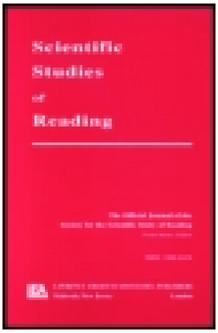

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Gender, Context, and Reading: A Comparison of Students in 43 Countries

Ming Ming Chiu & Catherine McBride-Chang
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Gender, Context, and Reading: A Comparison of Students in 43 Countries

Ming Ming Chiu and Catherine McBride-Chang
Chinese University of Hong Kong

In 43 countries, 199,097 fifteen-year-olds completed a reading comprehension test and a questionnaire. We analyzed the data using multilevel regressions of Rasch-estimated test scores to test the associations of gender and context on reading achievement among adolescents. In every country, girls outscored boys. Reading enjoyment mediated 42% of the gender effect. No other predictor significantly mediated the gender effect. Log gross domestic product per capita accounted for most of the differences across countries. Family socioeconomic status (SES), schoolmates' family SES, number of books at home, and enjoyment of reading all positively correlated with individual reading achievement. Modeling a student's likelihood of being a poor reader yielded similar results. This study suggests that a comprehensive model of reading achievement must include variables at the country, family, school, and student levels.

Are adolescent girls better readers than adolescent boys? Why or why not? The answers to these questions are undoubtedly complex. Although research studies suggest that girls tend to outperform boys in some reading tasks (Wagemaker, Taube, Munck, Kontogiannopoulou-Polydorides, & Martin, 1996) and that boys tend to be overrepresented among those diagnosed as reading disabled (e.g., James, 1992; Muter, 2003; Stein, 1994), conclusions to be drawn about gender differences in reading are limited by a number of factors. First, as Maccoby (1998) pointed out, conceptualizing gender as a discrete variable without regard to the context in which children are developing and learning tells us relatively little about the importance of gender for a given phenomenon. Much of a given student's context can

Correspondence should be sent to Ming Ming Chiu, Department of Educational Psychology, 314 Ho Tim Building, The Chinese University of Hong Kong Shatin, N.T. Hong Kong. E-mail: mingming@cuhk.edu.hk

be understood in terms of the identity of his or her peers. Thus, it is possible that the sometimes-noted advantage of girls over boys in certain reading activities is as much a function of the influence of female peers, of whom girls tend to have more, as it is of being girls themselves.

In relation to literacy activities, context might further include variables such as interest in reading. Research has shown that reading knowledge (e.g., prior knowledge, breadth of reading) and interest in reading are distinguishable and have different associations with reading achievement (Bugel & Buunk, 1996; Wigfield & Guthrie, 1997). What is less clear is the extent to which interest in reading measured across groups might explain variability in reading performance. In other words, is there a group culture of reading interest that fosters reading success beyond the individual's own interests?

Apart from adolescents' peer groups at school, families have a strong impact on their children's academic achievement (e.g., Willms, 1999). One way in which families differ that has been related to early verbal interactions (Willms, 1999) and to subsequent academic achievement in children (e.g., Brooks-Gunn, Duncan, & Britto, 1999) is socioeconomic status (SES). Although effects of SES on academic indicators tend to be stronger for those in early and middle childhood, such effects tend to persist into adolescence (Brooks-Gunn et al., 1999). SES and parental education levels are often strongly correlated, though separable in associations with achievement (Brooks-Gunn et al., 1999).

Apart from these general family background variables, of most interest in this study was families' own valuing of reading as a context for literacy achievement. Given that a family has finite resources, it is possible for families of adolescent boys and girls to devote relatively more or less effort and money to obtaining books in the home as compared to other materials. In this case, families' focus on books might be another aspect of context that is important to consider in comparing reading achievement in adolescent boys and girls.

Although a few studies have examined gender in relation to reading achievement, the majority of these studies have focused relatively little on the context in which gender effects on reading may emerge. In this study, we examine the extent to which gender, in relation to SES, number of books in the home, and reading enjoyment, can account for adolescents' reading performance across schools and across countries. Although there is some research on each of these variables in relation to reading skills, most studies have examined each of these in a single country or context. Given the huge differences across countries in government support for schools, parental attitudes toward education, overall educational infrastructures, and curricula (e.g., McBride-Chang, 2004), the relative importance of reading enjoyment and home literacy environment to gender differences in reading performance across countries is unclear.

We initiated this research with the knowledge that effects of culture (e.g., Wagemaker et al., 1996), SES (e.g., Brooks-Gunn et al., 1999; Willms, 1999), and parental education levels (Brooks-Gunn et al., 1999; Willms, 1999) have all been linked to reading performance in children and adolescents in other studies. Gender has sometimes been linked to reading achievement variability as well (Hogrebe, Nist, & Newman, 1985; Rosen, 2001; Wagemaker et al., 1996). This study was intended to extend this literature by analyzing these facets at different levels of context, in addition to incorporating more specific reading-related variables at different contextual levels, to explain variance in reading achievement.

At the outset, we expected that differences across students in culture, SES, parental education levels, and possibly gender would likely explain some variability in reading performance across students. What was less clear, however, was the extent to which variables that were more specifically linked to reading activities, such as number of books in the home or students' self-reported interest in reading, would be associated with reading achievement apart from the broader demographic measures. We were also interested in the levels of context in which both the broad demographic measures and the reading-related variables might explain reading variability among these adolescents. Thus, for example, although the term *context* could be broadly construed as a representation of country per se, we also considered the impact of school-level context by testing whether school means of reading enjoyment were associated with reading performance across students.

We explored four questions. First, to what extent are parents' economic and educational attainments associated with adolescents' reading achievement? Second, does the number of books in the home account for differences in reading achievement? Third, to what extent does reading interest relate to reading achievement? Fourth, to what extent is gender associated with reading achievement? We address several of these questions at multiple levels of context. We examine SES at the country, family, and school levels, whereas we consider number of books only at the family level. We examine both reading interest and gender at the school and student levels. We review evidence on the impacts of economic factors across countries, schools, and families. We then highlight previous research on reading comprehension and individual student attributes, specifically number of books at home, student interest in reading, and student gender.

