father provides regular childcare (mothers' work hours in Year 1 are not available). Evening and weekend working are extremely common amongst all working mothers of children under 3, but strikingly more common in paternal care households. Paternal care is negatively associated with maternal working from home and strongly positively associated with maternal jobs that involve a relatively high degree of physical effort. Fathers who both work and provide childcare do tend to work slightly fewer hours than other fathers, as captured by a self-reported variable in Year 1 (the only available data on fathers' work hours). It is noticeable, however, that even where working fathers provide 16 or more hours a week of childcare, on average their market work hours per week still exceed 40. Hence we do not find evidence that working fathers modify their allocation of time to market work in anything more than very minor ways. Fathers with childcare responsibilities are more likely than other working fathers to work in the evenings/at night and are less likely to have jobs that require them to be away from home for days at a time. Altogether, this evidence is consistent with previous findings that shared parenting is strongly associated with non-standard working patterns of employed parents. Paternal childcare seems to be associated with a high degree of 'juggling' by parents, who find it difficult to fulfill both work and childcare commitments within a standard 9-to-5 schedule.

The remaining variables in Table B5 relate to the hypothesis that fathers providing childcare may be a negatively-selected group who provide temporary care following involuntary job loss. As noted above, this idea is put forward by Averett et al (2005) as a potential explanation for their finding that paternal care is associated with poorer outcomes among the children of working mothers. To get a handle on this, we explore a 'life event' question completed by the mother in each of the first 3 years regarding whether her partner lost his job in the preceding year. We find no evidence that paternal carers are substantially more likely to have suffered job loss than other fathers. It may be that some fathers in this group were able to find another job relatively quickly, so that it is not a good marker for unanticipated involuntary unemployment. We therefore take the sub-set of responses in which the mother indicated that the family was 'strongly affected' by the father's job loss, but again find little evidence that this is a primary driver behind fathers' adoption of primary childcare responsibilities. Mothers were also asked in pregnancy about the type of childcare arrangements they planned to use following the birth. Planning to use the father is very strongly associated with realized post-birth paternal care. These findings, together with the evidence that caring fathers are no more likely to be depressed than other fathers, and that they tended to have relatively positive attitudes to fatherhood during the pregnancy, lead us to conclude that there is little support for the hypothesis that paternal carers are disproportionately 'deadbeat' dads.

Table B1: Average differences in family social and economic endowments between paternal care and non-paternal care households

	All	Low paternal care sample	Medium paternal care sample	High paternal care sample
Mother's education: CSE/none	0.12	0.12 0.11	0.12 0.13	0.15 * 0.12
Mother's education: Vocational/O-level	0.43	0.45 0.47	0.42 0.42 **	0.39 ** 0.41 **
Mother's education: A-level	0.27	0.24 0.24	0.31 ** 0.27 **	0.31 ** 0.31 **
Mother's education: Degree	0.18	0.19 0.19	0.15 ** 0.18	0.15 ** 0.16 *
Father's education: CSE/none	0.17	0.16 0.16	0.18 * 0.16	0.18 0.18
Father's education: Vocational/O-level	0.30	0.29 0.28	0.31 0.30	0.33 * 0.34 **
Father's education: A-level	0.30	0.30 0.30	0.31 0.32	0.29 0.27 *
Father's education: Degree	0.24	0.26 0.26	0.20 ** 0.23 *	0.20 ** 0.21 **
Mother's occupational class: Semi/unskilled	0.09	0.08 0.08	0.10 * 0.09 *	0.09 0.11 **
Mother's occupational class: Skilled manual/non-manual	0.48	0.50 0.51	0.44 ** 0.48	0.45 * 0.41 **
Mother's occupational class: Managerial/technical	0.35	0.33 0.33	0.40 ** 0.35	0.38 * 0.40 **
Mother's occupational class: Professional	0.08	0.08 0.09	0.07 * 0.07	0.09 0.08
Father's occupational class: Semi/unskilled	0.10	0.09 0.08	0.12 ** 0.10 *	0.13 ** 0.14 **
Father's occupational class: Skilled manual/non-manual	0.39	0.37 0.38	0.42 ** 0.38	0.40 0.41
Father's occupational class: Managerial/technical	0.38	0.39 0.39	0.35 ** 0.38	0.35 * 0.35 *
Father's occupational class: Professional	0.14	0.15 0.16	0.12 ** 0.14 *	0.12 * 0.11 **
Father's age at birth: <25	0.05	0.05 0.05	0.06 * 0.05	0.06 0.07 *
Father's age at birth: 25-29	0.31	0.30 0.30	0.34 ** 0.32 *	0.34 * 0.31
Father's age at birth: 30-34	0.38	0.38 0.40	0.37 0.36 *	0.37 0.38

Father's age at birth: 35-39	0.17	0.19 0.18	0.15 ** 0.18	0.16 * 0.16
Father's age at birth: 40 or more	0.09	0.09 0.08	0.08 0.09	0.08 0.08
Mother's age at birth: <20	0.01	0.01 0.00	0.01 0.01	0.01 0.01 *
Mother's age at birth: 20-24	0.11	0.10 0.09	0.11 0.11 *	0.16 ** 0.13 **
Mother's age at birth: 25-29	0.41	0.39 0.39	0.46 ** 0.42	0.40 0.42
Mother's age at birth: 30-34	0.36	0.37 0.38	0.33 ** 0.35 *	0.32 ** 0.33 **
Mother's age at birth: 35 or more	0.12	0.13 0.13	0.10 ** 0.12	0.12 0.11
IMD of ward at birth: Lowest quartile in England	0.38	0.40 0.42	0.34 ** 0.37 **	0.33 ** 0.30 **
IMD of ward at birth: 2 nd lowest quartile in England	0.23	0.23 0.22	0.26 * 0.24	0.24 0.24
IMD of ward at birth: 2 nd highest quartile in England	0.20	0.19 0.19	0.21 0.20	0.19 0.20
IMD of ward at birth: Highest quartile in England	0.20	0.18 0.18	0.20 0.19	0.25 ** 0.25 **
Financial difficulties pre-birth: Highest 10%	0.06	0.06 0.06	0.06 0.07	0.08 0.07
Housing tenure in Year 2: Owner-occupier	0.89	0.89 0.90	0.90 0.89	0.87 0.85 **
Housing tenure in Year 2: Social housing	0.07	0.07 0.06	0.06 0.07	0.08 0.09 **
Housing tenure in Year 2: Other	0.05	0.05 0.05	0.05 0.05	0.05 0.07 *
Mother's social networks score (0-30) (mean)	23.8	23.7 23.7	24.0 ** 23.8	23.7 23.9
Child is a boy	0.51	0.51 0.52	0.50 0.51	0.55 0.51
Birth order (first-born = 0) (mean)	0.77	0.80 0.82	0.69 ** 0.73 **	0.70 ** 0.74 **
Number of under 16s in household at age 4 (mean)	2.29	2.33 2.36	2.24 ** 2.26 **	2.20 ** 2.23 **
Child is non-white	0.03	0.02 0.02	0.02 0.02	0.04 0.04 *

Numbers are the proportion of the sample with the given characteristic unless marked (mean), in which case number is the mean value for the sub-sample. The two lines for each variable give results partitioning the sample by:

Paternal childcare in **Year 1**

Paternal childcare in **Years 2 & 3**

Stars relate to t-test that mean for group is equal to mean for low paternal childcare group (** = $p < 0.01$; * = $p < 0.05$)

Table B2: Average differences in father's personal endowments between paternal care and non-paternal care households

	All	Low paternal care sample	Medium paternal care sample	High paternal care sample
Father's health in Year 1 (1-4, 4 healthiest) (mean)	3.47	3.47 3.45	3.49 3.49 *	3.48 3.49
Father's health in Year 3 (1-4, 4 healthiest) (mean)	3.38	3.37 3.37	3.40 3.38	3.38 3.39
Father's mental health: mean CCEI (pre-birth-Year 2) (mean, self-report, scored 0-46)	6.76	6.80 6.97	6.64 6.57 **	6.74 6.73
Father ever suffered anxiety/depression in 1 st 3 years	0.31	0.32 0.32	0.30 0.31	0.32 0.30
Father's feelings about impending birth (mean, measured pre-birth, scored 0-2)	1.28	1.27 1.25	1.27 1.29 *	1.33 * 1.31 **
Father attended antenatal class	0.34	0.33 0.31	0.35 0.36 **	0.39 ** 0.37 **
Father was present at birth of child	0.93	0.93 0.93	0.94 0.93	0.94 0.93
Father smokes (measured pre-birth)	0.29	0.27 0.27	0.32 ** 0.29	0.30 0.32 **
Father drinks alcohol less than once a week (measured pre-birth)	0.31	0.31 0.30	0.29 0.31	0.37 ** 0.35 **
Father drinks alcohol every day (measured pre-birth)	0.19	0.19 0.20	0.19 0.19	0.16 * 0.17
Father's locus of control (mean, measured pre-birth, self-report, higher scores denote more external locus)	3.44	3.38 3.33	3.51 3.41	3.61 * 3.70 **
Father found school a valuable experience (mean, measured pre-birth, self-report, scored 1-5)	3.85	3.88 3.92	3.82 3.87	3.78 * 3.70 **

See notes to Table B1.

