Melanie Wright Fox
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Family Instability and Children's Cognitive Trajectories in the US and UK

Abstract

Children from lower-income families in the United States and United Kingdom have lower academic performance from early childhood onwards, which leads to less education, lower incomes, and other disadvantages later in life. Family structure may explain some of these differences, as children from lower income families are more likely to be born to unmarried parents or see their father move out or a step-father moved in. This paper uses recent longitudinal data from the US Fragile Families and Child Wellbeing Study and the British Millennial Cohort Study to examine three questions: How large and how stable is the income/test score gap in the US and UK? How much of the gap is due to family structure and family instability, and do the effects differ between countries? Do the effects of family structure and stability differ by the age of the child at exposure? This paper shows that cognitive differences by income quintile are strong but relatively stable from early to middle childhood. Differences in the characteristics of mothers and families explain much of the initial cognitive gap, measured by vocabulary knowledge, between children from high and low income families, but around a quarter of a standard deviation still separates children from the highest and lowest quintiles. Changes in family structure, however, explain none of the gap in the US and little in the UK. Still, changes in family structure influence children's cognitive trajectories, with both biological and social father exits from the household preceding drops in children's cognitive scores. Entries can be associated with gains, but these are strongest when men enter during a child's first years and especially when it is the biological father entering.

Introduction

The consequences of income inequality for children's life chances have occupied both researchers and policy makers for decades, and concerns remain strong today. Sean Reardon (2011) recently focused attention on income's growing influence on education, arguing that the gap in academic performance between children from high and low income families is now as large as the gap between black and white students was fifty years ago, although he focused on scores at single points in primary and secondary school rather than trajectories. This finding is particularly important as success in school determines later academic achievements and career prospects (Duncan and Magnuson 2011). While Reardon and many others focus on specific points in children's educational careers, their trajectories are even more important. Examining gaps in language skills before and through school can illuminate the degree to which formal schooling minimizes, perpetuates, or exacerbates class disparities. The trajectory view also lets us isolate sensitive periods in a child's life, when factors such as family structure may have particularly strong effects of children's academic development. In addition, the reality that parents' income plays a crucial role in the educational trajectories of their children challenges the ideals of meritocracy and social mobility by suggesting that inequalities have become entrenched: low-income children are destined to remain low-income as adults and pass on their status to future generations.

In order to determine the best direction for future policies, we must understand the mechanisms through which income confers advantages on children's education. This research investigates three important questions that relate to this topic: 1) How large and how stable is the test score gap in the US and UK between children from families of higher and lower incomes? In particular, does this gap grow, shrink, or hold constant as children enter and progress through school? 2) Does family structure and stability affect children's cognitive trajectories, and do the effects differ by the age of the child at exposure? This question asks if children are harmed or helped not only by recent changes in their families, but also if there are long-term consequences of family structure changes. Family structure includes not only non-nuclear family forms such as single mothers and stepfathers, but also the changes families undergo as adults enter and leave the household. 3) How much of the income gap is due to family structure and family instability, and do the effects differ between countries? If family structures are harmful to children's cognitive scores and also unevenly distributed across income groups, these may explain some of the vocabulary disadvantage of children in lower income quintiles.

Changing family structure has become an area of increasing concern in these two countries. Media hype around books like Hanna Rosin's "The End of Men" and Charles Murray's "Coming Apart" has focused on children's experiences with cohabitation and single motherhood, even in middle class families, while growing up. Many worry that these increasingly common family forms will have negative impacts on children and their wellbeing, but datasets that are recent and detailed enough to study these trends are relatively new. This study contributes to the literature through its recent, longitudinal data. I use two national birth cohort studies in the United States and United Kingdom that have followed children and their families since around the year 2000 to investigate the possible effects of family structure changes on the development of children's vocabulary from early childhood through the first few years of elementary school. Since this study uses of longitudinal rather than cross-sectional data on each child, we can look at how gaps in vocabulary grow, narrow, or remain as children age and progress through early elementary education, as well as how events timed through childhood contribute to children's trajectories. My study's use of data from two countries adds an additional emphasis on the social context in which transitions take place, as effects may differ by culture and political setting.

My research suggests that much of the durable gap in cognitive skills between children in different economic quintiles can be traced to differences in family characteristics such as race, mother education, *in utero* conditions, and family size, some of which are also associated with family structure and family structure transitions. Previous research has suggested that family structure affects children's cognitive performance indirectly, such as through parental stress and schedule disruption, which makes this study a conservative estimator of any negative impact from changes in family structure. Still, I find that a social or biological father entry negatively affects a child's cognitive trajectory, regardless of when in early and middle childhood the exit occurs. Early entries show positive effects, but social fathers that enter after a child turns three do not appreciably alter the child's cognitive path, and later biological father entries decline in importance as well. Patterns and effect sizes are broadly similar between the two countries. Despite effects from family structure transitions on cognitive outcomes, these

ultimately explain very little of the overall differences in achievement trajectories between children in different income quintiles.

Review of Literature

Past research has produced important findings and areas of unresolved disagreement on which to build. First, there are large and persistent differences between the cognitive abilities of children in richer and poorer households in many modern, English-speaking countries, including the United States and the United Kingdom. Early disparities are important because they predict both later academic achievement and career trajectories in adulthood. As a result, these economic differences perpetuate social inequalities, with those from the lowest socioeconomic groups as children most likely to remain economically disadvantaged as adults. Much work focuses on this early gap and subsequent trends in cognitive abilities, but findings on the causes of these deficiencies are rather inconclusive.

One emerging area of study is the adult relationships in a child's household, from the marital status of parents at birth to changes in the residential status of a mother's partner or partners as the child ages. Research suggests that these transitions may be harmful, and the higher levels of residential instability observed among lower income groups points to the possibility that they may contribute to the cognitive gap. Both the United Kingdom and the United States show high levels of income inequality, and relationship instability is on the rise in both countries. As a result, data from these two countries offer an opportunity to examine this phenomenon in different, but broadly comparable cultural and political environments.

How large and how stable is the test score gap between income groups?

Literature from the US and UK consistently finds an income gap in cognitive skills. This gap is visible even among young children, and it grows or persists as children age. In addition, such a gap has been present for many years, and some evidence suggests that income may be evenly more strongly predictive of academic success now than it was fifty years ago.

Some have expressed concern that, even with equal opportunities, genetics and values that differ by class would produce differences in academic measures by income group (Jencks and Tach 2006). Still, the facts that gaps between economic groups both have grown over time and grow as children age, suggesting that social settings play an important role. As early as 9 months, children below 200 percent of the poverty line lag behind more affluent children in cognitive skills, and gaps are even larger by twenty-four months (Halle et al. 2009). By Kindergarten entry, gaps between the highest and lowest quintiles exceed a full standard deviation (Duncan and Magnuson 2011, Waldfogel and Washbrook 2011). Even compared to linguistically and historically related countries like Australia and Canada, cognitive gaps between high- and low-income children in the United States and United Kingdom by age four or five are particularly large (Bradbury et al. 2011). Many authors find that these gaps persist through the school years (Reardon 2011, Duncan and Magnuson 2011, Belfield 2007), and Magnuson et al. (2012) suggest that they may contract in the first two years of school but return to their original size by eight grade in the US, while gaps in the UK remain stable until age 11 and then increase. In addition, Reardon (2012) finds that income now plays as strongly a determinative role

in children's educational scores as race did fifty years ago, indicative of the growing influence of socioeconomic status. In general, a strong trend of economic inequality in children's cognitive ability holds in both the United States and the United Kingdom, despite differences in their educational systems, social welfare programs, and demographic compositions.