ECONOMICS AND READING ACHIEVEMENT

Much has been written about the impact of SES on reading achievement. For example, studies have shown that countries with higher real gross domestic product (GDP) per capita generally show higher student achievement (Baker, Goesling, & Letendre, 2002; Heyneman & Loxley, 1983). This may happen directly through government spending on schools or indirectly through higher nutritional standards or better health care (e.g., UNICEF, 2001). For example, when parents lack basic nutrition, children are more likely to be born prematurely, face exposure to potentially harmful environments (e.g., lead poisoning), or suffer general inattention or lethargy (Tesman & Hills, 1994; UNICEF, 2001; Vernon-Feagans, Hammer, Miccio, & Manlove, 2001). All of these problems are associated with difficulties in learning. Although the many complexities involved in explaining the association of country-level wealth with children's reading performance are beyond the scope of this article, this strong association is important to acknowledge in this large-scale cross-cultural study of reading performance. We included country-level GDP in our analyses accounting for variability in reading achievement because of the vast differences across countries in available resources, educational and otherwise.

Economic resources are similarly important at the family and school levels. For example, students with greater access to family capital (often called SES) typically show higher academic achievement (Bradley & Corwyn, 2002; Brooks-Gunn et al., 1999; Coleman, 1988). Family capital includes financial capital (wealth or material resources), human capital (nonmaterial resources such as education), and social capital (resources achieved through social connections such as job status). SES can affect student achievement through more learning opportunities via more education resources (Benabou, 1996), effective parenting practices (e.g., Bornstein & Bradley, 2003), and higher parental expectations (Battin-Pearson et al., 2000; DeGarmo, Forgatch, & Martinez, 1999; Parcel & Menaghan, 1990).

Apart from individual-level capital, academic performance is also determined by the economic situation of the school (e.g., Ogle et al., 2003; Snow, Burns, & Griffin, 1998). For example, students attending private schools in the United States tend to outperform those in public schools in reading (Ogle et al., 2003). At least in the United States, private schools tend to have access to more monetary resources than do public schools. Snow and colleagues also noted that the differences in academic performance tend to be far greater across than within U.S. schools. Students in richer schools tend to outperform those in poorer schools; in comparison, differences across students within any given school tend to be relatively modest. Those from richer schools typically have more educational and material resources to share with classmates than do those from poorer schools. The extent to which these school-level findings apply across countries was explored in this study, where we included highest level job status in the family and mothers' highest education level attained at both the individual and school levels as measures of privilege.

PRIORITIZATION OF READING AND READING ACHIEVEMENT

Are there effects of family literacy that are separable from this general educational and economic capital within the family? In this study, we examine one effect of prioritizing literacy within the family on reading performance as indicated by the number of books in the home while controlling for family SES. In a classic study of literacy resources across neighborhoods, Feitelson and Goldstein (1986) found that in neighborhoods in which children have more books, the children show higher reading scores. Given that children from richer schools tend to outperform those from poorer schools (Ogle et al., 2003; Snow et al., 1998), this link may not be surprising. Furthermore, several studies, mostly within a single culture, have shown that extended exposure to reading materials is associated with both early reading development (e.g., Applebee, Langer, & Mullis, 1988; Morrow, 1983) and reading achievement (e.g., Clark, 1976). Although such associations are likely partially determined by education and earnings within the family, we tested the extent to which more books in the household (i.e., a valuing of literacy exposure) would be associated with reading achievement apart from general effects of education and income earning within a given home or school.

INTERNAL MOTIVATION AND READING ACHIEVEMENT

We also considered the link between adolescents' own interest in reading and their reading achievement scores. In studies of younger children, interest in literacy activities is associated with literacy achievement (e.g., Crain-Thoreson & Dale, 1992; Mason, 1980; Scarborough, Dobrich, & Hager, 1991; Thomas, 1984; Wells, 1985). In many of these studies of younger children (Scarborough et al., 1991), interest in literacy activities is a measure of parental perceptions of children's interest rather than children's self-reports of interest. However, Wigfield and Guthrie (1997) demonstrated that fourth- and fifth-grade American children's self-reported reading motivation predicted both the breadth and the amount of reading children did over a school year. In that study, motivation was measured using several factors. In this study, involving a very large sample size, our measure of reading enjoyment was focused less on different aspects of reading motivation and more on simple enjoyment of reading. Although it seems reasonable that those who report relatively high levels of enjoyment of reading may perform better on tasks of reading comprehension, this hypothesis has been seldom tested among adolescents. However, in summing up the literature on interest in relation to learning, Eccles and Wigfield (2002) asserted that such interest is primarily associated with learning of text, particularly at deeper levels of comprehension. Researchers have distinguished interest in reading in both the situational (i.e., text features or aspects of the environment) and individual (i.e., individual variability in reported pleasure from reading) levels (Hidi, 2001). The individual and school levels of interest in reading were both tested in our study. We expected that greater individual interest in reading would correlate with reading performance, even after controlling for families' educational and financial capital and families' valuing of literacy.

GENDER AND READING ACHIEVEMENT

In accounting for social and economic resources and for prioritization of reading, we focused particularly on gender in relation to reading achievement in adolescents. Over the years, researchers have debated the extent to which girls outperform boys in tasks of reading comprehension and whether boys are more likely than girls to suffer from reading disabilities. Effects of gender on reading are difficult to disentangle from other gender differences. Across cultures, for example, boys with learning difficulties tend to be more active and vocal than are girls (e.g., Halpern, 2000) and hence attract more adult attention, especially when misbehaving ("the squeaky wheel gets the grease"). Given accompanying problem behaviors, overrepresentation of boys in relation to poor reading may be exaggerated (e.g., American Psychiatric Association, 1994). Nevertheless, exaggeration or not, boys are often overrepresented in epidemiological studies of dyslexia (e.g., James, 1992; Muter, 2003; Stein, 1994).

In this study, we explicitly identified poor readers, rather than dyslexics per se, across cultures. Despite the popularity of the term *dyslexia*, referring to children who have relatively high IQs and lower than expected reading scores, its uses are limited both within and across cultures (e.g., Siegel, 1989; Snowling, 2000; Stanovich, 2000). The main problem with this term is that it implies that those poor readers with higher and lower general cognitive abilities may require different reading interventions or display different reading strategies, ideas that have not been supported by empirical studies (e.g., Stanovich, 2000). In a study across cultures, the term *dyslexia* becomes increasingly confusing, because different countries tend to define dyslexia in different ways (e.g., McBride-Chang, 2004). Given that there are few parameters for estimating the prevalence of reading difficulties across cultures and that the term *dyslexia* is fraught with controversy, our analyses of possible gender differences in reading focused both on mean scores and on numbers of students scoring as poor readers according to the standards of the reading comprehension test they completed.