Table B3: Average differences in mother's personal endowments between paternal care and non-paternal care households

	All	Low paternal care sample	Medium paternal care sample	High paternal care sample
Mother's health in Year 1 (1-4, 4 healthiest) (mean)	3.26	3.26 3.27	3.27 3.25	3.22 3.26
Mother's health in Year 3 (1-4, 4 healthiest) (mean)	3.47	3.46 3.50	3.48 3.45 **	3.44 3.43 **
Mother's mental health: EPND >=12 in pregnancy	0.20	0.20 0.19	0.20 0.21	0.24 ** 0.23 *
Mother's mental health: EPND >=12 in Year 1	0.16	0.15 0.14	0.17 0.17 **	0.17 0.17 **
Mother's mental health: mean CCEI in pregnancy (mean, scored 0-46)	13.4	13.2 13.1	13.4 13.5	14.1 ** 13.7 *
Mother's mental health: mean CCEI in Year 1 (mean, scored 0-46)	15.2	15.1 15.0	15.4 * 15.4 **	15.4 15.4 **
Mother's mental health: CCEI in Year 2 (mean, scored 0-46)	11.1	11.1 11.0	11.0 11.2	11.3 11.2
Mother ever felt unattached to child (measured in Year 4)	0.07	0.07 0.06	0.07 0.07 *	0.08 0.07
Mother's feelings about impending birth (mean, measured pre-birth, scored 0-2)	1.30	1.31 1.30	1.29 1.30	1.28 1.31
Mother attended antenatal class	0.64	0.62 0.62	0.65 0.65 *	0.67 ** 0.64
Mother smoked during pregnancy	0.16	0.15 0.14	0.19 ** 0.16	0.17 0.20 **
Mother drank alcohol less than once a week before pregnancy	0.43	0.44 0.43	0.41 0.43	0.44 0.44
Mother drank alcohol every day before pregnancy	0.11	0.11 0.11	0.12 0.12	0.11 0.10
Mother's locus of control (mean, measured pre-birth, higher scores denote more external locus)	3.91	3.89 3.86	3.96 3.93	3.94 4.00
Mother found school a valuable experience (mean, scored 1-5)	3.97	3.99 3.98	3.96 3.98	3.87 ** 3.92

See notes to Table B1

Table B4: Average differences in early child characteristics (6 months or younger) between paternal care and non-paternal care households

	All	Low paternal care	BOYS Medium paternal care	High paternal care	All	Low paternal care	GIRLS Medium paternal care	High paternal care
Gestation < 37 weeks	0.05	0.05 0.05	0.06 0.05	0.04 0.05	0.04	0.04 0.04	0.05 0.04	0.03 0.05
Birthweight < 2.5 kg gestation >= 37 weeks	0.02	0.02 0.02	0.02 0.02	0.02 0.02	0.02	0.02 0.02	0.01 0.03	0.02 0.01
Birthweight (kg) (mean)	3.49	3.50 3.50	3.45 3.47	3.52 3.51	3.39	3.39 3.41	3.39 3.38	3.40 3.37
Special Care Unit at birth	0.07	0.07 0.06	0.08 0.08	0.06 0.08	0.05	0.05 0.04	0.04 0.05	0.04 0.05
Child's health in 1 st 6 mths (mean, 1-4, 4 healthiest)	3.54	3.54 3.56	3.53 3.55	3.53 3.46 **	3.60	3.61 3.61	3.59 3.62	3.56 3.55 *
Temperament at 6 mths								
Activity	100.8	100.6 100.7	100.7 100.6	101.8 * 101.4	100.1	100.1 99.9	99.9 100.0	100.0 100.4
Rhythmicity	99.8	100.1 100.2	99.0 * 99.5	99.8 99.8	99.8	100.1 100.1	98.8 ** 100.0	100.7 99.2
Approach	98.9	99.0 99.7	98.8 98.6 **	98.6 98.1 **	100.6	100.6 100.3	100.7 100.9	100.5 100.5
Adaptability	99.1	99.2 99.6	99.1 98.9	98.9 98.7 *	99.9	99.7 99.6	100.5 100.2	99.8 99.9
Intensity	100.0	100.0 100.0	100.3 99.8	99.9 100.6	99.8	99.6 99.3	100.4 100.1 *	99.7 100.2
Mood	100.0	100.2 100.6	99.9 99.8 *	99.7 99.4 *	100.6	100.7 100.7	100.4 100.7	100.3 100.2
Persistence	99.8	99.7 100.2	100.3 99.7	99.3 99.1 *	99.7	99.9 100.3	99.3 99.5 *	99.7 99.3
Distractability	100.0	100.1 100.2	100.1 99.9	99.4 99.8	99.8	99.8 99.6	99.4 100.1	100.4 99.6
Threshold	99.2	99.3 99.3	99.3 99.1	98.9 99.3	100.2	100.1 100.0	100.9 100.2	99.9 101.0 *
Development at 6 mths								
Social skills	99.2	99.1 99.3	98.6 99.0	100.9 ** 99.4	99.7	99.4 99.6	100.1 99.6	100.0 99.9
Fine motor skills	98.5	98.0 98.0	98.7 98.4	100.5 ** 99.5 **	99.9	99.7 99.9	100.0 99.8	100.7 100.1
Communication skills	99.0	98.8 99.0	99.2 98.7	99.9 * 99.6	99.3	99.0 99.2	99.6 99.2	100.4 * 99.8
Gross motor skills	99.1	98.7 98.6	99.1 99.1	101.1 ** 100.2 **	99.4	99.2 99.5	99.5 99.4	99.7 99.0

See notes to Table B1

Table B5: Average differences in other family characteristics between paternal care and non-paternal care households

	All	Low paternal care sample	Medium paternal care sample	High paternal care sample
Mother has higher education than father	0.23	0.21 0.21	0.27 ** 0.24 *	0.27 ** 0.28 **
Father has higher education than mother	0.31	0.32 0.32	0.29 * 0.32	0.31 0.29 *
Mother has higher occupational class than father	0.22	0.19 0.19	0.27 ** 0.21	0.29 ** 0.29 **
Father has higher occupational class than mother	0.34	0.36 0.36	0.30 ** 0.34	0.31 * 0.29 **
Responsibility of non-childcare housework in Year 2 (-2 = all father, 2 = all mother, mother-report, mean)	0.98	1.04 1.15	0.91 ** 0.93 **	0.77 ** 0.76 **
Responsibility of non-childcare housework in Year 2 (-2 = all father, 2 = all mother, father-report, mean)	0.74	0.80 0.88	0.68 ** 0.72 **	0.58 ** 0.55 **
Mother's average weekly hours of market work: Year 2 (sample in work at survey date only)	20.5	19.7 19.8	20.6 19.1	23.3 ** 23.5 **
Mother's average weekly hours of market work: Year 3 (sample in work at survey date only)	20.6	19.6 19.2	20.9 ** 19.1	23.7 ** 24.6 **
Mother ever worked weekends (sample ever in work 1 st 3 years)	0.54	0.46 0.42	0.67 ** 0.56 **	0.60 ** 0.64 **
Mother ever worked evenings/nights (sample ever in work 1 st 3 years)	0.59	0.53 0.47	0.71 ** 0.63 **	0.66 ** 0.70 **
Mother ever worked from home (sample ever in work 1 st 3 years)	0.16	0.19 0.22	0.12 ** 0.16 **	0.14 ** 0.11 **
Mother's job required physical effort (sample ever in work 1 st 3 years)	0.41	0.35 0.32	0.51 ** 0.41 **	0.48 ** 0.52 **
Father's average weekly hours of market work: Year 1 (sample in work at survey date only, self-report)	44.72	45.35 46.15	43.44 ** 44.23 **	43.84 ** 43.20 **
Father ever worked evenings/nights (sample ever in work 1 st 3 years)	0.31	0.29 0.28	0.36 ** 0.31 *	0.31 0.38 **
Father ever away for days due to work (sample ever in work 1 st 3 years)	0.48	0.50 0.52	0.44 ** 0.46 **	0.45 * 0.41 **
Father lost job is 1 st 3 years	0.15	0.15 0.14	0.15 0.16	0.17 0.17 *
Father lost job in 1 st 3 years and family was 'strongly affected'	0.07	0.07 0.06	0.08 0.07	0.07 0.08 **
Mother planned to use father for childcare during pregnancy	0.16	0.09 0.07	0.32 ** 0.18 **	0.28 ** 0.31 **

See notes to Table B1

Appendix C: Associations between paternal childcare and child's home environment

This section explores a number of factors that may mediate the relationships between paternal childcare and child outcomes. The variables used in this section are conceptually distinct from the endowment controls used thus far in that there is a significant possibility of reverse causation running from paternal childcare to these potentially endogenous regressors. This section explores descriptively how a number of dimensions of the child's environment differ with the use of paternal childcare. As before, we organize our variables into groups that are then introduced one at a time into our multivariate analysis, and also explore a number of additional features that are not included in the child outcome regressions. Details of the construction of all environmental controls used in the regression analysis are given in Tables 12 and 13.

C1. Household income

Table C1 shows how the first of our first dimensions of the child's environment, disposable household income, varies with paternal childcare status. We characterize household income as potentially endogenous because it reflects employment decisions that are made simultaneously with childcare decisions. Its association with paternal childcare is not clear a priori – the positive association of income with the greater maternal supply in paternal childcare households is balanced by the negative association of income with lower paternal labour supply. Table C1 shows that there is no strong unconditional relationship between paternal care and household income. Income tends to be slightly lower, on average, the greater the hours of paternal care, but this relationship is only significant for households in which fathers provide long hours of care in Years 2&3. This is perhaps not surprising as parents choose the allocation of time optimally and are unlikely to choose options that have serious deleterious consequences for household income.

