Published in final edited form as:

J Marriage Fam. 2010 October 1; 72(5): 1362–1376. doi:10.1111/j.1741-3737.2010.00770.x.

It Takes a Village (Perhaps a Nation): Families, States, and Educational Achievement

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Abstract

Research in the United States has shown that children growing up in 2-parent households do better in school than children from single-parent households. We used the Trends in International Mathematics and Science Study (TIMSS) data to test whether this finding applied to other countries as well ($N = 100,307$). We found that it did, but that the educational gap was greater in the United States than in the other 13 countries considered. Results from 2-level hierarchical linear models demonstrated that international differences in the educational gap were associated with several indicators of national policy and demographic contexts. No single policy appeared to have a large effect, but several policy combinations were associated with substantially reduced educational gaps between children from different family structures.

Keywords

childhood/children; cross-national; education; family policy; family structure; multilevel models

Extensive research has investigated the impact of the family on child outcomes, and some of the most consistent empirical findings relate to differences between children from single- and two-parent families. For instance, children from intact two-parent families have consistently been found to have better educational outcomes, such as higher achievement test scores or high school graduation rates. On average, however, differences in resources between single- and two-parent families are vast, and parental income has been shown to affect cognitive development and the likelihood of completing high school (Duncan, Yeung, Brooks-Gunn, & Smith, 1998). Nonetheless, an authoritative review of the extensive literature on this issue concluded that, on average again, growing up with only one biological parent lowers educational achievement, even after accounting for individual and family characteristics other than living arrangements (McLanahan & Sandefur, 1994).

The larger context in which the family operates matters, however, and in Western nations, child welfare also depends on a second institution, the state (in lieu of the proverbial village) (Furstenberg, 1997). Parents are essential because they provide the resources their children need, but they draw those resources from a larger environment that includes the labor market

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and government policies that mitigate some of the costs of raising children (McLanahan, 2000). For example, in an effort to reduce children's poverty risk, states may support disadvantaged families with income-based tax credits or with income supplements to families with dependent children, such as general tax credits, guaranteed maternity leave, or subsidized child care. States also affect other key aspects of family life, thus modifying parental decisions to work, receive more education, or change residence, and influencing the quality and quantity of parenting in multiple ways. State characteristics thus contribute indirectly to child outcomes, but more directly, state agencies regulate the public sphere in which minors evolve outside the custodial household, from defining educational curricula and licensing teaching staff to policing street activities. In more complex and perhaps more profound ways, states indirectly intervene in the private sphere of parental decisions by contributing services and resources that affect child-related consumption and thus complement parental investments. Differences between children from single- and two-parent families may thus partly reflect characteristics of both the market (in which two-parent families may be advantaged) and the state, whose policies may benefit all parents or may target particular family structures (thus attenuating market-driven inequalities).

In the United States, attention to the impact of state policies on parental behavior, with intended or unintended consequences for children, has increased in the wake of the welfare reforms of the late 1990s (the 1996 Personal Responsibility and Work Opportunity Reconciliation Act, or PRWORA). The primary goal of the reforms was to decrease welfare dependency by promoting recipients' entry into the labor force. Morris, Huston, Duncan, Crosby, and Bos (2001) reviewed the impact on children of these reforms and concluded that programs that included earnings supplements increased both parental employment and income, which had positive effects on elementary school-aged children. Parental employment alone may have reduced the monitoring of adolescents' behavior and contributed to increased behavioral problems and decreased school achievement. These studies illustrated the diversity of ways public policies may directly and indirectly affect child well-being and how the same program may have different impacts on youths of different ages, sexes, and other characteristics.

Persistent questions remain, however, about the interplay between parental and state influences. The preponderance of research at the family level, as opposed to the larger contextual level, originates largely in data availability. Policy changes are typically incremental, and except in rare circumstances (e.g., Duncan, Huston, & Weisner, 2007), studies have not been designed to allow researchers to take stock of their impact. Cross-sectional comparisons constitute appealing alternatives, in particular international ones, because different countries feature more variation in cultural and institutional contexts and provide more leverage to understand how policy contexts affect parents and children. National child poverty rates, for instance, vary dramatically across family structures but also across countries (Heuveline & Weinshenker, 2008). These differences can be traced in part to the different conditions under which states support individuals and families (Ditch, Barnes, Bradshaw, & Kilkey, 1998; Gauthier, 1996).

International studies pose challenges of their own, however. The ideal, quasi-experimental design is clearly not replicable on a large international scale. Even measuring an outcome in a comparable manner across many countries requires a great deal of survey coordination, which only a few large international surveys have managed. Obtaining precise indicators of any national policy provision that may influence child outcomes can also be challenging and can seriously constrain the number of countries that can be considered. Meanwhile, policy decisions are nested in complex national patterns, and it is nearly impossible to rule out other national characteristics that might simultaneously affect child outcomes and have an impact on policy decisions.

These limitations notwithstanding, educational achievement may be the most promising avenues for studying these complex interactions: Education is one of the dimensions of child well-being for which family structure has been shown to matter most conclusively, and it is the focus of some of the most comprehensive, standardized cross-national survey programs. Using the Trends in International Mathematics and Science Study (TIMSS), Pong, Dronkers, and Hampden-Thomson (2003) documented cross-national variation in the relationship between family structure and educational achievement among third and fourth graders in single-parent versus two-parent families. In the 11 countries under study, the authors found that the achievement gap was greatest in the United States and smaller in countries with more generous welfare systems. They considered eight specific national policies that equalize resources between the two types of families and found that the policies were associated with reduced achievement gaps. Using the Programme for International Student Assessment (PISA), Park (2007) linked the smaller gap in reading performance between 15-year-old students in single-parent versus intact families to the greater prevalence of widows among single mothers in five Asian countries and the United States. Both studies illustrated the need to control for the possibility that an apparent effect of policies actually originates in differences in the aggregate demographic environment in which families operate.