Overall effects of gender on reading performance in studies of the general population are also difficult to establish given the many contextual variables that may account for any differences found. For example, girls tend to report enjoying reading more than do boys (Guthrie & Greaney, 1991), and sometimes girls report being more motivated to read (Wigfield & Guthrie, 1997). Girls also tend to report reading more books than do boys (Elley, 1994). Finally, gender differences in literacy activities must be understood within a wider social context that can be crudely defined, at the very least, with reference to both educational and financial status of families across cultures (Wagemaker et al., 1996). Given this conceptualization of social context, we further considered whether gender interactions within a school itself might constitute part of students' socialization. Specifically, are the relative proportions of male and female students within a school or a country associated with a student's reading achievement?

Large-scale cross-cultural studies (e.g., Hogrebe et al., 1985; Rosen, 2001; Wagemaker et al., 1996) have consistently shown some gender differences in reading comprehension. However, with thousands of participants in these studies, even very small differences in mean levels of performance are significant, though not necessarily meaningful. Moreover, the directions of effects in such studies were not consistent (e.g., Hogrebe et al., 1985; Rosen, 2001). On some reading measures, boys outperformed girls. On others, girls outperformed boys. On still other reading measures, there were no differences (Hogrebe et al., 1985; Rosen, 2001; Wagemaker et al., 1996).

Conclusions about reading performance by gender in reading comprehension may differ depending on our definitions of reading performance. Whereas studies of dyslexia examine the prevalence of very poor readers in the general population, studies of gender and reading tend to focus on mean differences across entire samples of male and female participants. In this study, we analyzed the data on gender and reading comprehension using both approaches. We tested for male–female differences in both overall reading performance and the percentages of poor readers in different countries. Epidemiological studies have suggested that gender differences might show a greater disadvantage for boys in reading comprehension when only the gender ratios of the poorest readers were compared (e.g., James, 1992; Muter, 2003; Stein, 1994).

To review, we explored four questions in this large-scale study that focused broadly on understanding the underpinnings of gender in relation to reading achievement in adolescents. First, to what extent are economic and social capital at the country, family, and school levels associated with student reading achievement? Second, apart from family capital, does a family's commitment to literacy activity as crudely measured by books in the home explain variance in individual reading achievement? Third, is student enjoyment of reading uniquely associated with reading achievement, at either the school or individual level? Finally, does gender explain reading comprehension performance, and at what contextual levels, alone or in combination with other factors? For example, does the percentage of boys in a school or a country explain variance in reading achievement? We tested the extent to which our conclusion depends on whether students are examined as poor readers versus adequate readers as opposed to looking at gender group means. Large-scale studies of reading comprehension performance have examined many of the variables included in this study using various analytic techniques (Elley, 1994; Hogrebe et al., 1985; Rosen, 2001; Wagemaker et al., 1996). However, ours is among the first to examine effects at the individual, school, and country levels simultaneously using multilevel regression. We were particularly interested in the effects of school- and individual-level variables for explaining overall reading comprehension performance among adolescents across 43 countries.

METHOD

Data

The Organization for Economic Cooperation and Development's Program for International Student Assessment (OECD-PISA) assessed 15-year-olds' reading literacy and asked students and principals to fill out questionnaires in 2000. OECD consists of countries sharing the principles of the market economy, pluralist democracy, and respect for human rights. The study was initiated to help countries evaluate their school systems and consider ways to improve them.

International experts from 28 participating OECD countries defined reading literacy and each of the indexes discussed later, built assessment frameworks, created test items, double-blind forward-translated and backward-translated these items, pilot tested these items, and conducted factor analyses to test their validity and reliability (for details, including reliability and validity checks, see OECD, 2002; 15 non-OECD countries joined this study within 2 years.)[1] PISA defines reading literacy as the ability to understand, use, and reflect on written texts to achieve one's goals, develop one's knowledge and potential, and participate effectively in society. PISA test items represent the kinds of reading literacy that 15-year-olds would likely use. Example assessment items are available at the PISA Web site (www.pisa.oecd.org). Each participating student completed a 2-hr assessment booklet and a 30- to 40-min questionnaire.

Methodological Design

Investigating these research questions across a large number of countries and schools requires choosing a representative sample of 15-year-olds to test, creating precise tests and questionnaire items with which to collect the data, and modeling the data's complex relationships with suitable statistical tools. Random sampling might not yield a sample that is representative of the country's 15-year-olds. To do so, OECD (2002) sampled at the school level before sampling at the student level. OECD used stratified sampling with respect to neighborhood SES and student intake to select about 150 schools that would represent a broad spectrum. They then sampled about 35 students from each of the selected schools. Each country sampled at least 4,500 students. OECD (2002) then weighted the participant test scores and variables accordingly to represent the schools and the 15-year-old student populations of each country. For sampling details, see OECD (2002).

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[1]Participating OECD countries included Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States. Participating non-OECD countries included Argentina, Albania, Chile, Hong Kong–China, Indonesia, Israel, Latvia, Liechtenstein, FYR Macedonia, Peru, Romania, Russian Federation, and Thailand.

This representative sample of students should then be given precise tests and questionnaires. Traditional tests seeking to cover large amounts of mathematics, reading, and science content were often long, resulting in student fatigue and learning effects during the exam. To reduce these effects and to maximize evaluative precision, OECD used a balanced incomplete block (BIB) test. In a BIB test, each student only answered a subset of questions from the overall test (also known as a *subtest*; Lord, 1980). Because each pair of subtests shared overlapping questions, OECD (2002) analyzed the test scores by fitting a graded response Rasch model to the BIB data. The Rasch model estimated the difficulty of each item and the achievement score of each student based on the subtest responses (adjusting for the difficulty of each test item and calibrating all test items; Lord, 1980). Because the test included both multiple-choice and open-ended questions, the graded response aspect of the model captures the partial credit on student responses to open-ended questions (Samejima, 1969).

Like the tests, the questionnaire should also maximize precision. A traditional questionnaire probing an underlying construct with a single question and a limited number of possible responses (e.g., yes and no, or a simple Likert-type scale) often measures the construct coarsely, resulting in substantial measurement error. To minimize this measurement error, OECD (2002) included multiple measures for each theoretical construct and computed a single value from these measures with a Rasch model (Warm, 1989, estimates). This method is more precise than the traditional method of summing the response values of multiple measures (Jöreskog & Sörbom, 2002).

To model the complex relationships in these data precisely, multilevel analyses or multiple imputation is likely needed. Traditional ordinary least squares regressions tend to underestimate the standard errors of regression coefficients in clustered data (students within schools within countries). To address this concern, we modeled school- and country-level effects with multilevel analyses (Goldstein, 1995; also called hierarchical linear modeling, Bryk & Raudenbush, 1992).