C2. Parental relationship quality

Another potential explanatory factor is the quality of the parental relationship, or alternatively, the degree of family conflict. Parental childcare may be a marker for a more harmonious parental relationship, which has been shown to be associated with beneficial outcomes in children (e.g. Cummings and O'Reilly, 1997). We explore these ideas using a number of variables derived from mother reports about the nature of her

relationship with her spouse. To explore whether children in non-paternal care households are at greater risk of family conflict we use a score derived from 6 questions about the frequency that rows occur between the mother and her spouse, administered in Year 2 and in Year 3. Table C2 shows that, somewhat surprisingly, family conflict is more common in households in which the father assumed primary childcare responsibilities in the first year of life. We find no relationship between parental conflict and the use of paternal childcare in the later period that is concurrent with the conflict measure.

Our second measure of relationship quality is derived from 7 questions on how the mother rates her satisfaction with various aspects of the parental relationship. We find that paternal care in Years 2 & 3 is associated with greater maternal satisfaction with the relationship, but find no association between care in infancy and maternal satisfaction. The third measure relates to the frequency that the parents engage in leisure activities outside the home. We find that paternal childcare is strongly associated with greater shared parental activities outside the home. That we find this for paternal care in Year 1, as well as in Years 2&3 suggests that this may reflect a selection effect, rather than a causal influence of paternal childcare on the parents' relationship. Our final measure of relationship quality relates to the degree of communication between the spouses. We find that in general paternal childcare is associated with better communication between parents, the exception being paternal care for medium hours in Year 1, which is not associated with better communication in the following period than little or no paternal care.

The finding that medium hours of paternal care in Year 1 is associated with greater parental conflict and no improvement in parental communication or maternal satisfaction may help to explain the poorer behavioural outcomes of children experiencing this type of paternal care. However, children in long hours of paternal care in Years 2&3 tend to have parents with higher quality relationships, so this mechanism is unlikely to explain boys' poorer cognitive outcomes. It must be noted that all the relationships shown in the descriptive tables are unconditional, and may alter when controls for other types of heterogeneity between paternal and non-paternal care households are included.

C3. Attitudes to parenthood

The warmth of parental interactions with children is one aspect of parenting that is difficult to capture using questionnaire methods, yet may be crucially important for children's development. It is possible that paternal carers are, by their nature, warmer, more nurturing fathers and it is also possible that primary childcare responsibilities themselves promote a more positive relationship between father and child. On the other hand, paternal childcare may be an indicator that the mother-child relationship is less close, or may affect mother-child bonding because of the mother's regular and prolonged absence. To explore this we use a number of items completed by the parents about the feelings towards the child and parenthood in general. The hope is that responses to these questions are related to the manner in which each parent interacts with the child in practice. Examples of these items are statements like: 'It is a great pleasure to watch my child develop'; 'Having this child has made me feel more fulfilled'; and 'I would have preferred that we had not had this child when we did' (see Table 12 for further details).

Maternal attitudes are measured at both 8 and 33 months. The figures in Table C3 show few differences in these variables depending on the childcare responsibilities of the father, so it does not appear that, on average, mothers who are less bonded with their children rely on fathers for childcare to a greater degree. We also have fathers' responses to the attitudinal questions at 8 months only. We find a strong positive association between paternal childcare and father's attitudes on the enjoyment scale, but not on the confidence scale. The relationship with paternal enjoyment in Year 1 is similar whether we look at paternal care in Year 1, or in Years 2&3, which suggests that fathers who go on to assume childcare responsibilities already had relatively positive attitudes prior to that care taking place. In case these findings on paternal attitudes are biased by the non-random response to the partner questionnaires (see Section 3.5), we also explore several mother-completed measures about the attitude of the father to the child. The items used in these scores are highly similar to the ones used to construct the self-reported measures although they include several other items. Our results replicate the findings for the father's own enjoyment score – father's who provide primary childcare have significantly more positive attitudes to parenthood than fathers who do not. These findings do not appear responsive to the timing of childcare

and the reporting of attitudes, implying a selection rather than a causal link from childcare to attitudes.

C4. Parenting behaviours and the home environment

Table C4 explores how a number of measures of parenting behaviours and the home environment are associated with paternal childcare. We can think that the effects of paternal childcare are capturing something about the quality of the environment in which children who experience shared parenting are raised. If the fathers who care for infants and toddlers do not provide a positive and stimulating environment for their children when they are in charge, then this may help to explain some of the negative effects we have identified. Even if caring fathers do engage well with their children, it may be that mothers in such circumstances are less involved, and it is this that we pick up in our negative estimates. Of course, the reverse may be the case – that mothers seek to compensate for time away from the child by increasing the ‘quality’ of the time when they are there. This possibility has received empirical support from analysis of time use data, e.g. Bianchi (2000).

The first variables in Table C4 are parenting measures that are constructed identically for both the mother-child and father-child interactions, and capture the frequency of activities like reading to and playing with the child. We see that there is no significant difference in the average degree of maternal interactions by paternal childcare status in either period. Hence it seems that mothers do not reduce their inputs when childcare time is shifted to the father, at least as captured by these 5 activities. The one exception is the frequency that the mother puts the child to bed at 38 months. Here we find that mothers do this activity less frequently if the father is involved in primary care of the child. The fact that we find no differences depending on whether paternal childcare was used in the earlier period suggests that this reflects the substitution of paternal for maternal care time rather than selection.

Fathers who engage in regular childcare, however, score substantially higher on these kinds of interaction measures than fathers who spend little or no time in childcare without the mother present, and the intensity of care is positively related to the frequency of interactions. The fact that we find differences in fathering activity at 6 months between fathers’ childcare status in Years 2&3, and similarly that we find

differences in involvement at 38 months by childcare status in Year1, suggests that we may be observing selection rather than the causal effect of paternal childcare on father interactions. In other words, fathers may supply this level of involvement regardless of whether or not they are engaged in childcare duties. More detailed analysis (not shown) reveals significant differences in every one of the items that make up the interaction score, not just the total, and also in a number of other measures of parental involvement not shown here. Regardless of the direction of causation, these findings suggest that children who experience paternal care also experience more parental interactions in total than other children because maternal involvement does not fall when father involvement increases. However, it is noticeable that the mean levels of the father-child interaction scores are lower than the mother-child interaction scores across the board. This may simply reflect the greater time spent by the mother with the child, or potentially also the fact that both parents' interactions are mother-reported. But if it is the case that the frequency of parent-child interactions is lower when the father has primary responsibility for childcare than when the mother has responsibility, this would help to account for the poorer cognitive development of boys who experience long hours of paternal care in Years 2&3. Unfortunately, our data do not allow us to observe the quality of interactions that take place specifically when the father is alone with the child.

The next section of Table C4 explores maternal investments for which we have no comparable data on the father. Breastfeeding provides an attractive potential mechanism for explaining the negative effects of paternal childcare. Lactation is the one aspect of parenting that suggests a biological advantage to maternal care. We find that mothers were slightly less likely to initiate breastfeeding when the father subsequently assumed some responsibility for childcare, but this effect is neither uniform nor large. Mothers who begin breastfeeding, however, do tend to stop sooner when fathers are involved in childcare, and this effect is strongly significant and monotonic in the intensity of paternal care. Another maternal input for which we have data is the extent of the mother's teaching activity at 30 months. Mothers were asked if they teach the child 7 topics, scoring one point for each. Previous research has shown that this variable is strongly linked with children's later cognitive attainment (see Gregg et al, 2005), although there is possible reverse causation here running from the child's developmental ability to the mother's teaching behaviour. We find no evidence

that children in paternal childcare receive less maternal teaching and, in fact, find that teaching is significantly higher only among the group where we find negative cognitive effects, namely long hours of paternal care in Years 2&3.

The final maternal-only variables relate to how often she talks to the child whilst she is engaged in other activities such as housework, scored from 0 (never) to 4 (always). This measure may be an indicator of the general nature of the linguistic interaction the child receives from day to day, which is likely to be an important predictor of cognitive attainment and is difficult to capture in more direct questions about specific interactions. Here we find some evidence that mothers who leave the child with the father for long hours may try to compensate by interacting more fully when they are present. This is because we find significant differences only by paternal childcare that is contemporaneous with the measure of talking whilst occupied, and not between childcare that occurred before or after the date of measurement.

The remaining variables in Table C4 are designed to capture a number of other features of the child's environment. We find that paternal care in Years 2&3, but not in Year 1, is associated with more frequent visits to shops. Visits to the park or to family and friends are generally slightly more common in paternal care households, and this is the case both when the child is an infant and a toddler. We also find that children in long hours of paternal care in Years 2&3 are taken to libraries, places of interest or places of entertainment slightly more frequently than other children. Again, these results provide little help in explaining the poorer cognitive outcomes of boys in this type of care.