This area of study is meaningful as cognitive skills are predictive of many other life outcomes, so gaps in scores by class perpetuate other inequalities. Those with lower cognitive scores are less likely to finish high school and enroll in college, less likely to hold a consistent job, more likely to receive welfare, and more likely to spend time in prison, and more likely to experience a non-marital birth (Duncan and Magnuson 2011, Rouse 2007, Moretti 2007, Waldfogel et al. 2007, Shonkoff and Phillips 2000). All of these trends perpetuate social inequalities by class, and they also generate costs for the government in terms of tax dollars lost and resources consumed (Knudsen et al 2006, Waldfogel et al. 2007, Rouse 2007). For both equity and financial reasons, thus, it is critical to learn more about the diverging cognitive paths of children from different economic backgrounds. Although past research has clear suggestions that these gaps are large and durable, the pattern of class differences as children ages remains less clear.

What are the effects of family structure and stability, and do they differ by the age of the child at exposure?

Family structure has been widely studied for its effects on children's lives. Children born to unmarried parents are likely to be disadvantaged in a number of ways. In addition to structure when the child is born, later family structure changes may affect children through several pathways, direct and indirect. The change may disrupt their family routines and remove positive (or perhaps negative) influences, or it may introduce step-parents or step- and half-siblings that increase competition for the mother's time and family resources (McLanahan and Percheski 2008). Instability may also have indirect effects, increasing stress or depression in mothers and impeding their ability to parent as well (Cooper et al. 2009, McLanahan and Percheski 2008, Osborne and McLanahan 2007, Ginther and Pollak 2004). Alongside stress, certain family arrangements may bring stigma to the family. Single mothers and unmarried parents have traditionally been looked down upon in both the United States and the United Kingdom, although trend data suggests that public opinion is becoming more tolerant toward non-nuclear families (Thornton and Young-DeMarco 2001, British Social Attitudes 2013). This stigma can lead to lower levels of social support for single parents, adding to any relationship or financial stress and psychological hardship. For these reasons, one might also expect instability to matter more in some contexts than others. Families with higher economic resources might better be able to handle the financial strain of a relationship dissolving, and some relationship changes might affect mothers' mental health more than others.

Researchers often find associations between family structure and transitions and later child outcomes. First, several studies look at how children born into different types of families fare. Over the years, numerous studies have found that children who spend time in single parent households have lower educational attainment (Ginther and Pollak 2004, Sigle-Rushton and McLanahan 2004, McLanahan and Sandefur 1994), and Boggess (1998) finds that children living with stepfathers are less likely to graduate from high school.

Beyond educational outcomes, family structure has been tied to other forms of child wellbeing that may influence learning or at least accompany better cognitive performance. Bzostek (2008) finds that non-biological father figures living in the households are as positive for children as biological fathers in terms of children's behavior and health. McLanahan and Booth (1989) find economic insecurity is high in mother-only families due to lower earnings from single mothers. Behavior also is worse among children from unmarried parents (Cavanagh and Huston 2006, Brown 2004).

Although family structure at birth is important, we may miss important variation in children's lives by only looking at structure at one point in time. Children born to cohabiting parents are more likely to see parental disruption than those born to married parents (Manning et al. 2004), as are less economically well-off couples (Panico et al. 2010). Raley and Wildsmith (2004) suggest that cohabitation transitions are also common, and counting marriages misses much of the instability, especially among black families. These common changes are likely to have consequences, and this research builds on other work in examining the impact on children.

Some look directly at educational outcomes. Fomby (2011) found that family structure instability reduced the verbal scores of children in United Kingdom by school entry, particularly for children born to married parents. Others have also found negative cognitive impacts of instability (Kiernan et al 2011, Cooper et al. 2011, Waldfogel et al. 2010). Sweeney (2011) looks specifically at stepfamilies and finds that stepfather exits hurt children's educational attachment when a marriage is breaking up, and that any marital breakup is worse than a cohabitating couple breaking up for children's schooling. Others do not find any association between family structure changes and cognitive outcomes (Bzostek and Berger 2012, Schoon et al. 2012).

Other looks at other outcomes that are likely to be related to education. Children's behavioral skills may directly influence classroom learning and life chances. Maternal stress and parenting can either support or interfere with a child's learning. Beck et al. (2010) and Cooper et al. (2009) find that coresidential and dating transitions both are associated with increased maternal stress, and Beck et al. also see increases in harsh parenting. Similarly, Osborne and McLanahan find transitions between birth and age three are also associated with increased behavioral problems, moderated by maternal stress and parenting. Others also find that behavior problems increase with family structure changes (Ermisch et al. 2012, Kiernan et al. 2011, Cavanagh and Huston 2006, Ackerman 1999), although others just find this effect for white children (Fomby and Cherlin 2007) or just boys (Cooper et al. 2011). One set of authors separates exits and entries and finds that biological father exits and social father entries increase anti-social behavior, while biological father exits help behavior (Mitchell et al. 2013). The indication from these articles that family structure instability hurts parenting quality and increases mothers' stress, which in turn hurt child wellbeing, suggests that transitions could negatively influence cognitive performance through the same pathways. The Mitchell paper also suggests that entries and exits matter differently, as do whether or not the man transitioning through is a child's biological father or not.

The instability literature has yet to settle the question if the association between family structure and children's skills and behaviors stems from a causal relationship, selection of certain families into both instability and less favorable child outcome, or

simply the level of financial resources, for which a family structure serves as a proxy. Some claim that people sort into non-nuclear family structures based on characteristics such as young age, low self-esteem, and low cognitive ability that also cause lower achievement of their children (Fomby and Cherlin 2007). Others find that the resource losses after an adult leaves the household or gains when one enters explain much of the association between family structure and child outcomes (Schoon et al. 2011, Waldfogel et al. 2010, Ginther and Pollak 2004, Boggess 1998). Still, some of these authors find some effects of transitions on certain child outcomes or for certain subgroups even after controlling for the many complicating factors (Fomby and Cherlin 2007, Ginther and Pollak 2004, Boggess 1998), and some find that family instability is a risk factor more generally (Fomby 2011).

Family transitions are defined differently in some of these papers, from distinguishing different pathways of family change (Bzostek and Berger 2012, Kiernan et al. 2011, Schoon et al. 2011) to counts of changes in residence patterns (Cooper et al. 2011, Fomby 2011, Osborne and McLanahan 2007). This disagreement in results and methods suggests that this area of research is in need of further work to figure out when and what kind of transitions matter. There is also no work that looks at the possibility of differential effects of instability in family relationships between the United States and United Kingdom, which might point to other aspects of the social setting that interact with family change to alter how it affects children.

Research on age of exposure to changes in family structure is relatively thin. A recent article suggested that, contrary to other theories suggesting that all changes are negative, early entries by parental figures can actually play a positive role in the family by improving financial conditions and reducing maternal stress (Osborne et al. 2012). The earliest transitions seem to have particularly strong effects in most cases. Still, this is indirect evidence, as while economic condition and mothers' emotional wellbeing are expected to influence children's cognitive developments, the degree to which they do so remains unclear. Little research traces children and their family structures as children grow, which is a major reason why the present study can contribute strongly to the literature on child development and the ways in which family contributes.

An underexplored area of the research relates to the context or circumstances under which family structures and changes in them might have different effects on households and children. First, social welfare programs can help supplement income lost when one earner moves out. This would reduce the financial impact of family structure changes and possibly reduce the stress that accompanies financial challenges. Such an influence would suggest lesser influence of changes in countries with more generous social welfare programs. One study looked at fourteen countries in Europe to see if the policy environments limited the negative impacts of single parenthood on children's academics, and they found reduced negative impacts in places with strong welfare and family supports and wider gaps in places with weaker social safety nets, including England (Hampden-Thomas and Pong 2005). As the US has an even more reduced welfare state, such research would predict stronger negative effects of relationships transitions in the US than in the UK.