Because students did not answer all questions, data (4%) were missing that could reduce estimation efficiency, complicate data analyses, and bias results (Rubin, 1996). The use of Markov Chain Monte Carlo multiple imputation allowed us to address these problems more effectively than would other approaches (such as deletion, mean substitution, simple imputation; Rubin, 1996).

Variables

We modeled reading achievement using measures of gender, SES, number of books at home, and enjoyment in reading. Unless otherwise indicated, all variables were obtained or computed from the OECD-PISA database (OECD, 2002). All indexes, including SES, were standardized to a mean of 0 across OECD countries and a standard deviation of 1. Data from non-OECD countries were added after the computation of the indexes, resulting in slightly different means. Hence, a positive value on an index indicates a value above the OECD average, and a negative value indicates a value below the OECD average.

Gender. OECD (2002) coded for the student-level variable *girl* (girl = 1, boy = 0). OECD obtained the total number of 15-year-old girls and the total number of 15-year-old boys in each school from each principal. Using this information, we created the school-level variable percentage of girls in a school.

GDP per capita. We used the country-level variable GDP per capita, adjusted for inflation in 2002 U.S. dollars (Heston, Summers, & Aten, 2002), to measure a country's per capita income. We also tested whether log GDP per capita would fit the data better, given that GDP per capita showed a log-linear relationship with many outcomes (e.g., death rates; World Bank, 2004).

SES. To create the student-level variable *family SES,* we used LISREL software (Jöreskog & Sörbom, 2002) to do a single-level confirmatory factor analysis on the SES indicators (mothers' years of schooling, fathers' years of schooling, and highest job status of parents) and computed the composite factor scores for this SES factor (Jöreskog & Sörbom, 2002). OECD (2000) used Ganzeboom, De Graaf, and Treiman's (1992) index to measure the highest job status among a student's parents (ranging 16–90). Unfortunately, OECD (2002) did not collect data on parent income, which together with mother's education, father's education, and job status might have improved our measures of family SES and school mean of family SES. We also tested whether log SES would fit the data better, but it did not. See Appendix A for details.

Using each subsample of students within each school, we computed the mean of family SES as an estimate of the school-level variable, school mean of family SES. We did not use SES at the country level because the relevant measure of the country background in which these 15-year-olds are learning is the SES of the entire population, not only the SES of the 15-year-old's parents. We used GDP per capita to measure economic differences across countries because large, representative surveys of job status and schooling were not available for many countries.

Number of books at home. This was an ordered student-level variable derived from student responses to the question "How many books are there in your home? (There are usually about 40 books per meter of shelving. Do not include magazines)." The choices were (a) none, (b) 1–10 books, (c) 11–50 books, (d) 51–100 books, (e) 101–250 books, (f) 251–500 books, and (g) more than 500 books.

Index of reading enjoyment. This student-level Warm (1989) index was derived from students' level of agreement with the following nine statements: (a) I read only if I have to; (b) Reading is one of my favorite hobbies; (c) I like talking about books with other people; (d) I find it hard to finish books; (e) I feel happy if I receive a book as a present; (f) For me, reading is a waste of time; (g) I enjoy going to a bookstore or a library; (h) I read only to get information that I need; and (i) I cannot sit still and read for more than a few minutes. The choices for each question were an ordinal scale consisting of 1 (*strongly disagree*), 2 (*disagree*), 3 (*agree*), and 4 (*strongly agree*). The reliability of this index was 0.72 (OECD, 2002).

Poor reader. In addition to analyzing the scaled scores of students, we also analyzed the performances of especially poor readers relative to other readers. OECD (2002) designated a reading score below 335 as reading level 0. A student at reading level 0 is unlikely to do any of several tasks successfully (less than 50% of the time). These tasks include (a) using one criterion to find a piece of explicitly stated information in a text, (b) recognizing the main theme in a text when it is prominent, or (c) making a simple link between information in the text and common everyday knowledge (OECD, 2000). Following OECD's (2002) definition, we operationally defined the student-level variable of a poor reader as a student at reading level 0.

Analysis

We analyzed the data with multilevel analyses. Canada and Japan were not included in the regression analyses due to countrywide missing data, resulting in a data set of 193,841 students for the regression analyses. First, we tested the extent to which students' test scores varied substantially across countries and across schools with a multilevel variance components model (with no predictors) via the MLn software (Rasbash & Woodhouse, 1995). To make an explicit comparison with Snow et al. (1998), we did an additional variance components model for only the U.S. data. If scores show significant differences across countries or across schools, then multilevel analyses are needed of students (Level 1) within schools (Level 2) within countries (Level 3).

We modeled students' reading achievement with sequential sets of multilevel regressions (also known as hierarchical sets; Cohen & Cohen, 1983) to estimate the variance explained by each set of predictors. We entered the sets of predictors in order of likely temporal occurrence, importance, and theoretical interest: gender, log GDP per capita, family SES and school mean family SES, percentage of girls in school, number of books at home, and reading enjoyment. Our variance components model computed earlier with no predictor estimated the total variance of the outcome variable (reading score) at the country, school, and student levels. After adding a predictor to the regression model, the remaining variance was computed at each level. To compute the additional variance explained at each level, we use the following formula: 1 – [(remaining variance with added predictor) ÷ (remaining variance without predictor)].

The effects of each predictor might differ across countries or across schools. Therefore, we estimated these predictor differences using random parameters for each explanatory variable at the country and school levels (Goldstein, 1995). The MLn program converged on a three-level solution for overall fixed effects but not on estimates of variation of predictors across countries (random effects). Thus, for each of the 41 countries, we did separate sets of two-level regressions of students within schools (Goldstein, 1995). We compared the regression coefficients of each country's two-level analyses to discern country differences. To detect school-level differences in the two-level analyses, we used random parameters for each explanatory variable at the school level.

An alpha level of .05 was used for all statistical tests. Conducting many tests on one set of data increases the likelihood of a spurious correlation. To address this problem, we reduced this likelihood by adjusting the alpha level based on the number of predictors via Hochberg's (1988) variation on Holm's (1979) method. We tested whether each added set of predictors was significant with a nested hypothesis test (χ^2 log likelihood; Cohen & Cohen, 1983). To facilitate interpretation of the results, we report unstandardized regression coefficients.