Another aspect of the child's environment is the time spent in different activities. Children in paternal care households spend more time watching television than other children at 38 months, but also significantly more time playing outside. Children experiencing long hours of paternal care, but not those experiencing shorter hours, spend more time in the car than other children. We find few differences in time spent playing with other children. This finding is of particular interest given the suggestion that children may be disadvantaged by paternal care because fathers are excluded from mother and child support networks (e.g. Averett et al., 2005). If fathers are, or perceive themselves to be, less welcome in settings such as playgroups, then children

in paternal care may be deprived of the opportunity to take part in group activities with other children. We do not find any evidence here, however, that children in paternal care spend substantially less time with other children at age 3. Finally, we explore several measures of the material environment relating to how many toys and books the child owns. Here we find little evidence that children in paternal care households are more or less materially deprived than other children.

Overall, the results in Table C4 provide us with some evidence on the differential conditions experienced by children in paternal childcare. Such children tend to be breastfed for shorter periods, but it does not appear to be the case that they experience poorer quality maternal interactions along other dimensions, at least those captured by our variables. As the quality of father-child interactions is increasing in the amount of paternal-only childcare, such children appear to receive greater parent-child interactions overall than other children. This may help to account for the positive association we find between some types of paternal care and children's social development. Children in some paternal care households do spend more time than other children in activities with little cognitive component, such as playing outside, watching television, spending time in the car and on outings to shops. However, they also receive, if anything, more cognitively stimulating interactions like being read to, being taught and talked to by the mother and visiting libraries. One finding of interest is that even though fathers who provide childcare do engage in more frequent interactions with their children than other fathers, on average their interaction scores still fall short of those provided by the mother. This may simply reflect the fact that mothers spend a greater amount of time in total with the child. But if fathers do not provide as much cognitive stimulation as mothers when they are the parent with primary responsibility, for example because they view their caring role as fulfilled simply by being present and watching over the child, then this may help to account for the poorer cognitive outcomes of some boys who receive paternal care. Finally, we address the idea that children in paternal care may be disadvantaged because fathers are excluded from mother-child support networks by examining the amount of time the child spends with other children at age 3. This measure provides no evidence to support the view that such children are deprived of the beneficial effects of group environments like playgroups.

C5. Measures of child health, temperament and ability between age 1 and age 3

Our final group of potentially endogenous controls has a different interpretation to that of possible mediators. This is a set of measures of child health, temperament and developmental ability measured between the ages of 15 and 30 months. In contrast to the early child endowment controls used in Section 6, it is clear that these measures are highly likely to reflect environmental influences. However, including them as controls can throw light on the extent to which the effects of shared parenting on school readiness identified in Section 6 have already emerged by age 2. Table C5 shows the association between these later child characteristics and paternal childcare. We do not discuss these results in detail here because of the large number of measures, and because our interest lies in how they modify the paternal childcare coefficients when included jointly.

C6. Differences in the fathering of sons and daughters

Our finding that the negative effects of one type of paternal care on cognitive outcomes are restricted only to boys raises the question of whether gender role concerns lead fathers to parent sons differently from daughters. For example, one stereotype may be that fathers' activities with sons focus on physical activities, like playing football, that are regarded as 'masculine', rather than on learning-related activities that involve sitting quietly and may be seen as more 'feminine'. Evidence from the developmental psychology literature discussed in Section 2.4 does suggest that father-child interactions tend to include a greater component of physical play than mother-child interactions. We explore the evidence here that fathers' interactions differ systematically with the gender of the child, but do not include these variables in our regression analysis because of our separation of the boys' and girls' sub-samples.

As a first piece of evidence we examine whether children experiencing paternal care tend to engage in more 'masculine'-typed play activities at 30 and 42 months. These measures are taken from the 33-item Pre-School Activities Inventory (Golombok and Rust, 1988), which assesses children's engagement in various sex-typed activities. The masculine play score captures the frequency the child engages in activities like playing with guns, trains, cars and aeroplanes, playing at fighting, and climbing or exploring. The feminine play score relates to items like playing at looking after babies or keeping house, dressing in girlish clothes and the avoidance of getting dirty or

taking risks. In the data shown in Table C6, both masculine and feminine scores are normalized to mean 100, standard deviation 10 on the full sample of children of both sexes for whom the data are available. We find that, as we would expect, boys engage in substantially more masculine play activities and girls in feminine activities. The difference in the mean scores between the two sexes is in excess of one standard deviation at both ages. However, we find no evidence that children who experience paternal care tend to have a more masculine orientation than other children, or indeed any substantial differences in either score by paternal childcare status. The one exception is that girls experiencing medium hours of paternal care in Years 2&3 tend to have very slightly higher masculine play scores and correspondingly lower feminine play scores than girls experiencing maternal-only parental care. Hence we find no evidence here that boys experiencing long hours of paternal care in Years 2&3, and who have poorer cognitive ability on school entry, differ in terms of gender-typed behaviour from other boys.

As a second piece of evidence, we explore in more detail whether the nature of paternal interactions differs between sons and daughters, and also whether this relationship varies with the father's childcare responsibilities. Table C7 compares the mean values of a number of measures of father-child interactions between the fathers of boys and the fathers of girls, where each item is scored between 0 (never) and 2 (often). The left panel relates to parenting measures taken at 6 months and is broken down the father's childcare responsibilities in Year 1. The right panel relates to parenting measures taken at 38 months and is also broken down by father's contemporaneous childcare responsibilities in Years 2&3. Significance stars relate to a t-test of the null hypothesis of no gender differences in father's parenting style.

We do find some evidence of differences in parenting styles between the fathers of girls and the fathers of boys. In infancy these differences are largest amongst fathers who provide little or no regular hours of primary care and are generally insignificant amongst fathers assuming childcare responsibilities. By the toddler years, these differences are more widespread and larger in magnitude, and are found even when fathers supply primary childcare. Fathers tend to bathe and feed boys slightly more frequently than they do girls, both in infancy and when they are toddlers, with the exception that at 38 months this pattern is reversed and fathers tend to bathe girls

slightly more frequently than boys. Girls tend to be read to, sang to and cuddled by their fathers more frequently than boys, whilst boys tend to play with their fathers more frequently than girls, both physical play and play with toys, and also to be taken for walks by their fathers more often. They are also likely to be put to bed by their fathers more often at age 3 than girls. These results are suggestive that the activities that fathers engage in with their daughters contain a greater cognitive component than the activities they engage in with sons. It is noticeable, however, that these differences are generally not large and in particular tend to be smaller when fathers supply long hours of childcare.

Table C1: Average differences in household income between paternal care and non-paternal care households

	All	Low paternal care sample	Medium paternal care sample	High paternal care sample
Average disposable weekly household income in Years 3 and 4 (1995 prices, equivalised, £ per week)	241.5	242.4 245.5	242.6 240.7	235.0 235.8 **

Numbers are the proportion of the sample with the given characteristic unless marked (mean), in which case number is the mean value for the sub-sample.

The two lines for each variable give results partitioning the sample by:

Paternal childcare in **Year 1**

Paternal childcare in **Years 2 & 3**

Stars relate to t-test that mean for group is equal to mean for low paternal childcare group (** = $p < 0.01$;

* = $p < 0.05$)

Table C2: Average differences in parental relationship quality between paternal care and non-paternal care households

	All	Low paternal care sample	Medium paternal care sample	High paternal care sample
Rows with partner score (mean over Years 2 & 3, scale 0-14)	3.63	3.55 3.58	3.79 ** 3.63	3.76 * 3.70
Mother's satisfaction with partner score (mean over Years 2 & 3, scale 0-21)	15.56	15.55 15.35	15.51 15.73 **	15.70 15.61 *
Going out score (mean over Years 2 & 3, scale 0-15)	5.95	5.84 5.80	6.19 ** 6.03 **	6.05 * 6.05 **
Parental communication score (mean over Years 2 & 3, scale 0-18)	15.13	15.09 14.93	15.12 15.21 **	15.34 * 15.32 **

See notes to Table C1

Table C3: Average differences in attitudes to parenthood between paternal care and non-paternal care households

	All	Low paternal care sample	Medium paternal care sample	High paternal care sample
Mother's enjoyment of parenthood at 8 months (mean, scale 0-15)	13.15	13.16 13.15	13.13 13.15	13.15 13.16
Mother's enjoyment of parenthood at 33 months (mean, scale 0-15)	13.08	13.09 13.06	13.01 13.07	13.14 13.14
Mother's confidence in parenting at 8 months (mean, scale 0-18)	14.62	14.60 14.58	14.63 14.61	14.68 14.71 *
Mother's confidence in parenting at 33 months (mean, scale 0-18)	14.23	14.20 14.16	14.23 14.23	14.34 14.35 **
Father's enjoyment of parenthood at 8 months (mean, scale 0-15, self-report)	13.14	13.03 12.98	13.27 ** 13.21 **	13.48 ** 13.28 **
Father's confidence in parenting at 8 months (mean, scale 0-15, self-report)	15.02	15.02 14.96	15.01 15.07	15.04 15.05
Father's attitude to parenthood at 8 months (mean, scale 0-22)	15.61	15.42 15.18	15.91 ** 15.81 **	16.03 ** 16.00 **
Father's attitude to parenthood at 33 months (mean, scale (0-18)	17.36	17.27 17.09	17.47 ** 17.48 **	17.62 ** 17.61 **

See notes to Table C1

Table C4: Average differences in parenting behaviours and the home environment
between paternal care and non-paternal care households

