Single-Parenting "Pathology" not Required: Differences in Time and Money Explain Educational Achievement Gaps

Patrick Heuveline
Hongxing Yang
Matthew Weinshenker
Jeffrey M. Timberlake

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Abstract

Research in the United States has shown that children growing up in two-parent households do better than those in single-parent households on a number of outcomes, educational achievement in particular. Cross-national studies have also documented consistent achievement gaps across family structures. However, cross-national studies aimed at measuring educational outcomes in a comparative manner in a large number of countries have serious limitations with respect to the measurement of parental background. Key characteristics of the home environment, such as household income, may not be assessed and non-resident parents ignored altogether. We show that even a very crude imputation method for assigning values to key missing variables may substantially alter cross-national analyses. Specifically, adding imputed values for time spent with both parents and household income entirely accounts for the achievement gap with children from two-parent households for children from single-parent households. However, a significant gap remains for children from step-parent households.

Keywords Living Arrangements, Cross-national, Single-Parent Families, Stepfamilies, Child Outcomes

Highlights

Research shows children faring better in two-parent than in single-parent households

We investigate the mechanisms of the international two-parent advantage in education

Differences in household income and time with both parents explain this advantage

There seems to be no additional effect of growing up with a single parent *per se*

In the United States, one of the most consistently documented differences in child outcomes is between children from single-parent families and those from two-parent families. The different economic situations in which these families operate have early and conclusively been shown to constitute a substantial part of the story. Attempting to account for the contribution of differences in household income to children outcome gaps, studies have documented reductions in the order of one-third to two-thirds (e.g., McLanahan and Sandefur 1994). Economic status remains today the most clearly established mechanisms explaining some the differences in child outcomes, such as cognitive development or the likelihood of completing high school (Duncan et al. 1998). Guo and Harris (2000) further decomposes the impact of family poverty on intellectual development into mediating mechanisms that include maternal involvement with the child, cognitive stimulation, and the quality of non-maternal care of the child. Consistent with a child developmental model in which the key ingredients are the "quality" and the "quantity" of parenting, another key mechanism might be the "time deficit" experienced by single parents (Hill et al. 2001; Bianchi et al. 2006).

Attributing causality to family processes is complicated by selection into family forms. Comparative research might be helpful in this regard as selection mechanisms likely differ for, say, cohabiting parents in Sweden and in the United States. To the extent that childhood living arrangements partly explain differences in child outcomes in the United States, we might anticipate similar differences in other countries, as proposed by Sara McLanahan (2004) in her presidential address to the Population Association of America. Living with a single parent is a risk factor for poverty across Western Nations, though nowhere as severe as in the United States where it trumps even race (Heuveline and Weinshenker 2008). If governments may use financial

transfers to reduce the economic constraints of single-parent families—and many do (Danziger et al. 1995; Misra et al. 2007)—they can do less about time constraints, with the notable exception of publicly funded early education. Studies have documented child outcomes differences across family structures in many countries now, but different survey protocols complicate the identification of common mechanisms.

The most convincing evidence to date may thus have come from international survey programs that collect standardized data across a fairly large number of countries. These provide nationally-representative data that can be pooled to assess the impact of growing-up in different living arrangements after controlling for contextual influences in the different countries. In the field of education, in particular, several studies have documented universal differences in achievement, varying in magnitude though they are, across living arrangements at the time of the survey (Pong et al. 2003; Heuveline et al. 2010; Hampden-Thompson 2013). What makes this conclusion seem compelling is that the results are derived from analyses of two different international survey programs (The International Math and Sciences Study—TIMSS—and the Program for International Student Assessment—PISA) that have devoted exceptional care to measurement equivalence, that is, measuring educational achievement not only in the most comprehensive but also the most comparable manner across diverse countries. The limited information provided on the children's familial environment is a severe shortcoming, however. First, data on the household where the child lives may masks important differences in non-resident parents' involvement. Second, even with respect to conditions at home, the survey questionnaires do not collect household income data. These limitations obscure the identification of the mechanisms through which these differences may operate.

In this paper, we replicate the results of one of these earlier studies and use an imputation technique to estimate two key missing controls. Our basis for imputation is limited to a child's living arrangement and country of residence at the time of the survey. We thus assign to a child the average household income, say, for her country and living arrangement. This is obviously a very coarse imputation of household income, but it must be compared to the alternative. Not including any imputed variable amounts to assuming that household income has no effect, or as we know this not to be the case, assigning rather to each child the average household income across all countries and living arrangements. In other words, we only account for the fraction of the total variance that is between country and between living arrangements, but this is better than to account for none. We thus deem the model estimated with imputed variables preferable to the model without, and find that the addition of imputed variables substantially alters conclusions about the consequences of growing up in different family structures.