To facilitate interpretation of the results, we report the effect on a students' reading literacy of a 10% increase in each continuous predictor above its mean (10% effect = $b \times SD \times [10\% / 34\%]$; 1 SD ≈ 34%). We also tested whether any of the predictors mediated the gender effect using a multilevel version of the Sobel (1982) test (Krull & MacKinnon, 2001). If the mediation is significant, we also report the percentage change in the effect, computed as $1 - (b'/b)$. The regression coefficient of the predictor without the mediator in the model is indicated by b, and b' is the regression coefficient when the mediator is in the model.

We used multilevel binary Logit and Probit to predict the likelihood of a student being a poor reader using the same model described previously. Poor reader is a binary variable, bounded between 0 and 1, with nonconstant variance and nonnormal error terms. Because least squares regressions make assumptions that violate the previously mentioned conditions, their standard errors are biased (Finney, 1971). Logit models address these concerns by estimating the likelihood that a variable value is at a higher value rather than a lower value (e.g., 1 rather than 0; Thisted, 1988). We can create multilevel Logit models with a Logit link function (Goldstein, 1995). To interpret the effect of a predictor in multilevel Logit models, we used the odds ratio, computed from the antilog of the regression coefficient (Thisted, 1988).

The three-level model with only girl as a predictor did not converge, but all subsequent models did converge. Country-by-country two-level analyses did not converge for many countries due in part to the small number of poor readers in these countries, and hence were not analyzed. As the underlying distribution of disabled readers in community samples across countries is unknown, we repeated the analysis with multilevel Probit to ensure that the results were not dependent on the Logit distribution assumptions (Finney, 1971).

RESULTS

In every country, girls outscored boys in reading. The explanatory model further showed that gender, log GDP per capita, family SES, schoolmates' SES, number of books at home, and reading enjoyment were all significantly associated with reading score. Only reading enjoyment mediated the gender effect.

Summary Statistics

The countries in this study were fairly wealthy (mean GDP per capita = US $10,577). The highest job status within a family spanned the full range of Ganzeboom, De Graaf, and Treiman's (1992) index of 16 to 90 with a mean of 47. See Table 1 for summary statistics (see Appendix B for correlation and covariance matrixes). Furthermore, most mothers were well educated, averaging over 11.1 years of schooling. Meanwhile, fathers were only slightly more educated, averaging 11.5 years of schooling. These high levels of income, job status, and education showed in the high numbers of books in the home: 62% of the students had at least 51 books at home.

As mentioned previously, because many non-OECD countries scored below the OECD standardized mean of 500, the overall mean for the countries in this study was 472. About 9.5% of the students tested fell below OECD's minimum reading achievement level and were classified as poor readers. Reading enjoyment was standardized to an OECD mean of 0, so the mean of 0.05 showed that students in non-OECD countries enjoyed reading a bit more than those in OECD countries.

Girls Outscored Boys

Girls had higher average reading scores than did boys in every country, and this difference was significant in every country except Romania and Peru (see Table 2). This result shows that the gender difference in reading is not an isolated phenomenon but is widespread in many countries around the world. The overall gender differences ranged from 6 points in Peru to 59 points in Albania, with a mean difference of 33 points, showing that the gender difference varies substantially across countries and is likely affected by the country-specific conditions for boys and girls. Also, gender and reading score showed a univariate correlation of .14, a small but substantial effect on reading scores. Having shown prima facie evidence of gender differences, we turned next to in-depth multilevel analyses.

Explanatory Model

The three-level variance components model showed clustering effects and the need for a multilevel model. About 25% of the differences in reading scores occurred at the country level, 30% occurred at the school level, and 45% occurred at

TABLE 1
Summary Table of Reading Score, Reading Score Below Level 1, and Its Significant Predictors

Variable	*M*	*SD*	*Min*	*Max*	*n*
Reading score (Rasch)	472.112	108.730	48.800	854.690	199,097
Reading score below Level 1 (%)	0.095	0.293	0	1	199,097
Girl (= 1, boy = 0)	0.508	0.500	0	1	197,781
% 15-year-old girls per school	0.508	0.221	0	1	197,781
Log GDP per capita (ln US$)	9.100	0.597	7.625	9.881	199,097
Family SES (index)	–0.049	1.038	–3.591	0.054	177,688
Highest job status among parents (raw)	47.116	16.928	16	90	184,898
Highest job status—school mean (raw)	47.116	9.064	16	79	184,898
Mother's years of schooling (raw)	11.148	3.723	0	18	182,555
Mother's years of schooling—school mean (raw)	11.156	2.261	0	16.667	182,555
Father's years of schooling (raw)	11.458	3.678	0	18	177,688
Father's years of schooling—school mean (raw)	11.458	2.163	0	18	177,688
Reading enjoyment (index)	0.052	0.948	–3.030	3.230	193,396

	% of Students Selecting Each Category							
	None	*1–10*	*11–50*	*51–100*	*101–250*	*251–500*	*More Than 500*	*n*
No. of books at home	2%	13%	23%	21%	18%	13%	10%	193,841

Note. The type of measure is described in parentheses. GDP = gross domestic product; SES = socioeconomic status; ln = natural logarithm.

the student level. Although differences in reading scores across countries were large, 75% of the differences were within a country. Hence, cross-country comparisons must incorporate the large differences among students within each country. Furthermore, reading score differences within a school were larger than those across schools (in the United States, 71% of the differences were within schools, and 29% were across schools in this study), contrary to the results of Snow et al.'s (1998) smaller study. Hence, researchers seeking to model students' reading achievement would likely benefit from considering explanatory variables at all three levels—country, school, and student. The results that follow refer to a predictor's first entry into the regression model, controlling for all earlier predictors (see Table 3).

TABLE 2
Girls' Mean Reading Scores Exceed That of Boys in All Countries

	Mean Reading Scores		
Country	*Girls*	*Boys*	*Difference*
Albania	378	319	59
Argentina	437	393	44
Australia	546	513	33
Austria	520	495	25
Belgium	525	492	33
Brazil	404	388	16
Bulgaria	455	407	48
Canada	551	519	32
Chile	421	396	25
Czech Republic	510	473	37
Denmark	510	485	25
Finland	571	520	51
France	519	490	29
FYR Macedonia	399	348	51
Germany	502	468	34
Greece	493	456	37
Hong Kong–China	533	518	15
Hungary	496	465	31
Iceland	528	488	40
Indonesia	380	360	20
Ireland	542	513	29
Israel	459	444	15
Italy	507	469	38
Japan	537	507	30
Korea	533	519	14
Latvia	485	432	53
Liechtenstein	500	468	32
Luxembourg	456	429	27
Mexico	432	411	21
The Netherlands	547	517	30
New Zealand	553	507	46
Norway	529	486	43
Peru	330	324	6 (*ns*)
Poland	498	461	37
Portugal	482	458	24
Romania	455	443	12 (*ns*)
Russian Federation	481	443	38
Spain	505	481	24
Sweden	536	499	37
Switzerland	510	480	30
Thailand	448	406	42
United Kingdom	537	512	25
United States	518	490	28

Note. This difference is significant in all countries except Romania and Peru.