Alternatively, cultural settings may alter both behavior prior to relationship dissolution and effects of such break ups. As to the former, women living in countries

where relationships are less stable may expect that the fathers of their children may not always remain their partners. Kathryn Edin and Maria Kefalas's study of Philadelphia mothers found that this uncertainty encouraged women to be more self-sufficient and retain financial independence even within long-term relationships, that they need "something to fall back on (Edin and Kefalas 2005: 113). Similarly, Kathleen Gerson finds that while young women, of all races and economic groups, aspire to long-term equal partnerships, they also invest heavily in their own self-reliance to be prepared for potential single parenthood or divorce. One woman she interviewed called relying on a marriage to last "false security" (Gerson 2010: 137), and many echoed themes like, "I feel like I always have to be ready if my husband leaves me," (ibid 130) and, "You have to set up insurance policies for yourself in life" (ibid 125). Such positions suggest women that expect relationships to be less stable prepare themselves, financially and potentially even emotionally, for their eventual dissolution. This preparation could dull the impact an exit has on their resources and stress levels, tempering the effect on children's outcomes as well. One might expect variation among groups of women within a country that see more parental relationships break up or between countries with different levels of household dissolution. The above studies suggest many American women prepare themselves financially for relationships to end, but the literature reveals little about British women that would lead to different behaviors in the UK.

Alongside women's individual views, society-level judgments of different family types may shape the social assistance or stigma that she receives from others. Single motherhood has long been a stigmatized category, in the both the US and UK, frequently associated with low-income women and, in the US, with black women (McLanahan and Garfinkel 1989). Divorce also has a past of stigmatization, which again has softened as divorce has become more common and more spread across families of all types. More recently, single parenthood and cohabitation have become more common, and alongside this, negative perceptions of parents in both categories have attenuated somewhat. In the US, a survey asking about the morality of unmarried childbearing prompted the moral censure of 47.2% of women and 41.4% of men in the mid-1970s, but by the late 1990s those disapproving had declined to 34.9% of women and 36.3% of men (Thornton and Young-DeMarco 2001). Moral objections remained slightly higher in the UK in 1994, with 43.5% of women and 48.7% of men finding non-marital childbearing always or sometimes morally wrong (British Social Attitudes 2013). Likewise, only half of American mothers disagreed that parents should stay together for their children, even if unhappy, in the early 1960s. By 1993, 83.7% of these same women and 90.2% of their daughters disagreed (Thorton and Young-DeMarco 2001). British women of all ages expressed less disapproval at 49.0%, or more of a tendency to encourage parents to stay together, by 1994 (British Social Attitudes 2013). Still, these attitudes show a fair amount of permissiveness in both countries, albeit somewhat higher in the US.

Although there is not a literature looking as variations in social stigma toward unmarried or single parents by frequency in the area, literature from criminology suggests that incarceration carries the greatest stigma among groups where experience with ex-offenders is most rare (Hirschfield and Piquero 2010). This suggests we might expect stigma toward single mothers to be strongest in societies where such families are less common and weakest in places where such families are normalized. To the extent that society is more accepting of women that experience family structure changes, this may

decrease the stress that women feel. Single motherhood has also been associated with lower social support (McLanahan and Booth 1989, Smith 1980), but contexts where single mothers are more accepted may be more supportive and limit the resource shock that follows relationship dissolution. As a result, children living in societies where views of non-nuclear families are more accepting may experience less harsh consequences following a residential exit.

These two contextual hypotheses, social welfare through the government reducing disadvantage and social stigma compounding it, produce contrasting expectations for how residential transitions will influence families differently in each country. Stronger negative consequences for transitions and non-marital families in the UK would suggest that stigma and social support play a larger role, while stronger effects in the US would suggest that the policy context matters more. Similar effects of family structure in both countries either suggests that both effects are operating and cancelling each other out or that context matters little for how family structure changes influence children's academic outcomes.

How much of the gap is due to family structure and family instability?

If children from high income backgrounds are more likely to do well in the school, and so are children from stably married homes, instability in their home lives of lower income families may explain some of these children's lower achievement. Past research on children in both the US and UK indicate high instability in early years, although it is far higher in the United States (Kiernan et al. 2011). Many papers note that instability is higher in non-married parent families (Kiernan et al. 2011, Kiernan 2004, Osborne and McLanahan 2007, Manning et al. 2004, Raley and Wildsmith 2004), but because differences in family structure are highly correlated with class (McLanahan 2004), this also implies a class gradient in exposure to instability.

Only one article explicitly addresses the contribution of family structure to income, Waldfogel and Washbrook (2011). They address the extent to which family structure contributes to the income gap in cognitive skills at age five, when children enter school. They define family structure in terms of family pathways, with stable marriage, stable cohabitation, stable single motherhood, some single motherhood and some residential fatherhood, and other. These factors together, the authors find, explain only a tiny bit of lower income children's academic disadvantage. This method, however, misses details of the "other" category, as well as the separate effects of family structure at birth and subsequent changes. It is possible that a more detailed measure could find a greater contribution of family structure to the income gradient in cognitive scores. In addition, the model in this paper looks at timing and trajectories, to investigate if any effects are durable or if they fade in addition to if changes in any particular stage of a child's life have greater effects. In these ways, the present study builds upon Waldfogel and Washbook's work.

United States & United Kingdom

The US and UK are similar in many aspects of their structures and history, but differences in cultures and institutions may also result in variation of how income and family structure operate in the two countries. Both countries have pronounced and increasing economic inequality. The gap between the 90th and 10th percentiles for real

disposable household income in the United Kingdom more than doubled between 1970 and 2000 (Fabian Commission 2006), and the difference between these percentiles' weekly earnings increasing by more than 55% in the US from 1963 to 2005 (Autor et al. 2004). This points to increasing polarization of wages in both countries. Current percentage shares of income by country, as shown in Table 1, reveal a similar story, both before and after adjusting for taxes (Congressional Budget Office 2008, Fabian Society 2006). In general, the overall distribution is relatively similar, suggesting that cognitive trajectories by income should be relatively similar if cognitive path is determined by relative position within the country's income distribution.

Table 1. Share of total income by household income quintile in the US and UK, Pre- and Post-Tax

Quintiles	Pre-Tax		Post-Tax	
	US (2004)	*UK (2003-4)*	*US (2004)*	*UK (2003-4)*
Lowest	4	3	5	7
2nd	9	7	10	12
3rd	14	15	15	16
4th	20	24	21	22
Highest	53	51	50	44

UK data: Fabian Society 2006: p. 124.
US data: Congressional Budget Office 2008. "Historical Effective Tax Rates, 1979 to 2005: Supplement with Additional Data on Sources of Income and High-Income Households." Table 3.

Alongside growing income inequality, both countries have also seen shifts in family structure in the last few decades of the twentieth century and into the twenty-first. From 1970 to 2000, the percentage of children born out of wedlock increased each decade in both countries, more than tripling in the US and more than quadrupling in the UK (Kiernan 2004). Cohabiting couples increasingly are raising children in each country as well (Kiernan 2004, Smock and Manning 2004). Furthermore, cohabiting relationships dissolve more quickly and frequently than marriages (Cherlin 2009, Kiernan 2004), as is shown in Table 2. While both countries show changing family forms, relationships break up more quickly in the US and children experience more transitions (Kiernan et al. 2011, Cherlin 2009). Overall, this suggests that both the US and UK are fertile ground for studying the impact of relationships instability on children, as many children in each country experience changes to their family structure by middle childhood.