In this article, we analyzed TIMSS data for the population of, mostly, seventh- and eighth graders. Although Pong et al. (2003) used these data for a younger population, we expected that any effect of national policies on parenting would accumulate over time and that therefore the effects might be larger and more easily detectable with older children (though not so old that selective dropping out of school would be a serious concern). On the basis of the above review, Figure 1 presents our conceptual model of the influences of the family and the state on children's educational outcomes. We expected first that, net of students' individual characteristics (Arrow III), family structure affected student learning through the quality and quantity of parenting available to them (Paths a and I). For instance, single parenting may reduce the quantity of parenting, although this depends on the involvement of the nonresidential parent. Poor communication between estranged parents or stresses in the custodial parent's environment might also affect the quality of parenting. We then hypothesized that policies could alter the relationship between family structures and educational outcomes because they affected the mediating factor in that relationship, namely the quantity and quality of parenting.

Our first hypothesis was thus that family policies that reduced resources disparities between single- and two-parent households also reduced the achievement gap between children in the different households (Path 1, b and I). We distinguished between two types of such family policies: those benefiting lone parents specifically (Hypothesis 1a) and those benefiting all families, but which by lifting all boats, so to speak, should also, in relative terms, reduce the gap in available resources (Hypothesis 1b). Those benefits might be financial or time benefits (e.g., maternal leave), which might likewise have a greater impact on single- than on two-parent households. Consistent with our conceptual framework, our second hypothesis (Hypothesis 2) is that public policies that affected public settings might also have an indirect (Path 2, c and I) or a more direct (Path 2 and II) effect on educational outcomes. In particular, we included two indicators of public funding for education, which might reduce the achievement gap by improving the quality of education for all children (as with Hypothesis 1b above, we considered that this effect might be more beneficial, in relative terms, to children in single- versus two-parent households). Other types of public expenditures (e.g., public libraries) might have an impact in the same direction, though not as strong as those targeting education specifically, as long as we expected the corresponding social programs to make more of a difference, in relative terms, for some children than for others.

To test these hypotheses, we began by comparing the achievement gap between students in single- versus two-parent households in the United States and in 13 other countries after accounting for parental and household characteristics. To link the international variation in achievement gaps to policy environments, we then pooled data across countries and estimated hierarchical linear models (HLMs) with country-level indicators at Level 2. Among those, besides eight national policies that tended to equalize resources across households, we considered two policies that aimed to directly improve educational achievement through public funding.

We recognized that we could not fully take into account the larger cultural environment affecting both parenting and policymaking. Prior studies have suggested that an important aspect that could be measured was aggregate demographic behavior. On the one hand, the growing prevalence of alternative family structures might contribute to reducing the stigma of once-rare types of families (Thornton, 1989), and institutional support for such family situations might be strengthened as their constituency grows. On the other hand, public assistance programs to, say, single parents, might also become more burdensome and less politically viable if single parenting becomes more prevalent. Pong et al. (2003) found demographic indicators such as out-of-wedlock birth ratios and divorce rates to be positively associated with both greater achievement gaps and less generous welfare systems. Extant demographic statistics, however, are limited in their capacity to characterize children's experiences of family structures. Out-of-wedlock birth ratios, for instance, do not differentiate between children born to cohabiting and to noncohabiting unmarried mothers, and divorce rates are based on all divorces, whether or not they involve children. Moreover, all the indicators refer to a single time period and do not account for children's experiences over time. Instead, we used three child-centered family indicators derived by Heuveline, Timberlake, and Furstenberg (2003) from the Family and Fertility Surveys (FFS).

We show that the estimated effect sizes are relatively modest for any single policy indicator but are not as trivial for some of the policy combinations. Three of our final models yielded estimates that suggested that half of the gross achievement gap was associated with a shift from one standard deviation (SD) above to one standard deviation below the international average on each of two policy indicators.

Method

The 1995 wave of the TIMSS provides our individual-level variables, whereas our country-level indicators were culled from multiple sources, with reference periods ranging from 1986 – 1995 (average) to 1998. Acquiring these indicators forced a trade-off between precision and the number of countries with available data, with fewer countries limiting the degrees of freedom in country-level analyses. Eventually, the intersection of these data sets includes the 14 countries, among which Germany, Sweden, and the United States represent Esping-Andersen's (1990) triad of welfare regimes, whereas Italy represents the Southern European type family scholars later suggested to add to the classic typology (e.g., Gauthier, 1996). Also included were a few countries from Eastern Europe (e.g., Czech Republic, Hungary) for which data had become available since the typologies were established. Our emphasis was on identifying the effects of specific policy indicators, however, rather than on interpreting international differences using such typologies. Even though 14 countries are actually more than in comparable studies, we still had few degrees of freedom for our analyses and followed a gradual, stepwise approach. We present our individual- and contextual-level variables below, and describe this strategy next.