	All	Low paternal care sample	Medium paternal care sample	High paternal care sample
Mother's interaction score at 6 months (mean)	8.55	8.55 8.52	8.54 8.54	8.54 8.60
Father's interaction score at 6 months (mean)	5.94	5.72 5.40	6.19 ** 6.12 **	6.62 ** 6.61 **
Mother's interaction score at 38 months (mean)	8.60	8.62 8.61	8.54 8.55	8.57 8.66
Father's interaction score at 38 months (mean)	7.14	7.01 6.65	7.35 ** 7.33 **	7.49 ** 7.71 **
Frequency mother puts child to bed at 38 months (scale 0-2, mean)	1.80	1.81 1.84	1.79 1.78 **	1.79 1.77 **
Frequency father puts child to bed at 38 months (scale 0-2, mean)	1.47	1.43 1.31	1.54 ** 1.54 **	1.57 ** 1.62 **
Mother initiated breastfeeding	0.82	0.83 0.83	0.79 ** 0.81 *	0.80 0.80 *
Duration of breastfeeding in months (initiated sample only, mean)	5.96	6.29 6.45	5.40 ** 5.79 **	5.12 ** 5.33 **
Mother talks to child when occupied at 6 months (scale 0 to 4, mean)	3.53	3.52 3.52	3.52 3.52	3.58 * 3.56
Mother talks to child when occupied at 38 months (scale 0 to 4, mean)	3.49	3.48 3.48	3.52 3.47	3.51 3.56 **
Mother's teaching score at 30 months (scale 1 to 7, mean)	6.41	6.39 6.38	6.43 6.39	6.44 6.48 **
Frequency of outings to shops at 6 months (scale 0-12, mean)	8.44	8.45 8.41	8.44 8.44	8.40 8.50
Frequency of outings to shops at 30 months (scale 0-12, mean)	8.34	8.31 8.26	8.39 8.36 *	8.39 8.45 **
Frequency of outings to park/friends & family at 6 months (scale 0-8, mean)	5.90	5.87 5.85	6.00 ** 5.92	5.89 5.96 *
Frequency of outings to park/friends & family at 30 months (scale 0-8, mean)	6.23	6.20 6.17	6.29 * 6.24 *	6.22 6.30 **
Frequency of outings to libraries/places of interest & entertainment at 30 months (scale 0-12, mean)	3.97	3.97 3.91	3.98 4.00	3.96 4.05 *
Weekly hours child outdoors at 38 months (top-coded at 14)	9.57	9.42 9.33	9.85 ** 9.62 **	9.90 ** 9.94 **
Weekly hours child watches TV at 38 months (top-coded at 14)	7.49	7.37 7.25	7.75 ** 7.52 *	7.71 * 7.89 **

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Table C4 continued

Weekly hours spent with other children at 38 months (top-coded at 14)	11.69	11.74 11.77	11.53 * 11.62	11.70 11.68
Weekly hours child in car at 38 months (top-coded at 14)	3.92	3.89 3.87	3.93 3.92	4.02 * 3.98 *
Toy score at 24 months (0-36)	23.59	23.67 23.69	23.53 23.51	23.28 ** 23.57
Number of books child owns at 6 months (top-coded at 12)	5.22	5.15 5.17	5.35 5.18	5.33 5.38
Number of books child owns at 30 months (top-coded at 12)	11.34	11.32 11.34	11.39 11.29	11.31 11.42

See notes to Table C1

Table C5: Average differences in later child characteristics (15 to 30 months) between paternal care and non-paternal care households

	All	Low paternal care	BOYS Medium paternal care	High paternal care	All	Low paternal care	GIRLS Medium paternal care	High paternal care
Health								
Child's health 6-18 mths (mean, 1-4, 4 healthiest)	3.53	3.55 3.55	3.50 * 3.54	3.47 * 3.49 *	3.60 3.60	3.60 3.60	3.60 3.59	3.58 3.59
Child's health 18-30 mths (mean, 1-4, 4 healthiest)	3.42	3.41 3.42	3.42 3.41	3.41 3.42	3.48 3.48	3.48 3.48	3.48 3.47	3.47 3.47
Child's health 30-42 mths (mean, 1-4, 4 healthiest)	3.38	3.39 3.35	3.37 3.41 *	3.35 3.38	3.44 3.44	3.43 3.43	3.45 3.45	3.43 3.43
Temperament at 24 mths								
Activity	100.8	100.7 100.8	100.9 100.6	101.0 101.0	99.2 99.2	98.9 98.9	100.1 ** 99.2	98.9 99.7
Rhythmicity	98.9	98.9 98.8	98.7 98.7	99.6 99.7	99.8 99.8	99.8 99.7	99.2 99.6	101.0 100.5
Approach	99.1	99.1 99.3	99.1 98.6	98.7 99.3	100.8 100.8	100.9 100.9	100.4 100.7	100.5 100.6
Adaptability	100.6	100.8 101.1	100.2 100.2 *	100.3 100.5	99.3 99.3	99.4 99.3	99.5 99.2	98.6 99.4
Intensity	100.1	100.1 100.6	100.5 99.9	99.7 99.8	99.8 99.8	99.7 99.6	100.5 100.0	99.4 99.7
Mood	99.5	99.5 100.1	99.5 99.0 **	99.6 99.2	100.4 100.4	100.4 100.5	100.6 100.2	99.3 100.3
Persistence	100.6	100.7 101.4	100.8 100.5 *	99.8 99.1 **	99.7 99.7	99.9 100.7	99.2 99.1 **	99.2 99.0 **
Distractability	100.2	100.3 100.9	100.2 100.0 *	100.1 99.3 **	100.7 100.7	100.9 101.2	100.6 100.7	99.3 ** 99.6 **
Threshold	98.6	98.8 98.8	98.0 98.6	98.2 98.0	101.4 101.4	101.5 101.4	101.6 101.5	101.0 101.2
Development at 18 mths								
Social skills	97.6	97.4 96.9	97.8 97.8 *	98.3 98.6 **	101.5 101.5	101.3 101.3	102.0 101.4	102.3 102.2
Fine motor skills	99.6	99.4 99.4	99.9 99.4	100.1 100.5 *	100.9 100.9	100.9 101.0	100.9 100.8	100.9 100.8
Communication skills	97.4	97.4 97.1	97.5 97.5	97.3 97.9	101.7 101.7	101.6 101.4	101.8 101.7	102.2 102.4
Gross motor skills	99.6	99.2 98.9	100.4 ** 99.7	100.2 * 100.7 **	99.5 99.5	99.1 99.2	100.5 ** 99.4	100.3 * 100.5 **

Continued overleaf

Table C5 continued

Development at 30 mths								
Social skills	96.0	95.0	96.1	96.9 **	103.2	103.1	103.2	103.7
		95.4	96.0	97.2 ***		103.2	103.0	103.5
Fine motor skills	98.8	98.6	99.1	99.4	101.5	101.4	101.9	101.5
		98.6	98.6	99.7 *	101.5	101.5	101.3	102.1
Gross motor skills	99.2	98.9	99.9 *	99.7	100.1	99.7	100.6 *	101.2 **
		98.8	99.0	100.2 **	100.1	99.6	99.9	101.1 **
Communication at 15 months								
Vocabulary	98.2	98.1	98.5	98.1	101.0	101.0	101.1	100.6
		98.2	98.0	98.5	101.0	100.9	101.0	101.2
Non-verbal communication	97.4	97.3	97.5	97.9	101.6	101.5	101.6	102.6 *
		97.3	97.4	97.7	101.6	101.2	101.6	102.5 **
Social development	98.1	98.0	97.9	99.0	101.1	101.0	101.6	101.0
		98.0	98.1	98.6	101.1	101.3	100.6	101.8
Communication at 24 months								
Vocabulary	98.2	98.3	98.1	98.0	102.4	102.4	102.9	101.8
		98.5	97.9	98.5	102.4	102.4	102.2	102.9
Grammar	98.1	98.2	98.0	97.4	101.4	101.5	101.4	100.5
		98.1	97.8	98.5	101.4	101.4	101.1	101.8

See notes to Table C1

Table C6: Average differences in gender-typed play activities between paternal care and non-paternal care households

	BOYS				GIRLS			
	All	Low paternal care	Medium paternal care	High paternal care	All	Low paternal care	Medium paternal care	High paternal care
'Masculine' play (30 mths)	104.7	104.8	104.7	104.3	94.6	94.6	95.0	94.2
	104.7	104.8	104.6	104.9	94.6	94.3	94.9	94.9
'Masculine' play (42 mths)	105.8	105.8	105.6	105.6	93.6	93.4	94.0	93.6
	105.8	105.7	105.6	106.3	93.6	93.2	93.8 *	93.8
'Feminine' play (30 mths)	93.9	94.1	93.6	93.5	106.8	106.8	107.1	106.3
	93.9	94.1	93.9	93.8	106.8	106.9	106.5	107.1
'Feminine' play (40 mths)	93.1	93.2	92.9	93.2	107.6	107.6	107.4	107.5
	93.1	93.0	93.2	93.2	107.6	107.9	107.3 *	107.5

See notes to Table C1

Table C7: Average differences in the frequency of father interactions between sons and daughters