Data and Variables

The Trends in International Mathematics and Science Study (TIMSS)

To replicate results from one of the earlier cross-national studies (Heuveline et al. 2010), we pool data for 14 countries from TIMMS, a study conducted by the International Association for the Evaluation of Educational Achievement (IEA) (The Organization for Economic Development and Cooperation, OECD, conducts PISA, the other large international survey program on educational outcomes). We only provide here a brief description of the TIMMS data used in the analyses (see IEA 1997 and Heuveline et al. 2010 for fuller details respectively about the survey and the selected variables).

We use individual data for students in two adjacent grades with a majority of them being 13- and 14-year olds at the time of testing ("Population 2" in TIMMS parlance)—in most

countries, seventh- and eighth-graders. These individual data contain background information on the students and their home environment, and a series of students' achievement scores in math and science. Different ways of combining the responses of students who did not all answer the same questions exactly provide different "plausible values" of students' achievement score (see IEA 1997 for further description), and the first plausible values in math and science are our dependent variables. These achievement score are standardized so that a standard deviation in their distribution amounts to 100 points.

Our focal independent variable is the student's living arrangement at the time of the survey. Constructed from 4 questions about co-residence with the mother, the father, a stepmother, and a stepfather, this variables has 4 categories: (1) living with both her mother and her father ("Two-parent household"); (2) not living with either parent ("Guardian household"); (3) living with only one of her parents and a stepparent ("Step-household"); and (4) living with only one of her parents and no stepparent ("Single-parent household").

Other available control variables include characteristics of the students, such as gender, country of birth, age and grade at the time of the survey. The available characteristics of parents were limited to father's and mother's education, which directly affects the quantity of parenting (Sayer et al. 2004). The characteristics of the household environment include household size, the number of books, and other items available in the household that could be used for learning (e.g., a personal computer). Since the number of items listed in the questionnaire varied across countries, we used a relative index (items owned as a proportion of the total) rather than an absolute count.

Imputed Variables

One limitation of the focal independent variable is that it only measures children's living arrangement at the time of the survey. Meanwhile, the category "living with a single parent at the time of the survey" may lump together children who have very different experiences with their non-resident parent. In the United States, the proportion of non-resident fathers who have seen their child in the last month drops from 63% one year after birth to 49% three years after birth, and the latter group had seen their child for an average of 8.9 days in the month (Tach et al. 2010). This attrition suggests that the length of time since co-residence ended is likely to be a good predictor of the intensity of current contact with the non-resident parent. Less clear is whether the effects of the reduced quantity of parenting when growing up with a single mother should accumulate over time. On the one hand, studies of parental separation suggest that the effects may not accumulate and worsen over time, but rather be most severe in the few years after the separation (Sigle-Rushton et al. 2013). On the other hand, the voluminous literature emphasizing the importance of skills acquired in early childhood (see Cunha and Heckman 2010 for a review) suggests that past differences might continue to affect educational outcomes at the time of the survey.

In any event, the survey categories derived from the living arrangements reported at the time of the survey can thus be fairly heterogeneous with respect to the past and current involvement of a non-residential parent. Some of the heterogeneity is between countries as illustrates another international study of educational achievement. Park (2007) actually attributes international variation in the relationship between family structures and performance to differences in demographic context (greater prevalence of widows among single mothers in a few Asian countries.) While out-of-wedlock birth ratios are higher than in the United States in

several other Western Nations, North European countries in particular, about 90% of extra-marital births there are to cohabiting parents (Kiernan 1992; Heuveline et al. 2003). Contrary to the United States where they tend to remain very fragile (McLanahan 2009), unmarried cohabiting unions with children are lasting living arrangements in some Western Nations—in Sweden, in fact, they last longer on average than marriages with children in the United States (Heuveline and Timberlake 2004). Unable to fully account for within-category heterogeneity in living arrangements, we can at least account for the international dimension (between-country) of heterogeneity. We use another large international survey program focused on family processes, the Family and Fertility Survey (FFS), and estimate in each country also in TIMSS the average number of years spent with both parents up to that age by 13-year olds living in each of the living arrangement categories described above. Across countries, the cut-off age at which we can reliably estimate this average number of years varies, and we thus estimate this as a proportion of the child's age. This new variable, childhood share with both parents, is thus imputed on the basis of students' living arrangement and country of residence at the time of the survey.