TIMSS Data and Household-Level Measures

Conducted by the International Association for the Evaluation of Educational Achievement (IEA) and implemented in 40 countries, TIMSS is the largest international study of educational achievement undertaken to date (IEA, n.d.). The TIMSS includes at least one and up to three populations of students in each participating country. We used here “Population 2” data, which include students enrolled in the two adjacent grades that contained the largest proportion of 13-year-old students at the time of testing—in most countries, seventh and eighth graders. In each country, sample selection was conducted in at least two stages. First, schools were selected by a systematic probability-proportional-to-size (PPS) technique in each explicit stratum (e.g., geographical region, public or private). In each sampled school, the most common design was to select one classroom per grade and to recruit all students in the classroom. In some countries, however, a third stage was introduced in which students were sampled with equal probabilities, either in a large classroom or across several classrooms selected with PPS in the school.

The survey included three separate questionnaires designed to collect background information on the school, the teachers, and the students and their home environment, though we analyze only the last of the three in this article. Our dependent variables were students’ achievement in math and science. Because time constraints did not allow each student to take more than relatively few items within each of the content areas of each subject, assessments of students’ mathematical and scientific skills were based on item response theory scaling and a multiple imputation or plausible values methodology based on Rubin’s (1987) work on multiple imputations. Providing a common scale or series of scales to measure each student’s performance, this approach achieves broad coverage and reliable indices of student proficiency in both subjects (math and science). Five imputed values were provided for each student in each subject to alleviate potential errors involved in this imputation process, but on further examination, the IEA (n.d.) concluded that “the imputation error could be ignored,” and recommend that “for the purpose of reporting international achievement, therefore, only the first plausible value [be] used” (sec. 6-3). Consistent with IEA recommendations, we report results using the first plausible values here; however, we conducted sensitivity analyses (available from the authors on request) that confirmed that the results were robust to the choice of alternative plausible values.

Our focal independent variable is the student’s living arrangement at the time of the survey. This categorical variable was constructed from four questions in the student questionnaire about coresidence with the mother, the father, a stepmother, and a stepfather: (a) a student living with both mother and father was classified as living in a “two-parent household”; (b) a student not living with either parent was classified as living in a “guardian household”; (c) a student living with only one of her parents was classified as living in a “step-household” if he or she lived with either a stepmother or a stepfather; otherwise, the student was classified as (d) living in a “single-parent household.” The questions about coresidence with the mother and the father did not explicitly refer to the biological mother and father, but they did implicitly, as indicated by later questions about stepmothers and stepfathers. Nonetheless, some misclassification might result from students’ not responding to the questions as intended.

Additional independent variables included characteristics of the students, their parents, and their households. For students, they included age (classified in three categories: [a] “Age < 12”; [b] “Age > 16”; and, for most students, [c] “Age between 12 and 16”), as well as the binary variables gender, native (combining all foreign-born students in a single category), and grade at the time of the test. (Unfortunately, there was no information on previous years, grade repetition in particular.) Because of the differences among national educational systems, the grade of same-age students can vary substantially from one country to another.

Most countries selected seventh- and eighth graders as corresponding to the target of 13-year-olds in Population 2, though New Zealand selected eighth and ninth graders, and students in Sweden and Switzerland were selected from three grades (sixth, seventh, and eighth). The “upper grade” category denotes students enrolled in the highest grade for the country (ninth for New Zealand, and eighth for other countries).

Parental characteristics were limited to their education. Mother’s education and father’s education were reported in six ordered categories, with the first corresponding to the least formal education. Household characteristics included number of books, also reported in five ordered categories. We created a possession index by adding items available in the household expected to influence learning directly (e.g., a personal computer) and dividing by the total number of items in the list. We used a relative rather than an absolute measure because the number of possible items ranged from 4 to 16 across countries. Sensitivity analyses (available from the authors on request) indicated that the models were robust to different specifications of the possession index, such as limiting the index to the four items reported in all countries. Finally, household size was the total number of household residents (including the student). Descriptive statistics for these variables are shown in the appendix.

Country-Level Data and Policy Indicators

We developed a country-level data set from published work in print and electronic format. For reasons discussed above, we took for demographic-context indicators three life-table measures of children’s cumulative experience with their parents among those derived by Heuveline et al. (2003) from FFS data (survey dates ranging from 1990 to 1997). First, births to single mothers measures the proportion of births to mothers who are neither married nor cohabiting at the time of birth. This measure is superior to out-of-wedlock rates commonly reported in national vital statistics because it accounts for parental cohabitation. Second, parental divorce or separation is the proportion of a birth cohort born to married or cohabiting parents who will experience their divorce or separation before reaching their 15th birthday. Finally, child-years without both parents measures the average number of years lived without both parents in the birth cohort, from birth to age 15 (see Table 1).

Policy indicators available in the few extant policy databases have similar limitations and measure general rather than specific provisions. As with the demographic indicators, we identified specific studies rather than relying on governmental or international statistics. This resulted in 10 country-level policy indicators of state support to families and parents, which may affect the economic and social capital available to students from single- and two-parent families. As shown in Table 1, the first seven policy indicators concern policies intended to equalize time or financial resources across households. To address Hypothesis 1a, however, only one indicator could be obtained, and not for all 14 countries, that reflected differential provisions for different family types, benefits to lone parents. The last three indicators concern public spending (Hypothesis 2) with two of them directly concerning education, total expenditures on education and enrollment rates at age 4. For that last indicator unfortunately, values could not be found for the period in which students would have been 4-year-olds. All other indicators were estimated for periods ranging from the late 1980s to the mid-1990s to describe conditions up to the TIMSS survey date of 1995 (see Table 1).