Table 2. Chances of a Residential Transitions by Age 9 (US) and Age 7 (UK)

		US	*UK*
	Income Quintile	**Odds of Residential Transition**	**Odds of Residential Transition**
Chance of Entrance	1	0.702	0.315
	2	0.660	0.256
	3	0.533	0.184
	4	0.353	0.116
	5	0.180	0.074
Change of	1	0.702	0.293

Exit	2	0.659	0.266
	3	0.533	0.203
	4	0.415	0.158
	5	0.198	0.123
Chance of Any Transition	1	0.832	0.378
	2	0.783	0.323
	3	0.653	0.238
	4	0.456	0.176
	5	0.243	0.133

These two countries are also particularly appropriate for a paired comparison because they share many characteristics that make them broadly comparable, including common history and language, racial and ethnic disparities between white natives and black and immigrant populations, and the income and family structure trends described above. Still, there are important differences between the countries that could temper the degree to which income and family trends might be expected to yield similar results in children's cognitive scores. British Prime Minister Tony Blair declared a war on child poverty in 1999, and child poverty rates fell sharply in the following five years (Waldfogel 2010). Sure Start, a comprehensive early childhood program targeting low-income children, was beginning in certain communities as data collection for the Millennial Cohort Study was taking place (Hannon and Fox 2005). British emphasis on early childhood and the underprivileged could minimize some of the differences among income quintiles in the UK relative to the US, where family and child support is less of a policy priority. Such a reaction is predicted by Hampden-Thompson and Pong's work (2005), in which they found that single motherhood had the most detrimental an impact on children's academic test scores in countries that are the least generous in their social welfare offerings.

Comparative research offers important benefits over a single-country analysis. To the extent that it finds similar results across settings, it suggests the corresponding mechanisms are not wholly dependent on a particularly social or political context. This then offers more generalizability for the findings to different countries or time periods. On the other hand, differences in operation of mechanisms suggest the potential importance of contextual variables such as the institutional order of a society, its cultural norms, specific policy initiatives, and so forth. Either way, comparative work encourages the researcher and readers to consider the broader institutional, political, and cultural setting and its influences, which may go unnoticed in research focused only on one country.

Theoretical Model and Hypotheses

This paper addresses several questions prompted by the current findings and needs within the literature. First, how strong are the disparities in vocabulary by income groups in the two countries, and how do these narrow or expand as children age? Second, how do entrances or exits of father figure influence children's education trajectories, and does the timing of changes to family structure matter? Finally, how do residential transitions contribute to the income disparities and different trajectories in cognitive scores? With all of these questions, I look for differences between the two countries.

For the first question, based on prior research, I expect there to be strong differences between economic quintiles in both countries, starting at age three and

persisting through the final measurements in the data, age seven in the UK and age nine in the US. I do not expect much change between the quintiles, though I predict any changes would be a widening of the differentials.

For the second question, the literature summarized above leads me to the theoretical models for either an entry into the household or an exit shown in Figure 1. Family transitions will affect financial and other resources on the household level: in the case of an exit, the family will likely lose financial resources, social bonds, and time spent on the child. For an entrance, they would likely gain financially, but the consequences for other resources, such as time, are less clear. With a partner present, possibly also bringing in children, the child might have to compete more for the mother's time and attention. On the other hand, the partner might provide time and attention to the child. Parents' time could also be altered by work schedules, which might shift after a change in family structure. For instance, a newly-single mother might have to take on additional work to maintain family income, which could reduce the change in financial resource but also limit her time at home. Thus, the trend is largely negative for an entry and either positive or mixed for an entrance.

In addition, mothers are likely to experience stress following exits from the family. Some of this may be related to financial changes, while some of it may be emotional consequences of a breakup. If society looks down upon single mothers, divorce, or the breakup of cohabiting couples, mothers may also experience stigma in the face of an exit that would increase their psychological burden. In the event of an entry, there may be stress on the household level as family members have to adjust their roles vis-à-vis each other and adapt to new patterns, but the mother may be less stressed from the positive side of relationship formation. On the other hand, an entry may relieve financial stress, and thus the overall effect of an entry on stress is unclear.

The effects of both exits and entries also might differ based on whether the person entering is the child's biological father or not. I would expect a biological father to be more invested in the child's life and to contribute more financially, so his entrances might help more and exits might be more harmful than that of a social father.

Both stress and resources then affect the quality of parenting and the overall educational environment for the child, such as books and stimulating toys, exposure to new environments like museums or zoos, or higher-quality childcare (Phillips 2011, Guo and Harris 2000, Bradley and Caldwell 1981). An environment with more resources and better parenting is likely to increase a child's cognitive scores, while one with fewer resources and lower quality parenting may reduce children's measured vocabulary. This causal chain is the same for either an exit or an entry, but the predictions vary.

This model predicts lower vocabulary outcomes from exits resulting from lesser finances and other resources and increased stress and psychological load. For entries into the household, the model predicts mixed or ambiguous results. Transitions are concentrated most heavily among those with the lowest incomes, as shown in Table 2, so one implication of this model on the national scale is that residential transitions should explain some portion of the income disparities in children's cognitive scores.

Between the countries, I expect similar impacts of transitions on cognitive scores as the theoretical model should operate similarly. This may not be the case for two reasons, which would lead to opposing hypotheses on how the effects of residential exits or entries would be expected to differ between the countries. First, the social welfare

system in the United Kingdom offers universal financial benefits for parents and increasing emphasizes early childhood education through Sure Start (Waldfogel 2010, Hannon and Fox 2005). To the extent that the UK provides more extensive support to parents and may lessen the financial burden of a single mother after a residential exit, I would predict less of an impact of residential exits on children's vocabulary in the UK than in the US. A study looking at the effects of single-parenthood in Europe, following this hypothesis, indeed found less negative effects in the countries with the most generous social support (Hampden-Thompson and Pong 2005). On the other hand, cultural distances might favor the US: as residential changes are more frequent in the United States, they may be less stigmatized and thus the psychological burden the mothers experience after an exit may be reduced. In addition, if women in the US expect that their relationships are likely to end, they may prepare a back-up plan by ensuring their own self-sufficiency (Gerson 2010, Edin and Kefalas 2005). This preparation may reduce the financial and even psychological shock of a relationship exit, thus reducing the impact of an exit on children in the US relative to the UK.

Timing of changes is a less studied area, so there are fewer preconceived expectations for when children might be most sensitive to family structure changes. While earlier exits might be most harmful in that preschool years are a time of neural plasticity and critical socializing and training that sets the groundwork for future leaning (Nelson and Sheridan 2011, Heckman 2006) , early entrances are more likely to be biological fathers than later entrances, which may suggest better outcomes for children when entrances are early (Osborne et al. 2012). School entry is another theoretically important point to investigate, as many policies interested in inequalities target schools. While some research suggests that inequalities persist over the school years (Magnuson et al. 2012), these say less about skills before school entry and do not generally address family structure. Family structure may be less impactful once school plays a larger role in the child's cognitive development, but the stress and disruption of a family structure change may also carry over to school attendance and functioning, thus minimizing the difference of impact from a family structure change before or after school entry. More research needs to be done on timing, as this study does, before clearer hypotheses on timing can be generated.

Data & Variables

I will use two large, panel birth cohort studies whose focal children were born around the year 2000. The Fragile Families Study is a stratified random sample of nearly 5,000 urban births in the United States, based on births from 1998 to 2000 in 20 cities with at least 200,000 people (for more detail, see Reichman et al. 2001). Cities were sampled first based on obtaining a diverse set of policy environments defined on three dimensions: welfare generosity, child support law rigor, and labor market strength. Within each city, the researchers sampled hospitals. In these hospitals, they randomly sampled births until they met quotas for oversampling non-marital births. Mothers and fathers were first interviewed around the time of birth, and they were followed up when the child was age one, three, five, and nine. Attempts were made to interview both parents, regardless of residence, although attrition is far higher among fathers. At ages three, five, and nine, interviewers also conducted in-home surveys, which include cognitive and physical assessments, neighborhood and residence observations, and

additional questions asked of the primary caregiver. Response rates were relatively low for the in-home component of the age three and age five surveys, with around 2,100 participants, and increased significantly to about 3,500 at age nine. Nine-year survey instruments also included a teacher survey and a survey completed by the focal child.