TABLE 3
Summaries of Seven Regression Models Predicting Students' Reading Literacy With Unstandardized Regression Coefficients, Standard Errors, and Standardized Regression Coefficients

	Regressions Predicting Reading Literacy						
Predictor	*Model 1*	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*	*Model 7*
Girl	22.730***	22.750***	24.120***	24.050***	24.010***	23.010***	13.420***
	(0.372)	(0.374)	(0.370)	(0.364)	(0.365)	(0.359)	(0.359)
	0.209	0.209	0.221	0.221	0.220	0.211	0.123
Log GDP per capita		75.530***	68.620***	38.280**	38.240**	35.030**	41.330***
		(9.281)	(9.224)	(12.320)	(12.320)	(11.840)	(11.770)
		0.417	0.379	0.211	0.211	0.193	0.228
SES			16.000***	14.280***	14.270***	9.380***	9.065***
			(0.211)	(0.211)	(0.211)	(0.216)	(0.210)
			0.152	0.136	0.136	0.089	0.086
School mean SES				71.360***	71.360***	65.680***	65.880***
				(1.089)	(1.089)	(1.049)	(1.021)
				0.446	0.446	0.410	0.412
% girls per school					8.183**	7.483**	5.903*
					(2.756)	(2.646)	(2.575)
					0.015	0.013	0.011
No. of books at home						10.670***	7.995***
						(0.130)	(0.128)
						0.154	0.116
Reading enjoyment							20.820***
							(0.190)
							0.179

Remaining variance at each level							
Country	2989***	1108***	1099***	2033***	2027***	1881***	1858***
	(666)	(253)	(249)	(453)	(454)	(418)	(414)
School	3576***	3576***	2958***	1737***	1735***	1588***	1506***
	(64)	(64)	(53)	(33)	(33)	(30)	(29)
Student	5416***	5416***	5829***	5291***	5290***	5121***	4820***
	(18)	(18)	(17)	(17)	(17)	(17)	(16)
Explained variance at each level							
Country	0.000	0.629	0.632	0.320	0.322	0.370	0.378
School	0.035	0.035	0.202	0.531	0.532	0.572	0.594
Student	0.018	0.018	0.042	0.041	0.041	0.072	0.126
Total	0.019	0.173	0.235	0.258	0.259	0.297	0.330

Note. Standard errors are in parentheses. GDP = gross domestic product; SES = socioeconomic status.
*$p < .05$. **$p < .01$. ***$p < .001$.

Gender. As indicated by the girl regression coefficient of 22.73 in Model 1 of Table 3, girls outscored boys by 22.73 points on average. Gender accounted for 1.9% of the variance in reading achievement.

GDP per capita. At the country level, 15-year-old students in richer countries scored higher in reading than those in poorer countries. Because log GDP per capita is the natural logarithm (ln) of the variable GDP per capita, we multiply its regression coefficient of 75.53 (in Model 2 of Table 3) by the natural log of (1 + 10%) to obtain 7.2 (= 75.53 × ln [1 + 10%]), which indicates that students in richer countries score 7.2 points per 10% rise in GDP per capita on average. (Ln GDP per capita explained more variance than GDP per capita did.) In addition, ln GDP per capita accounted for 63% of the reading achievement differences across countries and an extra 15.4% of the overall variance (15.4% = 17.3% – 1.9%; Table 3, Models 1 and 2). This result shows the huge impact of money, which accounted for most of the differences in reading scores between countries.

SES. The family SES of a student and of one's schoolmates was also associated with reading scores. Students averaged 4.7 points higher per extra 10% increase in their family SES (4.7 = 16.0 × 10% / [34% / 1 *SD*]; Table 3, Model 3). Family SES accounted for an extra 6% of the reading scores variance (Table 3, Models 2 and 3).

Controlling for the effects of a student's family SES, schoolmates' family SES was also associated with a student's reading score. Students scored 21 points higher per extra 10% increase in their schoolmates' family SES on average (21.0 = 71.36 × 10% / [34% / 1 *SD*]; Table 3, Model 4). Furthermore, schoolmates' family SES accounted for an extra 2% of the reading scores variance (Table 3, Models 3 and 4).

Percentage of girls in school. Controlling for the preceding variables, students scored 0.8 points higher per extra 10% of female schoolmates on average (0.8 = 8.18 × 10% / 100%; Table 3, Model 5), showing that the school's gender context affects a student's reading achievement as well. Percentage of girls in school accounted for less than 1% of the variance in reading achievement (Table 3, Models 4 and 5).

Number of books at home. Controlling for the preceding variables, students with more books at home scored higher (Table 3, Model 6). This effect was substantial, explaining an extra 3% of the variance (Table 3, Models 5 and 6). Number of books also partially mediated the effect of family SES, accounting for over 34% of its effect (34% = [14.27 – 9.38] / 14.27; Table 3, Models 5 and 6; mediation test: $z = 71.271$, $p < .001$). This result suggests that families with higher SES may tend to improve their child's reading achievement by enriching their home with more books.

Reading enjoyment. Reading enjoyment explained differences in reading scores and mediated gender effects (Table 3, Model 7). A student averaged 6.1 points higher for each 10% increase in reading enjoyment (6.1 = 20.82 × 10% / [34% / 1 *SD*]; Table 3, Model 7). Reading enjoyment accounted for an extra 3% of the variance (Table 3, Model 6 and 7).

Reading enjoyment partially mediated gender effects at both the individual and school levels. It accounted for 42% of the individual gender effect (42% = [23.01 – 13.42] / 23.01; Table 3, Models 6 and 7; mediation test: $z = 77.903$, $p < .001$). This result shows that girls have higher reading scores, and both girls and higher reading scores are associated with enjoying reading. No other predictor significantly mediated the effect of gender on reading achievement. In addition, reading enjoyment accounted for 21% of the school-level gender effect (21% = [2.65 – 2.58] / 2.65; Table 3, Models 6 and 7; mediation test: $z = 13.449$, $p < .001$). Students in schools with more girls tend to have higher reading enjoyment. Even after controlling for all of these variables, girls still outscored boys by 13 points on average.