Analytic Strategy

We first pooled the data from the 14 countries to investigate the relationship between single parenthood and students’ achievement and to explore variation among these countries. We employed two statistical models to analyze the pooled data. First, we used a fixed-effects model to estimate variation across countries. We added one dummy variable for each

country other than the United States, the reference category. We then created 13 interaction terms between each of the dummy country variables and the single-parent household category. Such a fixed-effects model is equivalent to a saturated HLM without random effects. With this model, we were able to compare across countries the achievement gap between children from single-versus two-parent households. Second, we used a two-level, random-effect HLM (Raudenbush & Bryk, 2002) to analyze how state policies and national demographic context might modify the effects of family structure on student academic achievement. For these models, missing data forced us to drop two countries (France and Latvia). The units of analysis are students and their households at Level 1 and students' country of residence at the time of the survey at Level 2.

Equation 1 depicts the Level 1 model, in which Y_{ij} is a test score in either math or science for student i in country j . That score was assumed to be a function of a country-specific intercept (β_{0j}), family structure (β_{1j} through β_{3j}), individual- and household-level covariates (β_{qj}), and a Level 1 residual (r_{ij}).

$$Y_{ij} = \beta_{0j} + \beta_{1j}(\text{Single})_{ij} + \beta_{2j}(\text{Step})_{ij} + \beta_{3j}(\text{Guardian})_{ij} + \sum_{q=4}^Q \beta_{qj}(\text{Controls})_{qij} + r_{ij}, \quad (1)$$

The Level 1 intercept and gap between children in single- versus two-parent households (β_{0j} and β_{1j}) were then modeled as function of an average intercept or gap across all countries (γ_{00} and γ_{10}), effects of family-policy (γ_{0r} and γ_{1r}), and demographic-context (γ_{0s} and γ_{1s}) variables, along with a residual term (u_{0j} and u_{1j}). For the gap between single- and two-parent families for instance, this Level 2 model is described by Equation 2:

$$\beta_{1j} = \gamma_{10} + \sum_{r=1}^R \gamma_{1r}(\text{Family Policy})_{rj} + \sum_{s=R+1}^S \gamma_{1s}(\text{Demographic Context})_{sj} + u_{1j} \quad (2)$$

With only 12 countries, however, we lacked the statistical power to include all our indicators simultaneously and followed a stepwise approach. Our initial set of models included only one policy or one demographic-context indicator at a time. Dropping the indicators that exhibited nonsignificant coefficients on their own, our next set of models combined one of the policy variables and one of the demographic indicators (results available from the authors on request). This intermediate set of models allowed us to further drop policy indicators for our final set of models. In this final set, the models combined one demographic indicator and two of the policy indicators, chosen among the indicators whose estimated effects were found to be robust to the addition of that demographic indicator between the initial set of models (e.g., on their own) and intermediate set of models.

Results

Pooled-Data Fixed-Effects Ordinary Least Squares Estimates

Table 2 presents results from fixed-effects models with pooled data from the 14 countries. The models provide tests of significance for international differences in achievement gaps between students from single- versus two-parent households. The estimated differences were derived from the coefficients of the interaction terms between country variables and the single-parent household category. Model 1 included controls only for the student's living arrangement, age, gender, and grade. Because the reference categories correspond to 13- or 14-year-old boys in the typical grade, living in a two-parent household in the United States, the intercept in Model 1 is the average test score of these students, and the coefficients of the

categories of living arrangement indicate the association between living arrangements and test scores in the United States. Model 1 estimates show the average scores to be 476.3 for math and 511.4 for science. For students with the same characteristics except country of residence, average scores in math were lower in only two countries (Italy and Latvia), but in science they were lower in 5 of the 13 countries (the same two above, in addition to Canada, France, and New Zealand).

Across living arrangements, the achievement gaps were more than one third of an SD lower for students from single-parent households than for those from two-parent households in the United States (−34.5 points in math and −35.8 points in science). As often found in studies of child outcomes by family structure, the educational performance of children from step-households was intermediate between that of children from single- and of those from two-parent households. However, the most consistent finding from Table 2, Model 1, was that achievement gaps in either subject were significantly greater in the United States than in each of the other 13 countries considered (interaction terms between country and single-parent household were all positive).

Model 2 included six additional variables: (a) mother's education, (b) father's education, (c) number of books in the household, (d) possession index, (e) household size, and (f) native. Consistent with prior results, the introduction of these background variables did not eliminate the estimated gaps between children in single- versus two-parent households in the United States but reduced them to slightly more than one fourth of a *SD* (−24.7 points in math and −26.0 points in science). For children in step-parent households, the educational gap in math (−18.4) was then close to that of children in single-parent households, but in science, the gap (−11.1) remained smaller by half. Parental education and household books and resources had the expected positive effects on students' scores, and as expected, those who were foreign born and/or from a larger household scored lower on average.

International differences retained their clear pattern, with the same five countries having lower average scores than the United States in science, and with the controls above, only Latvia was lower in math. The estimated gaps in either subject were still smaller than in the United States in each of the 13 other countries. The estimated gaps were significantly smaller in Germany and Sweden, two countries often used as exemplars of different welfare regimes than the American type and in most East European countries as well, but not in our lone South European country, Italy.