In the UK, the Millennial Cohort Study was based on a stratified random sample as well (for detail, see Plewis 2004). The researchers stratified by country within the United Kingdom (England, Wales, Scotland, and Northern Ireland) and then sampled wards, the electoral districts of the United Kingdom. They oversampled wards with at least 30 percent of residents classified as Black or Asian ethnic minorities in England and those in the poorest 25 percent of wards in order to capture disadvantage. Families with nine-month-olds in these districts were invited to participate as long as they were eligible to receive the Child Benefit, a measure mostly designed to exclude residents temporary to the UK. Children in the sample were born in specific months in 2000 and 2001 (some later births were included in Northern Ireland and Scotland), and primary caregivers and their resident partners were interviewed when the child was nine months old, three years old, five years old, and seven years old. Starting in the second wave, interviewers also conducted cognitive and physical assessments. Older siblings completed interviews at waves two and three. Teachers were asked to complete surveys when the children were five and seven.

For my data, I will include all children in each survey that have cognitive evaluations at every age as well as information on relationship statuses of their mothers. I also restrict my analysis to families whose income quintile is calculated in the UK and whose household income is collected or constructed in the US. In the UK, I only use the first child interviewed in each household to avoid intra-family correlation. Only one child was sampled in each Fragile Families household. My final models end up with 10758 children in the UK and 1403 children in the US. Most sample loss comes from missing cognitive measures, though some families are missing on other critical analysis variables. Only 1559 of the nearly 5,000 children originally sampled by Fragile Families have cognitive tests and the others were excluded from the study for missing information on other variables.

Limiting the data in these ways may result in sample selection as not all households originally sampled are in each survey with full data at all analysis waves. Even if the original samples are nationally representative or can be weighted to be representative of most families, families that are in all waves are definitely not. These waves require many hours of survey time and assessments, including in-home visits. They also require families be traceable at all waves, so a degree of stability may be important or at least consistency in contact information or family that can direct researchers to current locations. It is very likely that these families will differ from those on whom I have data in important ways. They are likely to have the most instability, which would cause them to move and make them more difficult to locate. They may also be those most disrupted by this instability if their contact information is broken or they cannot find the time to speak with interviewers. We are unable to capture the costs of instability for these families. This will be an issue for our estimates if these vulnerable families react differently to instability, which our data cannot show. There is no reason to believe *a priori* for this to be the case, however. In order to address selection as best as possible, I control for many factors of families that may differ and run a number of

robustness checks that define the sample along different terms. In particular, I use multiple imputation to limit use available information to estimate the impact of family structure transitions on a population with less missing cognitive data. This increases the sample size in the UK by slightly under 300 cases and in the US by around 2000 cases.

Cognitive Scores

Both studies contain cognitive assessments conducted during in-home components of their surveys that I will use together to form my dependent variables. The MCS uses one sort of evaluation at age 3 and 5 and another at age 7. At the youngest ages, the assessment is the Naming Vocabulary Subtest of the British Ability Scales, in which the child names pictures of common items. At age 7, the assessment used is the Word Reading Subtest of the British Ability Scales, which involves reading words off of cards. The data contain raw scores, abilities scores (not adjusted for age), T-scores (at ages 3 and 5), and standardized scores (for age 7). I will use the standardized and T-scores, which are adjusted for age. The T-scores are set to a mean of 50 and standard deviation of 10 and standardized are set to a mean of 100 and standard deviation of 15. In both cases, I convert these to Z-scores.

The FFCWS uses, at all waves from age 3, the Peabody Picture Vocabulary Test (PPVT). This assessment involves a test-giver showing the children cards with visual images that the children must identify by the proper name. The dataset contains both raw scores and those standardized by age in months to have a mean of 100 and a standard deviation of 15. I convert these into Z-scores as well.

One potential issue with these data is the different instrument used at ages five and seven in the UK, as any differences in outcomes may be due to variation across language skills rather than real gains or delays in progress as children age. While the US tests and the tests for British 3 and 5 year olds measure vocabulary and oral language, the measure for 7-year-olds is more in line with reading. Other research, however, has found that early oral language is a strong predictor of emergent language and reading capabilities (Marchman and Fernald 2008, Lonigan et al. 2000). In addition, cognitive assessments begin at age three, when skills might be difficult to measure accurately. A 2005 review article on early childhood assessments, however, notes that despite difficulties measuring children's cognitive skills in the past, recent tests have far more accuracy and predictive power (Rock and Stenner 2005). This further justifies the benefit of this study, with its cohorts of children born around the year 2000. This same review found the PPVT, the measure used in the US sample, to have good reliability but show particularly large racial gaps among young children.

Residential Transitions

My core variables are sets of binaries for the presence of a residential exit between interview waves and the presence of residential entries between interview waves, separately for biological and social fathers. Each set is calculated for three time periods: birth to age 3, ages 3 to 5, and beyond age 5. My variables are likely to be underestimates of actual family structure transitions due to assumptions implicit in the skip patterns in each survey, as the Fragile Families study does not ask about interim breakups if a couple is cohabiting at consecutive waves and MCS only asks this at certain waves. Due to this data constraint, if natural parents are cohabiting in successive waves and the survey does

not ask about interim relationships, there are assumed to be zero transitions. If a residential partner is the same as consecutive waves, there are also assumed to be zero transitions. Otherwise, I calculate entries and exits based on biological and social father presence in the household and survey questions about co-residential relationships between waves. These most likely miss very short cohabitations and temporary relationship interruptions.

This measure for instability is likely to be an underestimate, missing in particular transitions where the couple is together at two successive analysis waves but spends time apart in between. This might result in an underestimate of the consequences of transitions by diluting the actual differences between those counted as experiencing a transition and those counted as not doing so. As a result, to the degree that these cases are omitted, my estimates of the effects of transitions should be treated as conservative.

Income Quintile

Income quintiles are calculated for each country (Scotland, England, Wales, and Northern Ireland) within the UK for MCS respondents at the first wave. For the US, I use a constructed household income variable for age one that is distributed with the data. I then used national income quintiles based on the 2000 Census, as retrieved from the 2001 Current Population Reports: Consumer Income.

Control Variables

I use controls for the child's sex, biological parents' relationship status at the child's birth, mother's education (less than high school, high school equivalent, some college, college degree or more), mother's racial or ethnic group (white, black, South Asian in the UK or Hispanic in the US, and other), mother's immigration status, number of other children in household when child was one, if child was low birth weight, if the mother worked when the child was one, if the mother smoked during the pregnancy, and if the mother drank alcohol during the pregnancy. The sets of controls added in models two and three are similar to those used in other work (Waldfogel and Washbrook 2011, Kiernan et al. 2011). As parental characteristics are likely to directly influence children's learning and home and *in utero* environments may affect the health of and attention given to the child. In order to distinguish marginal effects of residential changes, it is important to control for known ways that families differ that can affect their children's vocabularies. Education and other family characteristics are related to both their likelihood of going through a change in family structure and children's outcomes, and thus controlling for them helps account for selection into family structure transitions and children's vocabulary that otherwise would be incorrectly measured as an effect of the transition. Most measures are from the 9-month MCS survey and the 1-year FF survey to maximize compatibility. These are thus measured prior to transitions and children's cognitive testing, which is important to avoid endogeneity. For this reason, variables measuring aspects that are likely to change in response to transitions, such as current family income, or in response to children's cognitive scores, such as parenting behaviors, are not included. I am also avoiding overcontrolling, where I could underestimate effects that are also associated with other changes in the family's life. Descriptive statistics, unweighted and thus over-representing underprivileged families in the UK and unmarried couples at the child's birth in the US, can be found in Table 3.