		Parenting behaviours at 6 months, by paternal childcare in Year 1				Parenting behaviours at 38 months, by paternal childcare in Years 2&3			
		All	Low paternal care	Medium paternal care	High paternal care	All	Low paternal care	Medium paternal care	High paternal care
Freq father bathes child	Boys:	0.97	0.89	1.07	1.20	1.83	1.87	1.81	1.80
	Girls:	0.94	0.86	1.12	1.07	1.86	1.90	1.83	1.85
Test $H_0 : \bar{x}_{BOYS} = \bar{x}_{GIRLS}$			**		*	**	*		*
Freq father feeds child	Boys:	1.26	1.13	1.51	1.52	1.76	1.76	1.75	1.80
	Girls:	1.22	1.11	1.44	1.43	1.73	1.70	1.76	1.71
Test $H_0 : \bar{x}_{BOYS} = \bar{x}_{GIRLS}$		*	**			*		*	**
Freq father reads to child	Boys:	0.74	0.71	0.75	0.88	1.54	1.45	1.58	1.62
	Girls:	0.78	0.72	0.87	0.92	1.58	1.46	1.63	1.70
Test $H_0 : \bar{x}_{BOYS} = \bar{x}_{GIRLS}$			**			*	**		*
Freq father sings to child	Boys:	0.95	0.91	0.98	1.09	0.97	0.86	1.02	1.10
	Girls:	1.01	0.97	1.05	1.19	1.08	0.98	1.13	1.17
Test $H_0 : \bar{x}_{BOYS} = \bar{x}_{GIRLS}$		**	**	*		**	**	**	
Freq father cuddles child	Boys:	1.89	1.87	1.91	1.94	1.88	1.84	1.89	1.91
	Girls:	1.90	1.89	1.93	1.95	1.91	1.88	1.93	1.94
Test $H_0 : \bar{x}_{BOYS} = \bar{x}_{GIRLS}$			**			**	**	*	
Freq father and child play with toys	Boys:	1.63	1.60	1.67	1.75	1.60	1.51	1.62	1.73
	Girls:	1.63	1.59	1.70	1.74	1.53	1.40	1.58	1.65
Test $H_0 : \bar{x}_{BOYS} = \bar{x}_{GIRLS}$			**			**	**	**	**
Freq father plays physically with child	Boys:	1.65	1.61	1.70	1.75	1.73	1.68	1.73	1.82
	Girls:	1.60	1.56	1.65	1.67	1.69	1.62	1.72	1.75
Test $H_0 : \bar{x}_{BOYS} = \bar{x}_{GIRLS}$		**	**	*		**	**	**	*
Freq father takes child for walks	Boys:	0.95	0.90	1.00	1.14	1.32	1.22	1.34	1.47
	Girls:	0.94	0.87	1.05	1.09	1.26	1.12	1.32	1.40
Test $H_0 : \bar{x}_{BOYS} = \bar{x}_{GIRLS}$			**			**	**	**	*
Freq father puts child to bed	Boys:	-	-	-	-	1.50	1.37	1.56	1.64
	Girls:	-	-	-	-	1.44	1.25	1.53	1.61
Test $H_0 : \bar{x}_{BOYS} = \bar{x}_{GIRLS}$						**	**	**	

Notes

All numbers are mean values for particular sub-group.

All items are scored from 0 (hardly ever/never) to 2 (often).

** and * indicate rejection of the null hypothesis that paternal interactions are of equal frequency for sons and daughters at the 1 and 5% levels respectively.

Appendix D: Full estimation results

Table D1: OLS estimates of the impact of paternal childcare with selection controls:

Entry Assessment, boys (N = 1609)							
Paternal childcare		Specifications:					
		(1)	(2)	(3)	(4)	(5)	(6)
Year 1: 5-15 hours	β	0.02 [0.04]	0.24 [0.45]	-0.08 [0.14]	0.07 [0.12]	0.09 [0.15]	0.12 [0.23]
	$\Delta\beta$		0.22 [0.84]	-0.10 [0.58]	0.04 [0.21]	0.06 [0.40]	0.10 [0.30]
Year 1: 16+ hours	β	-0.05 [0.06]	0.03 [0.04]	-0.05 [0.07]	0.33 [0.44]	-0.41 [0.54]	-0.08 [0.11]
	$\Delta\beta$		0.08 [0.22]	0.00 [0.00]	0.38 [1.20]	-0.36 [1.51]	-0.03 [0.06]
Years 2&3: 5-15 hours	β	-0.62 [1.13]	-0.67 [1.27]	-0.65 [1.17]	-0.84 [1.55]	-0.64 [1.21]	-0.85 [1.59]
	$\Delta\beta$		-0.05 [0.21]	-0.03 [0.21]	-0.22 [1.26]	-0.02 [0.13]	-0.23 [0.70]
Years 2&3: 16+ hours	β	-2.04 [2.66]***	-1.78 [2.35]**	-1.86 [2.53]**	-1.99 [2.67]***	-1.94 [2.60]***	-1.74 [2.30]**
	$\Delta\beta$		0.26 [0.77]	0.18 [0.88]	0.05 [0.19]	0.09 [0.47]	0.30 [0.70]
Included controls		A	A, B	A, C	A, D	A, E	A, B, C, D, E
Adj R ²		0.049	0.172	0.105	0.117	0.093	0.234
F-test (1)			7.69***	7.40***	7.28***	4.35***	
F-test (2)			4.19***	2.02	2.13**	3.47***	

Notes

Each column relates to a separate regression.

Standard errors (not shown) derived from bootstrap with 200 repetitions. Absolute z-values in brackets.

***, **, and * indicate significance at the 1, 5 and 10% levels respectively.

β = coefficient on paternal childcare dummy. $\Delta\beta$ = change in coefficient compared with column (1).

F-test (1) is the joint test of the significance of the control group added singly to specification (1).

F-test (2) is the joint test of the significance of the control group in specification (6).

Control groups (for details, see Section 6.2 and Tables 4 and 5):

- A. Childcare history
- B. Parental economic capital; mother's social networks; ethnicity; family size
- C. Father's mental and physical health; father's pre-birth attitudes and health-related behaviours
- D. Mother's mental and physical health; mother's pre-birth attitudes and health-related behaviours
- E. Birth weight and health of child at birth; child temperament, development and health at 6 months

Table D2: Estimates of the impact of paternal childcare with selection controls:
Entry Assessment, girls (N = 1512)

Paternal childcare		Specifications:					
		(1)	(2)	(3)	(4)	(5)	(6)
Year 1: 5-15 hours	β	0.34 [0.63]	0.75 [1.34]	0.37 [0.66]	0.39 [0.72]	0.43 [0.84]	0.88 [1.54]
	$\Delta\beta$		0.42 [1.65]*	0.04 [0.23]	0.05 [0.34]	0.10 [0.61]	0.54 [1.61]
Year 1: 16+ hours	β	-0.26 [0.32]	-0.23 [0.30]	-0.06 [0.08]	-0.51 [0.64]	-0.23 [0.29]	-0.15 [0.19]
	$\Delta\beta$		0.03 [0.09]	0.20 [0.89]	-0.25 [0.93]	0.02 [0.10]	0.11 [0.24]
Years 2&3: 5-15 hours	β	-0.19 [0.37]	-0.22 [0.46]	-0.13 [0.25]	-0.10 [0.18]	-0.04 [0.09]	-0.09 [0.18]
	$\Delta\beta$		-0.03 [0.11]	0.06 [0.42]	0.09 [0.55]	0.15 [0.92]	0.10 [0.30]
Years 2&3: 16+ hours	β	0.46 [0.77]	0.81 [1.43]	0.77 [1.33]	0.63 [1.09]	0.66 [1.13]	0.91 [1.61]
	$\Delta\beta$		0.35 [1.15]	0.30 [1.68]*	0.16 [0.86]	0.20 [0.98]	0.45 [1.10]
Included controls		A	A, B	A, C	A, D	A, E	A, B, C, D, E
Adj R ²		0.043	0.175	0.093	0.109	0.103	0.251
F-test (1)			8.21***	6.41***	7.48***	5.60***	
F-test (2)			4.75***	2.62**	3.39***	4.15***	

See notes to Table D1.

Table D3: Estimates of the impact of paternal childcare with selection controls:
Behavioural difficulties, boys (N = 2964)

Paternal childcare		Specifications:					
		(1)	(2)	(3)	(4)	(5)	(6)
Year 1: 5-15 hours	β	0.88 [1.87]*	1.04 [2.31]**	0.90 [1.92]*	0.99 [2.36]**	0.71 [1.60]	0.87 [2.06]**
	$\Delta\beta$		0.16 [1.15]	0.02 [0.17]	0.11 [0.61]	-0.17 [1.10]	-0.01 [0.04]
Year 1: 16+ hours	β	0.48 [0.80]	0.61 [1.04]	0.49 [0.81]	0.31 [0.54]	0.66 [1.12]	0.51 [0.85]
	$\Delta\beta$		0.13 [0.62]	0.01 [0.09]	-0.17 [0.70]	0.19 [1.01]	0.03 [0.09]
Years 2&3: 5-15 hours	β	-1.36 [3.43]***	-1.50 [3.86]***	-1.28 [3.29]***	-1.40 [3.82]***	-1.19 [2.99]***	-1.30 [3.52]***
	$\Delta\beta$		-0.14 [1.03]	0.08 [0.81]	-0.04 [0.24]	0.17 [1.23]	0.06 [0.28]
Years 2&3: 16+ hours	β	-0.27 [0.50]	-0.48 [0.90]	-0.27 [0.50]	-0.40 [0.81]	-0.06 [0.12]	-0.09 [0.19]
	$\Delta\beta$		-0.21 [1.20]	0.00 [0.02]	-0.13 [0.60]	0.20 [1.13]	0.17 [0.59]
Included controls		A	A, B	A, C	A, D	A, E	A, B, C, D, E
Adj R ²		0.020	0.085	0.068	0.150	0.100	0.233
F-test (1)			6.80***	12.59***	30.02***	14.52***	
F-test (2)			3.37***	2.92**	14.71***	8.83***	

See notes to Table D1.