Random-Effects HLMs

Table 3 presents results from our initial first set of HLMs. At Level 1, all individual level variables from Table 2, Model 2, were included except for country dummy variables and interaction terms, which were replaced by national indicators. For the sake of simplicity, Table 3 presents only selected country-level coefficients from the estimation of each of these models: γ_{10} , the estimated intercept of the achievement gap between children in single- versus two-parent households (i.e., in the absence of any policy and demographic differences across countries), and γ_{11} , the estimated slope of a single policy or demographic-context indicator (see Equation 2, with $r = 1$ or $s = 1$). For all models in this initial set, the estimated values of γ_{10} were significant and negative, which suggests that achievement gaps remained even after controlling for individual-level variables and canceling the effects of one of the policy or demographic-context indicators. All but one of the policy indicators had significant effects, which indicated a reduction in the achievement gaps in either math or science (i.e., $\gamma_{11} > 0$ for each individual indicator).

Significant coefficients do not necessarily indicate substantial effects, however. For instance, the coefficient for family or child allowances on math achievement gaps (.328)

associated only a 3.28 points reduction in achievement gaps with an increase in family or child allowances equivalent to 10% of the average male manufacturing wage. Family or child allowances never went much higher than 20% of the average wage (20.87% in Belgium, Table 1); therefore, switching from the least to the most generous policy in this respect could not eliminate the achievement gap, even net of Model 2 household variables at Level 1 (-14.712). By contrast, the coefficient for maternity leave benefits (.123) was less than half of the effect for family or child allowances, but the range of national policies went from 12 weeks in the United States to 65 weeks in Sweden. To assess effect sizes, Table 3 also presented the ratio of the intercept to the slope, expressed in standard deviations of the independent variable, which indicated by how many *SDs* an indicator would have to change to bring the residual achievement gap to zero.

With respect to policies targeting single-parent families, measured here by the single indicator lone parents benefits, Hypothesis 1a received little support. The estimates for this indicator were not significant in science, only marginally significant in math, and in both cases the estimated effects were quite small (6.83 *SDs* in the indicator corresponding to 1 *SD* in math score). With respect to policies benefiting all parents, measured here by the following seven indicators, Hypothesis 1b was better supported. Among the seven corresponding estimates, maternity leave benefits appeared to have the greatest potential impact on the achievement gap. According to our estimates, a 1.88 *SD* increase in maternity leave benefits would cancel out the residual (net of Model 2 household variables) achievement gap in science, and it would take more than a 3 *SD* increase to do the same with the gaps in math (3.21, Table 3).

The last policy indicator (enrollment rates at age 4) was the only one without a significantly positive effect on either math or science achievement gaps. The other two indicators pertaining to Hypothesis 2 (social expenditures and total expenditures on education) were among those with the most significant and largest effects, although none of the effects corresponding to a single policy indicator were very large. Finally, Table 3 indicates that at the country level, when the incidence of growing up with a single parent increased (either at birth or later through divorce) or when the duration of time spent without both parents increased, achievement gaps increased between children living in single- versus two-parent households. As for the size of the effects, reductions of about two *SDs* would absorb the gap in science, but only changes at least twice as large would bring about a similar effect on the gap in math.

Estimates from our intermediate set of HLMs (not shown) revealed that the effects of several policy indicators lost significance or were further reduced in size when combined with one of the demographic indicators. Furthermore, the estimates from models with duration with parents as a demographic indicator appeared very similar but weaker than those from models with parental divorce or separation. We thus dropped the former demographic indicator, and kept only the four policy indicators that provide the largest effects sizes in the intermediate models when combined with each of the two remaining demographic-context indicators. For the final set of models, combining two policy indicators and a demographic context indicator, this limited the number of models to six (number of possible pairs from the four selected policy indicators) with each demographic indicator. For each demographic indicator, two of the selected indicators related to family policies and the other two to public funding, and the six final models thus consisted of one model with two family policy indicators, one model with two public funding indicators, and four mixed models with one family policy and one public funding indicator. Results from our final models are shown in Table 4, in two panels (one for each demographic indicator), and with the top two and bottom two models in each panel being mixed models.

On the basis of the mostly positive correlations between policy indicators in the same welfare regime, we expected smaller coefficients in models with two policy indicators than in models with a single policy indicator (Table 3). Table 4 confirms this to be mostly the case, with a few exceptions, however, especially among the mixed models. The three models that yielded coefficient estimates for both policy indicators that were as large as or even larger than in Table 3 were the top two models in Panel 4A, with total expenditures on education and either tax and transfer benefits or maternity leave benefits (the latter for science only), and the top model in Panel 4B with family or child allowances and total expenditures on education (for math only). In terms of effect sizes, for the top model in Panel 4A, effects associated with a shift from being one *SD* below to one *SD* above the international average on both policy indicators would decrease the achievement gap in math by 19.7 or the achievement gap in science by 20.4 points. This compares with residual achievement gaps between children in single- versus two-parent households, net of Model 2 household variables, amounting to 24.7 points (math) and 26.0 points (science) in the United States (Table 2).

Discussion

Inasmuch as we understand a great deal more about how family influences children's learning than we do about the role of the state, our primary purpose in this article was to increase our understanding of the latter. To that end, we estimated models of student achievement that combined characteristics of the household resources available to them with characteristics of the larger environment in which these households operate. At the household level, our results first confirmed several well-established findings for households in the United States. Our most consistent result, however, was that the achievement gap between children in single- versus two-parent households was greater in both subjects in the United States than in any of the 13 other countries studied. For 10 of these countries, this remained so after controlling for household and parental characteristics, even though the resource gap between children in single- versus two-parent households also tends to be greater in the United States. We thus investigated whether policy or demographic environments have an impact on the achievement gaps between children in single- versus two-parent households.