No other variables were significant. Altogether, these variables accounted for 33% of the variance in reading achievement.

Differences Across Countries and Schools

The effects did not vary much across countries except for that of female schoolmates (see Tables 4 and 5). Students who had more female schoolmates scored higher only in Germany. In Korea and Luxembourg, students scored 2 and 6 points *lower* per extra 10% increase in female schoolmates, respectively. The effect was not significant in other countries. Hence, female schoolmates' overall significant effect was due largely to the outlier effect in Germany. In contrast, gender, students' and schoolmates' SES, number of books at home, and reading enjoyment had positive significant effects on students' reading scores in nearly all countries

TABLE 4
Summary of Two-Level Parameter Estimates Predicting Reading Literacy for Each Country (Upon First Entry)

	Predictor Effect on Reading Literacy					*% of Countries*	
Predictor	*M*	*SD*	*Min*	*Median*	*Max*	*Sig. –*	*Sig. +*
Girl	22.502	12.435	2.302	21.170	51.980	0%	95%
SES	17.489	10.658	2.267	14.880	51.080	0%	100%
School mean SES	81.873	37.324	5.028	78.830	178.200	0%	95%
% 15-year-old girls per school	12.285	45.572	–58.170	3.6662	59.100	5%	2%
Amount of books	9.872	4.577	0.758	9.480	18.040	0%	98%
Reading enjoyment	20.110	7.483	–1.291	18.360	33.920	0%	98%

Note. SES = socioeconomic status.

TABLE 5
Signs of Regression Coefficients on First Entry Into Two-Level Regressions Predicting Reading Literacy for Each Country

	Predictor					
Country	*Girl*	*SES*	*SES—School Mean*	*% of Girls in School*	*No. of Books*	*Reading Enjoyment*
Albania	+	+	+		+	+
Argentina	+	+	+		+	+
Australia	+	+	+		+	+
Austria	+	+	+		+	+
Belgium	+	+	+		+	+
Brazil	+	+	+		+	+
Bulgaria	+	+	+		+	+
Chile	+	+	+		+	+
Czech Republic	+	+	+		+	+
Denmark	+	+	+		+	+
Finland	+	+			+	+
France	+	+	+		+	+
FYR Macedonia	+	+	+		+	+
Germany	+	+	+	+	+	+
Greece	+	+	+		+	+
Hong Kong—China	+	+	+		+	+
Hungary	+	+	+		+	+
Iceland	+	+			+	+
Indonesia	+	+	+		+	+
Ireland	+	+	+		+	+
Israel	+	+	+		+	+
Italy	+	+	+		+	+
Korea	+	+	+	–	+	+
Lativia	+	+	+		+	+
Liechtenstein	+	+	+		+	+
Luxembourg	+	+	+	–	+	+
Mexico	+	+	+		+	+
The Netherlands	+	+	+		+	+
New Zealand	+	+	+		+	+
Norway	+	+	+		+	+
Peru		+	+		+	+
Poland	+	+	+		+	+
Portugal	+	+	+		+	+
Romania		+	+			
Russian Federation	+	+	+		+	+
Spain	+	+	+		+	+
Sweden	+	+	+		+	+
Switzerland	+	+	+		+	+
Thailand	+	+	+		+	+
United Kingdom	+	+	+		+	+
United States	+	+	+		+	+

Note. The symbols indicate a significant positive effect (+), a significant negative effect (–), and no significant effect (empty cell). Canada and Japan were not included in the regression analyses due to countrywide missing data. SES = socioeconomic status.

(95%, 100%, 95%, 98%, and 98%, respectively). Differences in these predictors' effects across schools within a country were not significant (all ancillary results are available from the authors on request).

Modeling Poor Readers

The gender composition of poor readers in each country was consistent with boys' and girls' mean scores in each country (Tables 6 and 2). As seen in Table 6, the percentage of poor readers in each country varied widely from 1% in Korea to 54% in Peru, showing that a student's environment is strongly associated with the likelihood of being a poor reader. Still, boys were more likely than girls to be poor readers in all countries. In addition to scoring lower than girls in reading on average, boys made up a greater proportion of poor readers. Furthermore, this difference was relatively large. In 90% of the countries, boys were at least 50% more likely than girls to be poor readers.

We also modeled the likelihood of being a poor reader (below level 0) using multilevel Logit (see Table 7; multilevel Probit showed similar results, available on request from the authors). The results were consistent with the previously noted scaled score results, with two exceptions. First, most of the variation occurred at the country (32%) and school (56%) levels, not at the student level (12%), in contrast to the scaled score results. Poor readers were often clustered together within a school, so that most schools had either many poor readers or few poor readers. Second, percentage of girls in school did not significantly predict the likelihood of being a poor reader, consistent with the country-by-country analyses. Otherwise, the same variables that correlated with higher reading scores also correlated with a lower likelihood of being a poor reader.

DISCUSSION

This large-scale international study demonstrated some of the complex associations among reading-related variables at the country, school, family, and individual levels via multilevel regression analyses. Overall, variables at each level of analysis accounted for substantial variance in reading comprehension. Country-level GDP per capita correlated with reading achievement, as shown previously (Baker et al., 2002; Heyneman & Loxley, 1983). Altogether, GDP effects at the country level and family and school SES levels accounted for 24% of the total variance in reading achievement. Number of books in the home, gender, and reading enjoyment also accounted for unique variance in reading comprehension apart from the social and economic capital variables. Analyses revealed somewhat different patterns of results depending on how reading achievement was conceptualized, as a continuous variable including each student's true mean score or as a dichotomous variable in which those who were poor in reading achievement were distinguished from those who were ade-