Table D4: Estimates of the impact of paternal childcare with selection controls:
Behavioural difficulties, girls (N = 2834)

Paternal childcare		Specifications:					
		(1)	(2)	(3)	(4)	(5)	(6)
Year 1: 5-15 hours	β	0.77 [1.64]	0.93 [1.96]*	0.78 [1.68]*	0.74 [1.65]*	0.89 [1.90]*	0.92 [1.95]*
	$\Delta\beta$		0.16 [1.04]	0.01 [0.10]	-0.03 [0.17]	0.12 [0.87]	0.15 [0.54]
Year 1: 16+ hours	β	0.11 [0.19]	-0.23 [0.39]	0.06 [0.10]	-0.11 [0.19]	0.04 [0.07]	-0.14 [0.24]
	$\Delta\beta$		-0.34 [1.55]	-0.05 [0.34]	-0.22 [0.88]	-0.07 [0.37]	-0.25 [0.73]
Years 2&3: 5-15 hours	β	-0.55 [1.43]	-0.72 [1.90]*	-0.50 [1.28]	-0.81 [2.10]**	-0.64 [1.66]*	-0.82 [2.10]**
	$\Delta\beta$		-0.17 [1.33]	0.05 [0.53]	-0.26 [1.60]	-0.09 [0.81]	-0.27 [1.24]
Years 2&3: 16+ hours	β	-0.21 [0.43]	-0.34 [0.70]	-0.23 [0.46]	-0.43 [0.93]	-0.26 [0.55]	-0.40 [0.86]
	$\Delta\beta$		-0.13 [0.72]	-0.02 [0.14]	-0.22 [1.06]	-0.05 [0.34]	-0.18 [0.66]
Included controls		A	A, B	A, C	A, D	A, E	A, B, C, D, E
Adj R ²		0.016	0.090	0.059	0.150	0.080	0.231
F-test (1)			7.62***	10.00***	29.09***	11.53***	
F-test (2)			4.30***	2.66**	12.92***	8.10***	

See notes to Table D1.

Table D5: Comparison of the effects of paternal with other types of childcare, with and without selection controls: Entry Assessment, boys (N = 1609)

Childcare hours		Controls: A only			Controls: A, B, C, D, E		
		Father	Family/ friends	Paid carer	Father	Family/ friends	Paid carer
Year 1: 5-15 hours	β	0.02 [0.04]	-0.84 [1.16]	-1.43 [1.56]	0.12 [0.23]	-0.68 [0.98]	-2.04 [2.31]**
	$\Delta\beta$				0.10 [0.30]	0.15 [0.34]	-0.62 [1.11]
Year 1: 16+ hours	β	-0.05 [0.06]	-2.27 [2.24]**	-0.72 [0.66]	-0.08 [0.11]	-2.28 [2.35]**	-1.87 [1.65]*
	$\Delta\beta$				-0.03 [0.06]	-0.01 [0.01]	-1.15 [1.55]
Years 2&3: 5-15 hours	β	-0.62 [1.13]	0.83 [1.40]	2.84 [4.00]***	-0.85 [1.59]	0.78 [1.34]	0.96 [1.35]
	$\Delta\beta$				-0.23 [0.70]	-0.05 [0.13]	-1.88 [3.49]***
Years 2&3: 16+ hours	β	-2.04 [2.66]***	0.69 [0.74]	5.05 [5.04]***	-1.74 [2.30]**	0.57 [0.64]	2.38 [2.34]**
	$\Delta\beta$				0.30 [0.70]	-0.12 [0.24]	-2.67 [4.13]***
Adj R ²			0.049			0.234	

Notes

Left panel and right panel relate to a single regression each.

Standard errors (not shown) derived from bootstrap with 200 repetitions. Absolute z-values in brackets.

***, **, and * indicate significance at the 1, 5 and 10% levels respectively.

β = coefficient on childcare dummy. $\Delta\beta$ = change in coefficient compared with left panel

Control groups (for details, see Section 6.2 and Tables 4 and 5):

- A. Childcare history
- B. Parental economic capital; mother's social networks; ethnicity; family size
- C. Father's mental and physical health; father's pre-birth attitudes and health-related behaviours
- D. Mother's mental and physical health; mother's pre-birth attitudes and health-related behaviours
- E. Birth weight and health of child at birth; child temperament, development and health at 6 months

Table D6: Comparison of the effects of paternal with other types of childcare, with and without selection controls: Entry Assessment, girls (N = 1512)

Childcare hours		Controls: A only			Controls: A, B, C, D, E		
		Father	Family/ friends	Paid carer	Father	Family/ friends	Paid carer
Year 1: 5-15 hours	β	0.34	-1.20	-0.18	0.88	-1.30	-1.09
		[0.63]	[1.71]*	[0.17]	[1.54]	[1.90]*	[1.10]
	$\Delta\beta$				0.54	-0.11	-0.92
					[1.61]	[0.26]	[1.50]
Year 1: 16+ hours	β	-0.26	0.79	1.43	-0.15	1.70	0.31
		[0.32]	[0.99]	[1.17]	[0.19]	[2.26]**	[0.27]
	$\Delta\beta$				0.11	0.91	-1.12
					[0.24]	[1.81]*	[1.53]
Years 2&3: 5-15 hours	β	-0.19	-0.22	1.57	-0.09	0.28	0.54
		[0.37]	[0.34]	[1.88]*	[0.18]	[0.50]	[0.68]
	$\Delta\beta$				0.10	0.50	-1.04
					[0.30]	[1.51]	[2.13]**
Years 2&3: 16+ hours	β	0.46	-0.24	2.59	0.91	-0.49	1.16
		[0.77]	[0.33]	[2.55]**	[1.61]	[0.69]	[1.18]
	$\Delta\beta$				0.45	-0.24	-1.43
					[1.10]	[0.53]	[2.20]**
Adj R ²			0.043			0.251	

See notes to Table D5

Table D7: Comparison of the effects of paternal with other types of childcare, with and without selection controls: Behavioural difficulties, boys (N = 2964)

Childcare hours		Controls: A only			Controls: A, B, C, D, E		
		Father	Family/ friends	Paid carer	Father	Family/ friends	Paid carer
Year 1: 5-15 hours	β	0.88 [1.87]*	-0.11 [0.19]	-1.12 [1.37]	0.87 [2.06]**	0.08 [0.14]	-0.27 [0.34]
	$\Delta\beta$				-0.01 [0.04]	0.19 [0.53]	0.85 [1.98]**
Year 1: 16+ hours	β	0.48 [0.80]	-0.26 [0.42]	-1.44 [1.47]	0.51 [0.85]	-0.06 [0.10]	-0.64 [0.62]
	$\Delta\beta$				0.03 [0.09]	0.20 [0.49]	0.80 [1.53]
Years 2&3: 5-15 hours	β	-1.36 [3.43]***	-0.17 [0.33]	-0.05 [0.08]	-1.30 [3.52]***	-0.04 [0.08]	0.09 [0.15]
	$\Delta\beta$				0.06 [0.28]	0.13 [0.48]	0.15 [0.40]
Years 2&3: 16+ hours	β	-0.27 [0.50]	1.15 [1.64]	-1.09 [1.34]	-0.09 [0.19]	0.88 [1.42]	-0.61 [0.80]
	$\Delta\beta$				0.17 [0.59]	-0.26 [0.59]	0.48 [1.08]
Adj R ²			0.020			0.233	

See notes to Table D5

Table D8: Comparison of the effects of paternal with other types of childcare, with and without selection controls: Behavioural difficulties, girls (N = 2834)

Childcare hours		Controls: A only			Controls: A, B, C, D, E		
		Father	Family/ friends	Paid carer	Father	Family/ friends	Paid carer
Year 1: 5-15 hours	β	0.77 [1.64]	0.04 [0.07]	0.42 [0.50]	0.92 [1.95]*	-0.04 [0.07]	0.95 [1.21]
	$\Delta\beta$				0.15 [0.54]	-0.08 [0.27]	0.53 [1.22]
Year 1: 16+ hours	β	0.11 [0.19]	-0.14 [0.17]	-1.01 [1.07]	-0.14 [0.24]	-0.11 [0.16]	-0.08 [0.08]
	$\Delta\beta$				-0.25 [0.73]	0.03 [0.06]	0.93 [1.96]*
Years 2&3: 5-15 hours	β	-0.55 [1.43]	0.83 [1.64]	-0.60 [0.98]	-0.82 [2.10]**	0.64 [1.40]	0.16 [0.28]
	$\Delta\beta$				-0.27 [1.24]	-0.19 [0.68]	0.75 [2.10]**
Years 2&3: 16+ hours	β	-0.21 [0.43]	2.02 [3.23]***	-1.20 [1.54]	-0.40 [0.86]	1.96 [3.25]***	0.00 [0.00]
	$\Delta\beta$				-0.18 [0.66]	-0.06 [0.17]	1.20 [2.76]***
Adj R ²			0.016			0.231	

See notes to Table D5.