Because of the difficulty in obtaining relevant and comparable indicators for many countries, linking international differences to national policies or demographic contexts presented several empirical challenges. This reduced the number of countries in the analyses and resulted in a rapid loss of statistical power as we included more policy or demographic indicators in our multilevel models. We therefore implemented a stepwise strategy, beginning with one indicator at a time and gradually dropping indicators to yield 12 final models with two policy and one demographic-context indicators each. Our initial models provided support for our Hypotheses 1b and 2, which associated policies benefiting parents and public spending with smaller achievement gaps between children in single-versus two-parent families. The lack of support for Hypothesis 1a with regard to policies benefiting lone parents specifically is perhaps counterintuitive but again likely reflects the empirical difficulty of consistently measuring these policies across many countries. The lack of support for the positive effect of enrollment at age 4 may reflect another empirical challenge mentioned above (reference period) but also, more substantively, the fact that enrollment is only partially affected by public funding.

The estimated effects in single-policy models were small, however, and in our final models, we moved toward estimating the combined effects of policies. Because of the myriad ways states can influence child outcomes, models with two policy indicators lack formal identification, and any claim to causality would remain questionable. The issue is therefore

whether alternative, more plausible explanations exist that would not rest with the policies themselves but would instead originate in other determinants of educational gaps that are correlated with policy indicators. For example, demographic context might, as argued above, confound the results, and the relative robustness of our models to the inclusion of demographic context indicators was reassuring in this respect.

Among the 12 final models, 3 exhibited modest but nontrivial effect sizes, with shifts from 1 *SD* below to 1 *SD* above the international average for both policy indicators amounting to close to half of the achievement gaps. In each of the three models, the policies associated with these reductions in achievement gaps were combinations of more spending on education and more benefits to parents, in the form of tax transfers, child allowances, or maternity leave. For some of these policies, an increase from 1 *SD* below to 1 *SD* above the international average would prove financially burdensome, up to 1.5% and 3.0% of the U.S. gross domestic product (GDP) in the case of, respectively, expenditures on family allowances and of total expenditures on education. Policies associated with tax transfers rather than additional expenditures may also entail substantial redistributions across families or between the market and families, and these may not prove politically viable.

However, these policy indicators are gross measures of the specific aspects of policies that might directly affect student learning or indirectly affect the same through inequalities in household resources. Public spending on education as a share of a country's GDP is a case in point, for such expenditures may contribute only indirectly to student learning. In fact, most school reforms aim to better utilize resources within relatively fixed spending limits. Between the two extremes (fixed total vs. across-the-board increased expenditures), targeted increases could achieve the same results on educational gaps as those documented here. In any case, our study confirms that the household and state environments codetermine achievement gaps and that an international perspective can shed light on not just whether but also how states affect student learning.

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Figure 1.

Conceptual Framework.

Note: Arrows I – III represent direct, proximate effects on student's educational outcomes. Arrows a – c represent indirect effects of living arrangements and policy environments that may affect educational outcomes through the quantity and quality of parenting. Arrows 1 – 2 represent indirect effects of policies through their effect on parental resources and public settings respectively. Dashed lines represent effects that are not analytically tested here.

Table 1

Policy and Demographic-Context Indicators, by Country (%), unless otherwise specified)

Country-Level Variables	Austria	Belgium	Canada	Czech Rep.	Germany	Hungary	Italy	New Zealand	Slovenia	Sweden	Switzerland	U.S.
Lone parents benefits	0	-64			-42		-7	0		0		-24
Family or child allowances	19.77	20.87	2.47	11.55	10.18	18.65	7.88	9.32	0		16.68	8.32
Expenditures on family allowances	2.23	2.14	0.78		0.92		0.46	0.67	0		4.88	0.24
Tax and benefit transfers	18.11	23.05	11.33		14.57		7.88	2.46	7.09		10.25	11.62
Parental leave rating (high = 2)	0	2			1		2	0		2		0
Maternity leave benefits	100	80	55		100		80	0		75		0
Maternity leave duration (in weeks)	16	15	15		14		20	14		65		12
Social expenditures	25.61	26.62	18.13	18.81	25.20		24.38	20.85		33.91	17.95	14.95
Total expenditures on education	6.05	4.84	5.8	4.55	4.54	4.6	4.65			6.73	5.51	5.2
Enrollment rates at age 4	73	97	43	77	84		96	95		67	29	59
Births to single mothers	13.6	1.5	8.3	5.4	15.2	4.4	2.2	12.6	6.8	5.5	3	16.2
Parental divorce or separation	26.2	15.5	26.2	29.4	24.1	22.9	8.7	36.4	6.8	28.5	19.7	35.1
Child-years without both parents	3.94	1.41	3.39	3.18	3.99	2.4	0.81	5.08	1.25	3.16	1.7	5.12