A second crucial limitation is the paucity of household-level controls even at the time of the survey, with only information of some of the household resources that might influence learning directly (e.g., a personal computer, or number of books in the household.) Of the many possible missing variables of interest, household income is arguably the best documented of the confounding factors that could account for differences in child outcomes across family structures. As described above, there are variables on assets that allow us to derive an index of household assets. The assets that were selected for the survey, however, were only those expected to have a direct potential effect on learning (e.g., a personal computer at home). While

those assets are certainly correlated with wealth, an index based on those assets is unlikely to fully capture the effect of household income on educational achievement.

To alleviate this limitation, we use the Luxembourg Income Study (LIS) to estimate household income from household type separately for each of the countries. We then translate the estimate into a comparable income using purchasing power parities (PPPs). As for childhood share with both parents, we thus treat household income as a missing variable and impute for each child the average household income for her country and her living arrangement.

Results

As did previous studies, we begin by showing that the achievement gap between students in single- and in two-parent households is significant and greater in the United States than in any other countries. As seen in Table 1, Model 1, the estimated gaps in the United States is just over one fourth of a SD (-24.7 points in math and -26.0 points in science) after accounting for the available parental and household variables. Before the inclusion of these variables, the achievement gaps were -34.5 points in math and -35.8 points in science (Heuveline et al. 2010). Parental education and household books and resources have the expected positive effects on students' scores, and also as expected, being foreign born and from a larger household have negative effects. The achievement gaps both in math and in science are estimated to be larger in the United States that in any of the 13 other countries, although the difference is not significant in the case of Italy. (All interaction terms, country*single-parent household have positive coefficients, results not shown.)

Table 1 also presents results from two additional models. Model 2 adds our imputed household income variable. In the United States, achievement gaps between students from single-parent and from two-parent households are reduced further to slightly over one fifth of a

SD (-20.2 points in math, and -21.3 points in science). Coarse though it is, our imputed variable thus reduces the predicted effect of living in a single-parent household at the time of the survey, further than extant survey variables alone. We now predict achievement gaps that are close to one-half of their predicted values without any parental and household controls (-34.5 points and -35.8 points). The estimated effects of other background variables hardly change, including the number of books and possession index. This is consistent with the fact that the survey attempted to measure possessions that potentially affected learning directly, not just wealth indicators.

Model 3 introduces the second imputed variable, childhood share with both parents. The effect on the achievement gaps between students in single-parent and two-parent households is quite dramatic. The estimated gaps are no longer significant, neither in math nor in science. Comparing the achievement gaps in the U.S estimated in Models 1 to 3, we thus find that the sizable achievement gaps of Model 1 between children in single-parent and in two-parent households are explained entirely by adding to parental and household characteristics available in the survey, the two imputed values for household income and children's time with their parents (measured, coarsely, by co-residence with both parents).

The results for children living with one parent and one step-parent are quite different. In Model 1, the estimated gaps without any imputed variables are smaller than for children living with a single parent. The estimated gaps are not affected by the inclusion of our imputed household income variable, but we did not necessarily expect an effect since unlike single-parent households, step-parent households are not necessarily worse-off economically than two-parent households. The effects are hardly more affected by the inclusion of our second imputed variable, and the gaps remain significant at -17.5 points in math and -10.3 points in science for children in step-parent households.

For our first imputed variable, the childhood share spent with both parents, the estimated coefficients are 55.7 in math and 49.9 in science. The effects on the achievement scores of a child spending her whole childhood (up to age 15) with both parents rather than with just one of them are thus estimated to amount to about half of a SD in math and in science, or about 3.7 points (math) and 3.2 points (science) per additional year. The estimates of the effect of household income are strongly significant but relatively modest. Each additional $1,000 is estimated to increase the math score by .134 and the science score by .144. In other words, $25,000 in additional annual household income is predicted to increase the math score by 3.4 points and the science score by 3.6 points, roughly as much as one additional year spent with both parents rather than one.