Table D9: Estimates of the impact of paternal childcare with potentially endogenous controls: Entry Assessment, boys (N = 1609)

Paternal childcare		Specifications:						
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Year 1: 5-15 hours	β	0.12 [0.23]	0.08 [0.15]	0.13 [0.24]	0.15 [0.27]	0.01 [0.01]	0.14 [0.26]	-0.02 [0.03]
	$\Delta\beta$		-0.04 [0.76]	0.01 [0.13]	0.02 [0.16]	-0.12 [0.52]	0.02 [0.07]	-0.14 [0.39]
Year 1: 16+ hours	β	-0.08 [0.11]	-0.04 [0.06]	-0.03 [0.05]	-0.16 [0.22]	-0.07 [0.09]	-0.07 [0.10]	0.01 [0.01]
	$\Delta\beta$		0.04 [0.55]	0.04 [0.38]	-0.09 [0.42]	0.01 [0.05]	0.01 [0.03]	0.09 [0.19]
Years 2&3: 5-15 hours	β	-0.85 [1.59]	-0.78 [1.47]	-0.79 [1.48]	-0.66 [1.22]	-0.87 [1.62]	-0.58 [1.16]	-0.33 [0.62]
	$\Delta\beta$		0.06 [0.96]	0.05 [0.75]	0.19 [1.30]	-0.03 [0.12]	0.26 [1.12]	0.52 [1.43]
Years 2&3: 16+ hours	β	-1.74 [2.30]**	-1.74 [2.31]**	-1.68 [2.24]**	-1.60 [2.09]*	-1.87 [2.44]**	-1.71 [2.22]**	-1.63 [2.11]*
	$\Delta\beta$		0.00 [0.01]	0.05 [0.56]	0.14 [0.79]	-0.13 [0.42]	0.03 [0.10]	0.11 [0.26]
Included controls		F	F, G	F, H	F, I	F, J	F, K	F, G, H, I, J, K
Adj R ²		0.234	0.236	0.241	0.242	0.283	0.334	0.380
F-test (1)			5.51	1.89	2.16	4.10***	8.15***	
F-test (2)			5.96	2.93	2.15	2.16**	6.30***	

Notes

Each column relates to a separate regression.

Standard errors (not shown) derived from bootstrap with 200 repetitions. Absolute z-values in brackets.

***, **, and * indicate significance at the 1, 5 and 10% levels respectively.

β = coefficient on paternal childcare dummy. $\Delta\beta$ = change in coefficient compared with column (1).

F-test (1) is the joint test of the significance of the control group added singly to specification (1).

F-test (2) is the joint test of the significance of the control group in specification (7).

Control groups (for details, see Table ?):

F. Full selection controls (see Table X)

G. Household income

H. Parental relationship quality

I. Parental confidence and enjoyment

J. Parenting behaviours and the home environment

K. Child health, temperament and development between 15 and 30 months

Table D10: Estimates of the impact of paternal childcare with potentially endogenous controls: Entry Assessment, girls (N = 1512)

Paternal childcare		Specifications:						
		(1)	(2)	(5)	(6)	(3)	(4)	(7)
Year 1: 5-15 hours	β	0.88 [1.54]	0.83 [1.45]	0.85 [1.48]	1.04 [1.76]*	1.08 [1.83]*	0.67 [1.20]	0.90 [1.51]
	$\Delta\beta$		-0.04 [0.86]	-0.02 [0.38]	0.17 [1.42]	0.21 [1.13]	-0.20 [1.08]	0.02 [0.07]
Year 1: 16+ hours	β	-0.15 [0.19]	-0.12 [0.15]	-0.25 [0.31]	-0.16 [0.20]	0.13 [0.16]	0.18 [0.22]	0.14 [0.17]
	$\Delta\beta$		0.03 [0.45]	-0.10 [0.90]	-0.01 [0.05]	0.28 [0.88]	0.33 [1.13]	0.29 [0.57]
Years 2&3: 5-15 hours	β	-0.09 [0.18]	-0.04 [0.07]	-0.10 [0.19]	-0.10 [0.18]	-0.25 [0.50]	0.02 [0.04]	-0.02 [0.05]
	$\Delta\beta$		0.06 [1.06]	0.00 [0.03]	0.00 [0.02]	-0.16 [0.67]	0.11 [0.61]	0.07 [0.21]
Years 2&3: 16+ hours	β	0.91 [1.61]	0.92 [1.61]	0.95 [1.67]*	0.96 [1.58]	0.54 [0.95]	0.63 [1.11]	0.50 [0.81]
	$\Delta\beta$		0.00 [0.07]	0.03 [0.45]	0.04 [0.22]	-0.37 [1.23]	-0.28 [1.23]	-0.41 [0.93]
Included controls		F	F, G	F, H	F, I	F, J	F, K	F, G, H, I, J, K
Adj R ²		0.251	0.253	0.255	0.259	0.295	0.323	0.372
F-test (1)			4.36	2.00	1.65	3.92***	5.59***	
F-test (2)			2.90	2.52	1.34	2.86***	5.30***	

See notes to Table D9

Table D11: Estimates of the impact of paternal childcare with potentially endogenous controls: Behavioural problems, boys (N = 2964)

Paternal childcare		Specifications:						
		(1)	(2)	(5)	(6)	(3)	(4)	(7)
Year 1: 5-15 hours	β	0.87 [2.06]**	0.86 [2.05]**	0.88 [2.11]**	0.84 [1.99]**	0.88 [2.10]**	0.60 [1.54]	0.61 [1.50]
	$\Delta\beta$		-0.01 [0.32]	0.01 [0.24]	-0.02 [0.17]	0.02 [0.13]	-0.27 [1.37]	-0.26 [0.99]
Year 1: 16+ hours	β	0.51 [0.85]	0.49 [0.82]	0.55 [0.92]	0.89 [1.47]	0.38 [0.64]	0.08 [0.14]	0.25 [0.42]
	$\Delta\beta$		-0.02 [0.46]	0.04 [0.54]	0.38 [1.99]**	-0.13 [0.79]	-0.43 [1.80]*	-0.25 [0.75]
Years 2&3: 5-15 hours	β	-1.30 [3.52]***	-1.35 [3.63]***	-1.23 [3.38]***	-1.03 [2.71]***	-1.20 [3.12]***	-1.05 [2.86]***	-0.82 [2.09]**
	$\Delta\beta$		-0.05 [1.51]	0.06 [1.35]	0.27 [1.96]**	0.10 [0.74]	0.25 [1.48]	0.47 [1.94]*
Years 2&3: 16+ hours	β	-0.09 [0.19]	-0.16 [0.33]	-0.07 [0.14]	0.18 [0.36]	0.20 [0.40]	0.38 [0.79]	0.45 [0.90]
	$\Delta\beta$		-0.07 [1.61]	0.03 [0.38]	0.28 [1.67]*	0.30 [1.59]	0.47 [2.32]**	0.55 [1.82]*
Included controls		F	F, G	F, H	F, I	F, J	F, K	F, G, H, I, J, K
Adj R ²		0.233	0.235	0.240	0.279	0.258	0.348	0.389
F-test (1)			3.91	5.89***	23.43***	4.39***	20.33***	
F-test (2)			5.21	2.52	12.80***	2.45**	15.28***	

See notes to Table D9

Table D12: Estimates of the impact of paternal childcare with potentially endogenous controls: Behavioural problems, girls (N = 2834)

Paternal childcare		Specifications:						
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Year 1: 5-15 hours	β	0.92 [1.95]*	0.91 [1.93]*	0.89 [1.86]*	0.96 [2.17]**	0.88 [1.83]*	0.56 [1.31]	0.52 [1.25]
	$\Delta\beta$		-0.01 [0.48]	-0.03 [0.79]	0.04 [0.32]	-0.04 [0.40]	-0.36 [2.06]**	-0.40 [1.65]*
Year 1: 16+ hours	β	-0.14 [0.24]	-0.17 [0.29]	-0.15 [0.26]	-0.22 [0.39]	0.00 [0.00]	-0.10 [0.18]	0.07 [0.12]
	$\Delta\beta$		-0.03 [0.70]	-0.01 [0.15]	-0.08 [0.48]	0.14 [0.87]	0.04 [0.20]	0.21 [0.64]
Years 2&3: 5-15 hours	β	-0.82 [2.10]**	-0.83 [2.14]**	-0.73 [1.86]*	-0.58 [1.54]	-0.71 [1.78]*	-0.72 [1.93]*	-0.46 [1.25]
	$\Delta\beta$		-0.01 [0.43]	0.09 [1.63]	0.24 [2.06]**	0.12 [0.98]	0.10 [0.65]	0.36 [1.66]*
Years 2&3: 16+ hours	β	-0.40 [0.86]	-0.36 [0.79]	-0.37 [0.79]	-0.10 [0.23]	-0.16 [0.33]	-0.32 [0.73]	-0.01 [0.03]
	$\Delta\beta$		0.03 [0.84]	0.03 [0.49]	0.29 [1.95]*	0.24 [1.52]	0.08 [0.39]	0.38 [1.30]
Included controls		F	F, G	F, H	F, I	F, J	F, K	F, G, H, I, J, K
Adj R ²		0.231	0.232	0.236	0.272	0.256	0.329	
F-test (1)			3.86	5.45***	18.08***	3.88***	16.05***	
F-test (2)			1.69	2.04	11.13***	3.04***	13.17***	

See notes to Table D9

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