Note: Lone parents benefits are the 1994 differences in tax and social security per month paid by lone parents compared to those paid by married couples as a proportion of the latter (parents with average earnings and two children aged 7 and 8). Family or child allowances are the 1986 – 1995 average ratios of monthly benefits for the first, second, and third child to male monthly earnings. Expenditures on family allowances are the ratios of a country's total expenditures on family allowances to its GDP (Gauthier, n.d.). Tax and benefit transfers are the 1986 – 1995 average ratios of monthly tax and benefit transfers to one-earner, two-parent, two-child families to male monthly earnings. Parental leave rating is a low/medium/high generosity scale for (either-parent) leave package (Bradshaw et al., 1996, Table 4.4 and 5.4). Maternity leave benefits are the 1996 ratios of benefits to average female worker salary. Maternity leave duration is also for 1996 (Lesthaeghe, 2000; except for Canada, Phipps (1999) and the United States (Clearinghouse on International Developments in Child, Youth, and Family Policies, n.d.), year 2001). Social expenditures and total expenditures on education are the 1995 ratios to national GDP, enrollment rates at age 4 are the 1998 proportion of children age 4 enrolled in education institutions (Organisation of Economic Co-operation and Development, n.d.). Births to single mothers are the proportions of a birth cohort born to unmarried, noncohabiting mothers, parental divorce or separation are life-table estimates of the proportion of a birth cohort that will experience parental divorce or separation by age 15, and child-years without both parents are life-table estimates of the number of years not spent cohabiting with both parents between birth and age 15 (based on early 1990s data; Heuveline et al., 2003).

Table 2

Ordinary Least Squares Estimates of Math and Science Scores, 14 Countries Combined

Variables	Math		Science	
	Model 1	Model 2	Model 1	Model 2
Constant ^a	476.345**	386.950**	511.448**	424.962**
Single-parent	-34.505**	-24.741**	-35.762**	-25.984**
Step-parent	-24.099**	-18.410**	-17.233**	-11.075**
Number of books		15.357**		17.203**
Possession index		11.879**		14.511**
Austria	47.851**	57.974**	28.748**	37.688**
Belgium-Flemish	82.407**	90.682**	26.020**	33.068**
Canada	20.928**	19.589**	-10.316**	-12.511**
Czech Republic	51.281**	54.822**	32.210**	33.325**
France	32.145**	40.544**	-40.427**	-33.421**
Germany	13.806**	24.847**	0.296	9.705**
Hungary	36.387**	35.559**	21.102**	17.598**
Italy	-12.440**	5.895*	-38.801**	-22.452**
Latvia	-7.201**	-15.655**	-57.116**	-68.142**
New Zealand	8.761**	7.394**	-8.638**	-11.024**
Slovenia	29.969**	38.816**	24.839**	32.053**
Sweden	38.010**	35.796**	21.866**	17.850**
Switzerland	67.197**	76.647**	11.371**	19.795**
Interaction country × Single parent				
Austria	33.481**	21.109**	37.829**	24.776**
Belgium-Flemish	22.746**	13.877*	26.973**	17.675*
Canada	14.424**	8.227*	20.300**	13.673**
Czech Republic	16.101*	6.799	25.319**	15.510*
France	21.814**	13.180*	24.130**	14.876*
Germany	20.465**	10.564*	27.644**	17.005**
Hungary	21.582**	13.611*	25.759**	17.485*
Italy	14.110*	3.930	19.580*	9.381
Latvia	30.125**	20.036**	34.851**	23.972**
New Zealand	13.893**	9.459*	11.227*	6.827
Slovenia	35.735**	21.639**	38.663**	23.780**
Sweden	20.522**	15.487**	24.619**	19.290**
Switzerland	23.309**	13.398**	34.490**	24.046**
Observations	100,307	100,307	100,307	100,307

Variables	Math		Science	
	Model 1	Model 2	Model 1	Model 2
Adjusted <i>R</i> -squared	0.13	0.20	0.11	0.19

Note: $N = 100,307$.

^a All models include dummy variables for guardian-parent, age 11 and under, age 17 and over, female, and upper grade (the reference categories are students living in two-parent households, aged 13 to 16, male, and in the modal grade). Models 2 also includes parental education categories, household size, and the child's country of birth (missing for France).

* $p < .05$ (conventional two-tailed tests).

** $p(M|D) > .95$ (Bayesian posterior probability of model parameter vs. parameter set to zero, given Bayesian information criterion difference D , with D estimated as $t^2 - \log(n)$; Raftery, 1995).

HLM Estimates of the Effects of a Single Country-Level Indicator on Math and Science Achievement Gaps Between Students in Single- and Two-Parent Households

Table 3

Country-Level Indicators	Math			Science		
	γ_{11}	γ_{10}	Ratio γ_{10}/γ_{11} (in SD_X)	γ_{11}	γ_{10}	Ratio γ_{10}/γ_{11} (in SD_X)
3A. Models with a family policy variable						
Lone parents benefits	0.097*	-16.112***	6.831	0.052	-15.789***	12.487
Family or child allowances	0.328***	-14.712***	5.826	0.402***	-11.415***	3.689
Expenditures on family allowances	1.886***	-15.369***	5.409	3.515***	-12.230***	2.309
Tax and benefit transfers	0.284	-15.147***	9.331	0.505*	-11.831***	4.099
Parental leave rating	2.974**	-15.301***	5.557	5.164***	-14.492***	3.031
Maternity leave benefits	0.123***	-15.227***	3.210	0.178***	-12.923***	1.883
Maternity leave duration	0.150***	-16.560***	6.601	0.178***	-14.878***	4.998
Social expenditures	0.693***	-14.264***	3.733	0.668***	-11.006***	2.988
Total expenditures on education	4.048***	-15.681***	5.207	3.480***	-11.877***	4.587
Enrollment rates at age 4	0.019	-15.294***	34.333	-0.071*	-12.909***	7.755
3B. Models with a demographic variable						
Births to single mothers	-0.542***	-13.542***	5.091	-0.987***	-10.106***	2.087
Parental divorce or separation	-0.365***	-13.214***	4.079	-0.610***	-9.786***	1.808
Child-years without both parents	-2.242***	-13.241***	4.295	-4.034***	-9.736***	1.755