With respect to international differences in the achievement gap between children from single- and two-parent households, the introduction of the imputed variables reduces the difference between the United States and other countries (results not shown). The difference between the United States and any other country remains positive, in both math and sciences, but is then significant with only 8 of the 13 other countries (and only marginally in 3 of the 8) in math, and with 11 of the 13 other countries (marginally in 1 of the 22) in science. In other words, the model now explains the disadvantage of children in single-parent households, and also shows that the disadvantage is counter-balanced by other factors in other countries more so than in the United States.

Discussion

In this paper, we attempt to circumvent some of the main limitations of large international survey programs on educational outcomes for the assessment of differences between children growing up in different family environments. To compare educational achievement among seventh- and

eighth-graders across countries, we use primarily the same child, parental and household-level data as Pong et al. 2003 and Heuveline et al. 2010. We complement these data with measures from two other international surveys. The first one is a measure of the proportion of her childhood that a child has lived with both parents at home, and the second one is a measure of household income at the time of the survey. Those measures are imputed based on living arrangement and country of residence at the time of the survey alone.

Some limitations of this study relate to the primary survey data, which constrains the operationalization of the key child developmental concepts—the quantity and quality of parenting. Quantity is here measured by the duration of co-residence with one rather than two parents. While residing with a single parent often entails a reduction in the total amount of time spent with either parent, an important determinant of this potential reduction is the involvement of the non-residential parent. Extensive variation in the amount of time non-co-residential fathers spend with their biological children notwithstanding, studies suggest that the main divide in involvement with children remains between co-resident and non-co-resident fathers (Deschamps 2005). As contact with their non-co-resident fathers tend to decay over time (Tach et al. 2010), we attempt to assess the differences in involvement among non-co-resident parents as a function of length of time since their co-residence ended. Admittedly, assessing the quality of parenting with household income is even less satisfactory. Non material factors matter, of course, but they are just more rarely measured in survey data. Moreover, even inequality in access to material resources is insufficiently captured with household income data that leaves aside other relevant dimensions of parental, and even multi-generational, wealth (Hao 1996; Pfeffer and Hallsten 2012; Mare 2011).

A second type of limitations originates in the imputation process. When focusing on a single country, researchers can often find more variables that overlap across surveys to anchor the imputation. In comparative research, adding data requirements often result in rapidly dropping countries. In the case of income, however, we know that "between-country inequality is the most significant component of overall world income inequality" (Korzeniewicz and Moran 1997). For children, living arrangements further capture some of the remaining within-country variance. In the United States for instance, a majority of the children living in a household headed by a single parent are below the poverty line, which is not so for any of the major ethnic groups (Heuveline and Weinshenker 2008). Nonetheless, imputation on the sole basis of these two variables is clearly no panacea, though it must be noted that the alternative of running models without imputation for key missing variables implicitly assumes the same values (at the grand mean) across children in all countries and all living arrangements. Systematic differences between countries and living arrangement in household income and the history of co-residence with both children would then appear in the coefficients for the country of residence and living arrangement dummy variables. Crude though it is, this imputation alters our interpretation of international differences in educational outcomes and of the achievement gaps across living arrangements. We focused on the latter in this paper.

Since besides differences in parental access, differences in household income are known to be substantial across household structures, we expected omission of access and income differences to lead us to incorrectly attribute to living arrangements *per se* some of the educational gaps that operate through differences in time spent with both parents and household income. These differences, however, do not explain much of the achievement gap between children in step-parent households and those in two-parent households. The achievement gaps

remain significant and negative, indicating that children in step-family households do less well on average than predicted on the basis of their access to both parents and the material conditions in their current households. This is in fact consistent with extant research on so-called recomposed families, which has shown that the return to a two-adult household does not fully compensate the total or partial absence of a biological parent (Amato and Keith 1991; Cherlin and Furstenberg 1994; Biblarz and Raftery 1999; Evenhouse and Reilly 2004). Remarriage often improves the financial situation of single mothers and their children (Morrison and Ritualo 2000), but may entail for the child a difficult transition with its associated emotional stresses (Kiernan 1992). Remarriages are on average less stable than first marriages, and the relationship to the non-biological stepparent is unlikely to survive the separation (Furstenberg and Seltzer 1986). Andrew Cherlin's (1978) designation of remarriage as an "incomplete institution" aptly underscores the fact that these differences between intact and recomposed families lie in part in the larger cultural and institutional context.