Methods

In order to look at the timing of changes and children's cognitive growth trajectories, I use a complex model that predicts scores and changes in scores based on transitions preceding each measurement, as well as with the control variables that address family selection into different income groups and cognitive dispositions. First, I have three data points for each person, so my observations of cognitive score are not independent of one another. My model takes into account the association between a child's past score or scores and present one, in order to be able to learn more about learning trajectory and the importance of the timing of family structure changes to it. Second, my data follows a time series, from age three to age five to a point during elementary school, either age seven or age nine. The model accounts for the amount of time that has elapsed since the past measurement, allowing for the spacing of measures to differ by country but assuming equal annualized growth beyond age five. I also am looking at characteristics of the family structure in the intervals between these measurements to see how recent events matter if early events have lagged impact. I also do not want to assume a linear growth pattern of cognitive scores, as theory does not necessarily suggest such linearity exists (Morgan 2001). As a result, the model I use allows the rate of growth to differ between ages three and five and past age five.

The model fitting these data and analysis is a multilevel, piece-wise random intercept model. This will allow for correlation between observations of the same child over time and to follow their own trajectory parallel to one that depends on variables such as family structure and changes and income quintile. Below are the equations used in the final model:

Level 1:

$$Y_{it} = A_i + B_i(\text{Years 3-5})_{it} + C_i(\text{Years Past 5})_{it} + u_i + e_{it}$$

Level 2:

$$A_i = \alpha_0 + \alpha_1(\text{IncomeQ}) + \alpha_2(\text{ResTrans0-3}) + \alpha_3(\text{MomChar}) + \alpha_4(\text{FamilyVars})$$

$$B_i = \beta_0 + \beta_1(\text{IncomeQ}) + \beta_2(\text{ResTrans0-3}) + \beta_3(\text{ResTrans3-5}) + \beta_4(\text{MomChar}) + \beta_5(\text{FamilyVars})$$

$$C_i = \gamma_0 + \gamma_1(\text{IncomeQ}) + \gamma_2(\text{ResTrans0-3}) + \gamma_2(\text{ResTrans3-5}) + \gamma_2(\text{ResTrans5+}) + \gamma_3(\text{MomChar}) + \gamma_4(\text{FamilyVars})$$

At level one, a child's cognitive score at a given age is a sum of an intercept A_i denoting predicted score at age 3, the product of a coefficient B_i that is a predicted annual slope from age 3 to 5 and the number of years lived in the interval 3 to 5, the product of a coefficient C_i that is a predicted annual slope from age 5 to 7 in the UK or to 9 in the US and the number of years lived in that interval, an individual error that is constant over time, and an individual error that varies over time.

A_i is given by the level two equation including income quintile, residential changes from ages 0 to 3, mother characteristics, and family background control. B_i includes all variables in A_i as well as residential transitions ages 3 to 5. C_i includes all the

above variables in addition to residential changes after age 5. As a result, residential changes affect cognitive outcomes at the end of the interval in which they occur and in all future time points, to allow for longer-term effects.

In the multilevel regression, I first allow initial cognitive score, at age 3, to vary by income group and for cognitive growth to vary by income quintile between ages 3 and 5 and again from age 5 to age 7 in the UK and to age 9 in the US. The second model includes basic mother characteristics: her education, her racial or ethnic group, and whether or not she is an immigrant. The third model adds other family controls, including if the child was low birth weight, the number of children in the household, the mother's age at first birth, if the mother smoked or drank during pregnancy, and the relationship between the child's biological parents when he or she was born. These controls are allowed to affect the intercept (shown in Table 4) as well as the slopes between ages (not shown). In the fourth model, I add in residential parental transitions and initial family structure to the second level equations for the intercept and growth coefficients.

I allow both recent transitions and those in previous intervals to count at each point. This lets me look at the full trajectories for children with early family structure changes, now just how these changes affecting their first measured score. The model allows effects to emerge immediately or emerge over years, as well as either diminish or endure over the child's life. Family structure changes between birth and age three are allowed to affect the child's initial measurement at age three as well as growth to age 5 and either 7 in the UK or 9 in the US. Changes between ages 3 and 5 can affect the changes in cognitive scores the child shows from age 3 to 5 as well as after age 5. Family structure changes in the final interval affect only changes in score after age 5.

This model will address the literature claiming selection into transitions is the only reason for their correlation with children's outcomes. It does not, however, distinguish the mechanisms through which transitions may have an effect, allowing for the possibility that financial resource changes explain children's vocabulary development. The theoretical model suggests, however, that financial resources are only one likely pathway, and that other resources such as time and attention and the stress and stigma felt in households are also affected.

Results

Some basic descriptive statistics provide details on the British and American samples by socioeconomic status. Both the MCS and FF studies contain oversamples of disadvantaged populations, as is shown by the population size in each quintile (Table 3). Markers of advantage follow an income gradient in both countries, with higher education, higher marriage, older ages at first birth, and fewer minority mothers in the top quintile as opposed to the bottom quintile. Marriage rates among respondents are higher in the UK, while single parenthood at birth is more common in the US. The US is also more diverse in terms of race and ethnicity, particularly in this sample, and white mothers are clearly underrepresented.

As past work has shown and Table 2 earlier in this paper demonstrates with the present data, chances of any residential transition are higher in the United States for all quintiles and all time periods. Both countries show a gradient by income, although the spread of transitions across quintiles is somewhat different. In general, the disparity between the top and bottom quintiles is stronger in the US. In addition, disadvantage is

more concentrated in the US, as is advantage, while the UK shows a smoother gradient of transition rates across the income spectrum.

Results of the four models over the US and the UK are shown visually in Figures 2 through 6. More detail is available in tables in the appendix. These all address different components of the three questions driving my research.

How large and how stable is the test score gap between income groups?

The gaps by income groups in the US and UK are large and persistent, as shown graphically in the first column of Figure 2 and in detail in Appendix Table 1. Model 1, which does not control for any selection factors, demonstrates strong differences in average cognitive scores by income group, with children from the highest income families showing the largest vocabularies. These disparities exist at age three and persist through middle childhood, particularly in the US. In the UK, the lowest income quintile is far below the other four, although it catches up partially between ages five and seven. The difference between the top and bottom groups is more than three-quarters of a standard deviation at age three and still half a standard deviation at age 7, a reduced but still large gap. Scores at age three in the United States show a strong advantage for the top income quintile, about a standard deviation above the lowest quintile. The middle and second highest quintiles are around half a standard deviation below the lowest group. Over time, the five quintiles remain spread out, with the top quintile retaining more than a quarter of a standard deviation advantage over even the next group, through age nine. The difference between the top and bottom in middle childhood is at least as large as at age 3.

Although the UK shows some evidence of the gap between children in the lowest economic quintile and all other narrowing once children start school, this may be either evidence of catch-up by poorer children or a vestige of the different test for cognitive ability used at age seven. If the difference is due to test, this would suggest that children are slightly less disadvantaged in the lowest socioeconomic class in terms of their reading ability than they are by vocabulary size. If the results reflect true changes in the distribution of children's cognitive scores, on the other hand, this suggest that schools may help the worse off recover from earlier disadvantages.

While the first column of graphs present descriptive statistics about children's actual cognitive test results, much of the reason for these large and durable gaps may be because of parental and family traits that lead families to be in particular income groups. This is addressed in two further models and shown in the difference between the left and right columns of Figure 2. Model 2 includes controls for mother's race or ethnicity, education, and immigration status. These have the expected effects, almost all significant, on cognitive scores at age three, with higher education predicting higher achievement and minority racial group and immigrant mothers associated with lower achievement. In the UK, minority and immigrant families have higher growth in between ages five and nine, recovering largely or even exceeding their initial disadvantages. There is little evidence of differences in trajectories by mother characteristics in the US, although children of immigrant mothers recover a small portion of their initial disadvantages between ages five and nine. Including these variables sharply reduces the initial differences between income groups, cutting the advantage of the top US quintile by around three-quarters. Maternal education plays a particularly large role in explaining the disparities by income,

but her race and immigration status, the family size, and the child being low birth weight also explain parts of the gap. Despite all of these controls, however, the highest income quintiles in each country remain a quarter of a standard deviation above the lowest group in the first measurement.