Note: $N = 100,307$. Level-1 models include variables shown in Table 2. Model 3. Each coefficient comes from a hierarchical linear model in which the corresponding family policy or demographic variable and all individual-level variables are included. β_{1j} is the coefficient of single parenthood (i.e., the achievement gap between single-parent and two-parent families). γ_{11} is the coefficient of either a family policy or a demographic variable predicting the achievement gap.

* $p < .10$.

** $p < .05$.

*** $p < .01$ (two-tailed tests).

Table 4

HLM Estimates of the Effects of Two Policy and One Demographic Indicator on Math and Science Achievement Gaps Between Students in Single- and Two-Parent Households

Policy Indicators	Math			Science		
	γ_1 : First Policy Indicator (1st PI)	γ_2 : Second Policy Indicator (2nd PI)	γ_3 : Demographic Indicator (DI)	γ_1 : First Policy Indicator (1st PI)	γ_2 : Second Policy Indicator (2nd PI)	γ_3 : Demographic Indicator (DI)
4A. Models with DI: Births to single mothers						
1st PI: Tax and benefit transfers &	1.026***		– 0.465***	0.749***		–0.834***
2nd PI: Total expenditures on education		5.331***			4.745***	
1st PI: Maternity leave benefits &	0.161***		0.154	0.197***		0.097
2nd PI: Total expenditures on education		3.924*			3.523**	
1st PI: Social expenditures &	0.503***		–0.306*	0.379**		–0.743***
2nd PI: Total expenditures on education		2.159			1.375	
1st PI: Tax and benefit transfers &	–0.162		0.027	–0.126		–0.001
2nd PI: Maternity leave benefits		0.133***			0.183***	
1st PI: Tax and benefit transfers &	0.069		–0.316*	0.334		–0.792***
2nd PI: Social expenditures		0.808***			0.496*	
1st PI: Maternity leave benefits &	0.073***		0.125	0.154***		–0.003
2nd PI: Social expenditures		0.527**			0.222	
4B. Models with DI: Parental divorce or separation						
1st PI: Family or child allowances &	0.412***		– 0.406***	0.340***		– 0.733***
2nd PI: Total expenditures on education		4.447***			4.394**	
1st PI: Maternity leave benefits &	0.174***		0.164	0.199***		0.058
2nd PI: Total expenditures on education		3.036*			3.126*	
1st PI: Social expenditure &	0.391**		–0.419***	0.223		–0.770***
2nd PI: Total expenditures on education		3.678**			4.216**	
1st PI: Family or child allowances &	0.221		0.367	–0.036		0.300
2nd PI: Maternity leave benefits		0.155***			0.219***	
1st PI: Family or child allowances &	0.253		– 0.167	0.324*		–0.658***

Policy Indicators	Math			Science		
	γ_{11} : First Policy Indicator (1st PI)	γ_{12} : Second Policy Indicator (2nd PI)	γ_{13} : Demographic Indicator (DI)	γ_{21} : First Policy Indicator (1st PI)	γ_{22} : Second Policy Indicator (2nd PI)	γ_{23} : Demographic Indicator (DI)
2nd PI: Social expenditures		0.568**				
1st PI: Maternity leave benefits &	0.129***		0.361*	0.202***	0.144	0.290
2nd PI: Social expenditures		0.390*				

Note: $N = 100,307$. Level 1 models include variables shown in Table 2, Model 3. For each subject, each row represents one hierarchical linear model in which the corresponding two family policy variables, one demographic variable, and all individual-level variables are included.

* $p < .10$.
** $p < .05$.
*** $p < .01$ (two-tailed tests).

Appendix A1

Descriptive Statistics, TIMSS Variables (categorical unless indicated otherwise)

Variable	Categories/Mean	Values
Family structure	Two-parent	0.7589
	Single-parent	0.1401
	Step-parent	0.0877
	Guardian-parent	0.0133
Age	11 and under	0.0017
	12 to 16	0.9908
	17 and over	0.0075
Gender	Male	0.5008
	Female	0.4992
Grade	Upper	0.4758
	Lower	0.5242
Number of books	10 or less	0.0506
	11 to 25	0.1189
	26 to 100	0.2883
	101 to 200	0.2201
	More than 200	0.3221
Possession index (proportion) ^a	Mean	0.6762
Paternal education	Finished primary	0.0551
	Some secondary	0.1986
	Finished secondary	0.368
	Some postsecondary	0.0847
	Some university	0.0688
	Finished university	0.2248
Maternal education	Finished primary	0.0628
	Some secondary	0.209
	Finished secondary	0.3879
	Some postsecondary	0.0684
	Some university	0.0818
	Finished university	0.1901
Household size (number of persons)	Mean	4.5522
Native	Yes	0.929
	No (immigrant)	0.071

^aThe index is the sum of the possessions at home divided by total number of possessions listed in the questionnaire. The list varies by country but includes a calculator, a computer, a study desk, a dictionary, and up to 12 additional items.