On the contrary, our results suggest that the achievement gap between children living with a single parent and those with both parents at home originate in different material and relational backgrounds. Even though achievement gaps appear even larger for children in single-parent households than for those in step-parent households, accounting for the two key forms of parental investment in children, time and money, explains the gaps for children growing up with a single mother. In other words, we do not estimate any additional residual effect on educational outcomes, or any additional "pathological" effect of single-parenting originating either in the home environment (e.g., differences in single parent-child interactions, lack of gendered role model) or in the larger context (e.g., stigma related to the perception of children from single-parent household at school). We estimate rather that the educational gaps between children in

single- and two-parent households are entirely mediated by differences in household income and contact with both parents. We should caution against taking this substantive finding as definitive, given that our methodological finding is that omitted variables can radically change the results of cross-national analyses. Other potential omitted-variable biases are possible and even those we tried to address were accounted for in an admittedly crude manner. More work is clearly needed before we can conclusively identify the mechanisms that explain achievement gaps between children from single v. two-parent households, and whether differences in key parenting endowments, such as available time and money, entirely explain these gaps without necessarily looking for differences in how these endowments are used.

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Table 1: Predicted Math and Science Scores, 14 Countries Combined (t-statistics in parentheses)

	Math			Science		
Variables	Model 1	Model2	Model 3	Model 1	Model 2	Model 3
Constant[a]	386.950***	378.724***	336.187***	424.962***	416.388***	378.256***
	(193.49)	(121.46)	(39.36)	(201.71)	(126.77)	(42.04)
Single-parent	-24.741***	-20.225***	6.277	-25.984***	-21.277***	2.480
	(12.37)	(8.45)	(1.14)	(12.34)	(8.44)	(0.43)
Step-parent	-18.410***	-18.317***	-17.554***	-11.075***	-10.978***	-10.295***
	(19.69)	(19.58)	(18.55)	(11.24)	(11.14)	(10.33)
Guardian-parent	-30.224***	-29.359***	-3.255	-23.928***	-23.027***	0.373
	(12.94)	(12.50)	(0.60)	(9.72)	(9.30)	(0.07)
Age 12 and under	-5.092	-5.239	-5.270	-7.726	-7.879	-7.907
	(0.81)	(0.83)	(0.84)	(1.16)	(1.19)	(1.19)
Age16 and over	-37.698***	-37.685***	-37.666***	-26.478***	-26.464***	-26.447***
	(12.46)	(12.46)	(12.46)	(8.31)	(8.31)	(8.30)
Female	-6.633***	-6.634***	-6.665***	-17.224***	-17.225***	-17.253***
	(12.79)	(12.79)	(12.85)	(31.52)	(31.53)	(31.58)
Upper grade	37.865***	37.860***	37.850***	38.516***	38.512***	38.503***
	(71.57)	(71.56)	(71.55)	(69.11)	(69.10)	(69.09)
Maternal Education	4.115***	4.031***	4.052***	3.554***	3.466***	3.485***
	(16.38)	(15.97)	(16.06)	(13.43)	(13.04)	(13.11)
Paternal Education	5.565***	5.126***	5.210***	4.794***	4.336***	4.412***
	(22.70)	(18.53)	(18.81)	(18.56)	(14.88)	(15.12)
Number of books	15.357***	15.328***	15.331***	17.203***	17.173***	17.175***
	(63.87)	(63.72)	(63.74)	(67.92)	(67.76)	(67.78)
Possession index	11.879***	11.904***	11.809***	14.511***	14.537***	14.452***
	(6.81)	(6.82)	(6.77)	(7.89)	(7.91)	(7.86)
Foreign-born	-17.111***	-17.073***	-17.073***	-26.726***	-26.687***	-26.687***
	(16.06)	(16.02)	(16.03)	(23.81)	(23.77)	(23.78)
Household size	-2.792***	-2.784***	-2.791***	-3.804***	-3.796***	-3.802***
	(16.39)	(16.34)	(16.38)	(21.20)	(21.15)	(21.18)
Household						

		0.166***	0.134***		0.174***	0.144***
Income		(3.44)	(2.75)		(3.40)	(2.81)
Childhood share with both parents			55.686***			49.918***
			(5.35)			(4.55)
Observations	100307	100307	100307	100307	100307	100307
Adjusted R-squared	0.20	0.20	0.20	0.19	0.19	0.19

[a] The reference categories are students living in the United States, in two-parent households, aged 13 to 16, male, and in the modal grade. All models include two dummy variables for each country, one for the country, and one interaction term country*single parent.

* p<0.10; ** p<0.05; *** p<0.01 (two-tailed tests).