In the third model, I add controls for more numerous aspects of the *in utero* environment and family background. This reduces the income coefficients for cognitive score at age 3 in the US and UK and the overall separation between cognitive trajectories. Still, variation by socioeconomic status remains. This model shows an initial advantage in the US of over a quarter of a standard deviation for the highest income quintile relative to the lowest, growing to approximately .31 standard deviations by age 7. The UK shows increasing advantages in the upper three quintiles between ages 3 and 5, while the lowest catches back up somewhat between ages 5 and 7. While the overall difference between the highest and lowest quintiles is .16 standard deviations at age 3, it contracts only slightly to .14 at age 7. Still, economic differences in children's achievement remain significant, statistically and meaningfully, in both countries through early childhood, even after accounting for family characteristics.

Together, these two models suggest that much of the reason that children in higher income quintiles have consistently higher cognitive scores is because their mothers are more educated, the pregnancies resulting in these children were healthier, and the families are more likely to be from advantaged racial groups. This can be seen in the narrower distribution of scores by income quintile on the charges on the right side of Figure 2 relative to that on the left. Even despite all of these selection forces, however, children's success is meaningfully predicted by the socioeconomic conditions in which they were born. Such advantages remain as children age and progress through school. This result was expected based on past work looking at educational trajectories by class, such as Magnuson et al. 2012.

How does the timing of family structure changes matter for children?

1) Family Structure at birth

Prior to asking if family structure affects the income distribution of children's cognitive scores, I establish that it matters for cognitive score trajectories at all. First, a growing body of research concentrates on marital status of parents at the time a child was born, suggesting advantages for children of married couples over those born to cohabiting parents or single mothers (Ginther and Pollak 2004, Sigle-Rushton and McLanahan 2004, McLanahan and Sandefur 1994). I ran a set of models predicting cognitive trajectories by relationship status at birth, always controlling for family structure transitions to ensure that the results are not merely capturing the effects of structural change, which is more common among the unmarried. The expectation of non-marital disadvantage is borne out in the statistical model shown in the first graph of Figure 3, which shows that children of single mothers in both countries start with lower cognitive scores and that their disadvantage grows through middle childhood. Children of cohabiting unions in the UK start out on par with children in married parent families, but they steadily lose ground, while children of cohabiters in the US begin disadvantaged and neither gain nor lose ground. These findings support the disadvantage to children of unmarried parents found in previous studies.

Model 3, shown on the right in Figure 3, shows that much of the difference in these trajectories can be attributed to characteristics of parents that correlate with their marital status. After accounting for these factors, children in cohabiting unions are roughly on par with children born to married parents throughout middle childhood. Children of single parents still show increasing disadvantage through the years, albeit at a lower level, suggesting that this family structure type itself contributes to children's difficulties in learning.

2) Early Family Structure Changes, Birth to Age 3

In addition to parental relationship at birth, children may experience many changes to their family structure as they age. First I look at changes between when the child is born and when he or she is three and cognitive skills are first assessed. As Figure 4 shows, these early changes have lasting consequences. Model 1, not shown, controls for relationship status at birth only, and it shows that children whose fathers leave the household fare poorly over time. Even with a full set of family controls, although not including income quintile, children in both countries whose fathers left in early years end up over a fifth of a standard deviation behind stable peers by age 7. Father entry, on the other hand, shows positive growth by age 9, suggesting children are better off if father enter than if mothers remain stably single.

Early presence of a non-biological father figure has less clear results, and they seem to differ by country. In the US, an entering social father hurts a child's cognitive score at age 3, but these children catch up with stable peers by age 5. Adding an exit appears to produce further disadvantage that may be enduring, although standard errors are high on estimates for these trajectories as social father exits in early years are rare and the US sample is relatively small. In the UK, social father entry provides a boost to children's scores at ages 3 and 5 that erodes over time, although much of this advantage may be from selection into families that tend to gain social fathers. If the social father exits in these early years, this appears to counteract any benefits, but as in the US low frequency of this event adds to standard errors. Results suggest that children suffer from the loss of a social father just as from the loss of a biological father, though the advantages from social fathers are more questionable, particularly in the US.

3) Preschool Family Structure Changes, Age 3 to 5

Changes after age three but before school entry can also show durable effects, though not always as strong as effect from the earliest transitions. These patterns are revealed in the graphs in Figure 4. In both countries, children whose fathers left the household during that time fell behind children in stable households by age 7, with children in the US seeing a drop by age five and children in the UK seeing a more delayed decline. While father entries boosted cognitive scores in the earliest years, that pattern is less clear for entries while children are preschool aged. US children do not seem to benefit, while UK children show some delayed benefits. Similarly, social father exits showed negative effects for children in both countries by age 7, though the damage was stronger in the UK. Social father entries seemed to have minimal effects. Overall, these results suggest that a father figure entering a child's household has the strongest positive effects when children are very young, below age three. Losing a father figure, social or biological, continues to hurt children even if this happens once they reach preschool age.

4) Elementary School Family Structure Changes, Ages 5 to 7 or 5 to 9

The final set of trajectories addresses family structure changes after school entry, shown in Figure 6. As in earlier periods, biological father exits hurt the child's cognitive trajectory. Once I have accounted for selection through a full set of controls, biological father entries seem to have only a minimal benefit, which is also consistent with the effects of entries in preschool years. The story with social fathers is almost identical at this age, with small benefits from entries and disadvantages with exits. All but biological father entries are statistically significant in the US. While point estimates in the UK are similar in magnitude, standard errors are larger because of fewer transitions and thus none are statistically significant in the model with full controls.

Overall, both biological and social fathers clearly are important to children and their academic success. Children born to single mothers have disadvantages over children born in two-parent households, and they continue to fall behind as they age and progress through school. Still, family structure changes can either boost children's skills or contribute to them falling behind. Biological fathers have the strongest positive effect by entering between a child's birth and age three, though children in the UK still see gains when their fathers join the household before children enter school. In later periods, gains are minimal or nonexistent. This suggests increased challenges to incorporating a father back into the family once the child grows older, which is in line with the article by Osborne et al. (2012) highlighting benefits to early entries.

Social father entries are less clearly positive, although at least they do not seem to have the negative effects on children that others have found (Mitchell et al. 2013, Boggess 1998). Children in the US that gain a social father in early years start out behind but quickly catch up, while those in the UK see an initial benefit that declines. Social father entries seem to have little benefit if they occur over the preschool years, and in the UK this pattern seems to continue for social fathers joining the household after children enter elementary school. In the US there is some evidence of a slight gain for children gaining social fathers in this late period. In general, these results echo much of the ambiguity of the model for father figure entries. On the balance entrances seem to have little effect, at least if they occur after children turn three, and social fathers even then help children less than biological fathers.

On the other hand, exits of both biological and social fathers leave enduring negative effects on children, regardless of when they occur. This is in line with the exit diagram in Figure 1, where an exit strains financial resources as well as likely increasing psychological strain and the mother's parenting stress.

How do residential transitions contribute to the income disparities in cognitive scores, and do these effects differ between the two countries?

Cognitive gaps by income status exit and last for children in both the US and UK, and certain changes in family structure seem to affect children's cognitive performance. As there is an association between income and family structure changes, the remaining question is if these family structure changes explain some part of the income gap. I address this question by adding family structure variables to the income quintile model discussed in answering the first research question, shown in the final columns of Appendix Table 1.

In the US, adding family structure and residential transitions barely alters the difference between the highest and lowest quintiles at age 3, which stays around a quarter

of a standard deviation. It only slightly reduces the widening of the quintiles, itself still insignificant at each interval, between ages 3 and 7, so that the overall difference between high and low income children in the model with family structure is 0.32 standard deviations at age 7 instead of 0.34 in the model without family structure. These figures also suggest that family structure explains about two percent of the total difference in cognitive scores between children in the highest and lowest quintiles by age 7. Overall, family structure changes contribute modestly at most to the income gradient in cognitive scores and its growth as children age in the US.

In the UK, adding the family structure variable reduces the gap only slightly more. From the model with full controls, adding family structure reduces the top quintile's advantage at age three from .18 to .16, and by age 7 from .17 to .14 standard deviations. Family structure explains 5.5 percent of the overall differential between the top and bottom quintiles by age 7. This is higher than the US largely because there is less variation at this point to explain, but it also suggests that family structure plays a slightly larger role in explaining the income gradient in cognitive scores in the UK than in the US. Still, family structure is only a minor component of the large and durable gap between children high and low income families.

Robustness Checks

One potential concern with this study is missing information, particularly in the United States. In the Fragile Families study, many children are missing cognitive scores at ages three or five, though rates are higher at age nine. Children in the Millennial Cohort Study generally have more complete information, though there remain some missing items. I used multiple imputation to use existing information to estimate the model if fewer items were missing, in particular family structure transitions where this information is incomplete and cognitive scores at three and five years when cognitive scores are present at age seven in the UK or age nine in the US. Using five iterations of multiple imputation, I reran the models. This increased the sample by nearly 2000 cases in the US, from 1403 to 3334. The same process only increased the UK sample by around 300.

On the whole, the multiple imputation did not change the conclusions from the data through various models. Point estimates were lower in many cases, particularly in the US, although usually the coefficients remained significant. A few somewhat anomalous earlier findings were more in the expected directions in these models as well: the second highest income quintile in the US is closer to its expected position in controlled trajectories and nearly eliminating the crossover shown on the right side of Figure 2. In addition, the gain from social fathers entering after age 5 in the US drops to nearly zero, which is consistent with the null effect social father entries have in the US at early time periods and in the UK contemporaneously.

Only one finding suggests a different story. While social father exits during preschool years in the US were mildly negative in the original samples, they are null in the multiple imputation models. Still, in general these results suggest that while the point estimates from some models may be too large, the direction, pattern, and significance appear robust.

To further check the selectivity of the US sample, I ran OLS regressions of family transitions on age three cognitive scores for all children with cognitive scores at age three and with family structure data for the waves up to that point, then again for cognitive score at age 5 for those with cognitive scores at five and family structure data to that point, and then again on those with cognitive scores at age 9. At three, the only significant family structure variable is a negative effect of a social father entry. As we see most effects growing over time, this is in line with the trajectory models. At five, both early biological fathers movements have significant effects in the directions expected, as does a father exit in the preschool years. This matches the trajectory models, where social father effects at age five are null for both early and preschool changes. Finally, nine year models show negative effects for three exits: biological fathers in preschool and both types of father figures during school years. Changes from the earliest years do not show up as significant, which is somewhat surprising, but the others are consistent with the trajectory models show above. Still, these earlier changes in family

I also ran several models with interactions on different terms. First, I used interactions of income quintiles and residential transition binaries at all levels in both countries. In each country, occasional interaction variables were significant, but neither the significance nor direction of coefficients showed a significant pattern. In general, the pattern seemed to suggest that residential transitions do not have strongly distinct effects for families of diverging socioeconomic statuses.

Next, I interacted gender with transitions to see if changes in household composition were particularly harmful or helpful for girls relative to boys, since literature on instability has shown gendered effects of instability on behavioral outcomes in early childhood (Bzostek and Berger 2012, Cooper et al. 2011, Cavanagh and Huston 2006). In general, girls' cognitive skills are higher than boys', although this advantage is reduced by age 7 in both countries. There are no statistical differences in early changes in father residential status for boys or girls, although generally the direction of effects suggests fathers' exits may be slightly harder on girls. Early social father entries also seem to help girls more based on large differences in predicted scores between boys and girls at age 7 even accounting for the female cognitive score advantage, although the interaction is only significant in the US. Overall results suggest that girls may show stronger effects than boys, either in positive or negative directions, on their cognitive scores following at least certain changes in family structure. Still, many of these differences were small and even large ones often statistically insignificant, which suggests caution in drawing conclusions.

Finally, I interacted relationship status of the biological parents at birth with relationship transitions, following suggestions from Fomby (2011) that children born to cohabiting parents were less susceptible to negative effects from parental transitions than children from married parents (not shown). More coefficients were significant in this set of interactions, but the directions of effects varied by interval, yielding few clear patterns. In total, these interactions suggests that the impacts of transitions by initial family type and sex of the child are worth exploring in other studies with high sample size and incidence of family change, but we do not have clear expectations for how these families may respond differently to changes in residential status of biological and social fathers.

Summary and Conclusion

In this study, I first look at how large and durable the vocabulary gap is by income in both the United States and United Kingdom, tracing children from age three through middle childhood. I find that economic inequality in cognitive scores of children is strong and durable in both countries, reinforcing findings elsewhere in the literature. The gaps are larger and more evenly spread in the US, and the top three quintiles in the UK are tightly clustered above the bottom two once controlling for family background. Still, disparities remain between 0.27 and 0.32 standard deviations across all ages in the US and between 0.14 and 0.27 standard deviations in the UK. This suggests that parental background explains much of the association between income and cognitive scores, but income remains important to children's cognitive development in both countries.

Second, I ask how family structure transitions at different points in the child's life influence vocabulary and the learning trajectories, as well if family structure changes have different effects in the two countries. I find that biological father exits contribute to lower achievement trajectories, regardless of when they occur over early and middle childhood, in both countries. Father entries help increase children's vocabulary when they occur between birth and age 3, but later entries are less effective. Social father exits are seem to generally hurt children's cognitive performance, whenever they occur. Social father entries are less clear. In the US, I see no effect of social father entries before the children enter school and potentially small positive effects of entries after age five. In the UK, children with social fathers that enter before age three see temporary gains that fade by age seven. Later entries show little effect, though the direction is positive. In sum, the model suggesting that a father figuring leaving the household hurt children is supported. This analysis does not address the hypothesized pathways, reduced financial and other material resources as well as increased maternal stress following an exit. These should be explored in detail in further research. Entries play a more ambiguous role, although even stepfather entries do not appear to lead to negative outcomes, as some have hypothesized. Father entries also seem to be better earlier in a child's life, highlighting the importance of the first few years of a child's life.

Finally, I ask the degree to which changes in family structure impact the income gradient of cognitive scores across early childhood. In both countries, family structure explains little of the gap once selection into income groups is taken into account, only two percent of the difference in the US and 5.5 percent of the difference in the UK between children in the top and bottom income groups by age seven. In both places, much of the income gap remains unexplained. This suggests that family structure plays a minor role at most in magnifying class differentials in the UK and in the US.

Even if family structure does not explain much of the income gap, three findings of this study remain important to future work on disparities among children. First, income is a powerful determinant of children's cognitive scores, and this effect emerges early in life and remains visible as children progress through school. While this itself is not proof of unequal opportunities, it does suggest that higher income children have certain advantages, and how they gain and retain their academic edge should be explored in more depth. Second, changes in children's family structure and in particularly the exit of a father figure hurts children's academic performance in a durable manner. Although this particularly study does not reveal the mechanisms leading to this association, it does

suggest that stability and two-parent households can help children's performance. Work in the future should look specifically into how structural changes directly affect children to best determine how to help families going through transitions. Income support and mental health or social support could be important pathways to help families and in turn children's academic performance, but more work should be done to target these types of programs most effectively.

Finally, this research suggests that effects of family structure are not broadly different between the countries, despite notable differences in the social support structure. Based on a higher social wage in the UK, one might expect family changes to hurt material resources less and dull the negative impacts of father figure exits. On the other hand, the greater frequency of family structure instability in the US might reduce social stigma related to maternal stress. That trends are similar in both pattern and magnitude suggests that either these two influences are offsetting of that family structure instability confers disadvantage on children regardless of structure, details that also are worth further investigation in future work.

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