TABLE 6
Summary Table of Percentage of Poor Readers in Each Country

Country	*% Boy*	*% Poor Readers*	*% Boys Who Are Poor Readers*	*% Girls Who Are Poor Readers*	*Ratio of Boys Who Are Poor Readers to Girls Who Are Poor Readers*
Albania	47.8%	44.0%	54.8%	34.1%	1.6
Argentina	46.9%	22.6%	28.2%	17.7%	1.6
Australia	51.5%	3.2%	5.2%	1.1%	4.8
Austria	49.4%	3.9%	5.8%	2.0%	3.0
Belgium	50.2%	8.4%	10.0%	6.7%	1.5
Brazil	47.1%	22.1%	26.5%	18.2%	1.5
Bulgaria	52.4%	17.7%	23.3%	11.6%	2.0
Canada	49.6%	1.9%	3.2%	0.7%	4.5
Chile	45.9%	20.2%	24.1%	16.8%	1.4
Czech Republic	46.3%	5.8%	7.9%	4.0%	2.0
Denmark	49.9%	6.0%	7.8%	4.3%	1.8
Finland	48.5%	1.5%	2.4%	0.7%	3.3
France	49.0%	4.3%	6.0%	2.6%	2.4
FYR Macedonia	51.0%	34.8%	45.3%	23.9%	1.9
Germany	48.1%	10.0%	11.9%	8.2%	1.5
Greece	50.3%	8.7%	12.6%	4.8%	2.6
Hong Kong–China	49.9%	2.7%	3.9%	1.4%	2.7
Hungary	50.5%	7.2%	9.0%	5.4%	1.7
Iceland	48.9%	4.2%	6.3%	2.1%	3.1
Indonesia	49.5%	31.5%	34.8%	28.2%	1.2
Ireland	47.8%	2.8%	4.1%	1.5%	2.7
Israel	45.7%	14.9%	17.5%	12.7%	1.4
Italy	48.4%	5.2%	7.4%	3.2%	2.3
Japan	50.5%	2.8%	4.3%	1.3%	3.2
Korea	55.3%	1.2%	1.5%	0.8%	2.0
Latvia	47.2%	13.1%	18.2%	8.6%	2.1
Liechtenstein	49.7%	8.4%	11.0%	5.9%	1.9
Luxembourg	49.2%	13.7%	17.1%	10.4%	1.6
Mexico	48.9%	15.9%	18.7%	13.1%	1.4
The Netherlands	49.3%	1.9%	2.3%	1.6%	1.5
New Zealand	50.8%	5.3%	7.5%	3.0%	2.5
Norway	49.9%	5.9%	8.2%	3.6%	2.3
Peru	48.8%	54.4%	57.4%	51.5%	1.1
Poland	52.5%	8.9%	12.2%	5.1%	2.4
Portugal	47.0%	10.4%	13.0%	8.0%	1.6
Romania	44.9%	10.7%	12.1%	9.5%	1.3
Russian Federation	49.6%	8.8%	12.5%	5.3%	2.4
Spain	48.0%	4.0%	6.1%	2.1%	2.9
Sweden	50.5%	3.3%	4.5%	2.0%	2.3
Switzerland	49.7%	7.1%	8.7%	5.5%	1.6
Thailand	41.5%	9.9%	15.1%	6.1%	2.5
United Kingdom	49.7%	3.7%	4.9%	2.5%	2.0
United States	47.4%	6.5%	9.0%	4.2%	2.2

TABLE 7
Summaries of Five Logit Regression Models Predicting Poor Reader With Unstandardized Regression Coefficients, Standard Errors, and Standardized Regression Coefficients

	Logit Regressions Predicting Poor Reader				
Predictor	*Model 1*	*Model 2*	*Model 3*	*Model 4*	*Model 5*
Girl	–0.632***	–0.680***	–0.651***	–0.654***	–0.540***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
	–0.632	–0.680	–0.651	–0.654	–0.540
Log GDP per capita	–1.658***	–1.491***	–0.555	–0.439	–0.588
	(0.279)	(0.283)	(0.404)	(0.397)	(0.395)
	–0.997	–0.897	–0.334	–0.264	–0.354
SES		–0.331***	–0.256***	–0.178***	–0.178***
		(0.009)	(0.009)	(0.009)	(0.009)
		–0.343	–0.265	–0.184	–0.184
School mean SES			–2.172***	–2.075***	–2.074***
			(0.048)	(0.048)	(0.047)
			–1.478	–1.412	–1.412
Amount of books				–0.241***	–0.213***
				(0.006)	(0.006)
				–0.380	–0.336
Reading enjoyment					–0.318***
					(0.010)
					–0.298
Remaining variance at each level					
Country	1.021***	1.056***	2.175***	2.109***	2.084***
	(0.237)	(0.240)	(0.493)	(0.474)	(0.466)
School	3.268***	2.927***	1.823***	1.778***	1.765***
	(0.079)	(0.072)	(0.048)	(0.047)	(0.046)
Student	0.691***	0.688***	0.680***	0.669***	0.659***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Explained variance at each level					
Country	0.463	0.445	0.000	0.000	0.000
School	0.025	0.127	0.456	0.469	0.473
Student	0.026	0.031	0.041	0.057	0.072
Total	0.165	0.217	0.216	0.236	0.244

Note. Standard errors are in parentheses. GDP = gross domestic product; SES = socioeconomic status.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$

quate readers and above. In the following, we highlight the results of this study that were particularly novel given our multilevel analysis.

SES

One striking result of our data analyses was that the school-level variable *family SES* of schoolmates within a school was a stronger predictor of variability in reading comprehension than was the student-level variable *family SES* of each student. This finding highlights the importance of the school environment for reading achievement. Researchers (e.g., Ogle et al., 2003; Snow et al., 1998) have demonstrated greater variability in reading achievement across schools than within schools in the United States. Our results suggest that school is a powerful contextual tool in understanding reading achievement. Within this framework, the school a child attends is particularly important because of the influences of his peers, who have been affected by their own parents. The schools, in turn, may foster an educational climate that, among other things, provides an environment of a given level of general appreciation for learning or reading enjoyment. Within this school context, particularly among adolescents, who tend to have a strong sense of peer solidarity (e.g., Harris, 1995), parents' individual attainment may be far less important in explaining reading achievement than is the literacy environment provided by the schools. Peer influence may be key in this respect. Other studies (for a review, see Willms, 1999) have also focused on more obvious features of the school environment, including cooperation among principals, teachers, and students, to understand the value-added effects of schools on students' achievement. This study's findings are in line with those of previous studies demonstrating unique effects at both the family and school levels in predicting student achievement (Willms, 1999). However, future research should continue to address the specific mechanisms by which schools provide value-added effects beyond individual and family characteristics of the student in a way that this study could not.

Poor Reader

Results on reading performance variability across schools differed somewhat depending on how we conceptualized reading achievement. Although studies within a given country (Ogle et al., 2003; Snow et al., 1998) have shown greater reading achievement differences across schools than within schools, we found greater differences within schools than across schools, but only when the data were analyzed using students' true reading scores. In these analyses, 25% of the total variance occurred at the country level, 30% occurred at the school level, and 45% occurred at the student level. In contrast, these results differed when the data were analyzed dichotomously by testing whether a student was a poor or adequate reader. In this case, most of the variation occurred at the country (32%) and school (56%) levels, not at the student level (12%). Taken together, these results demonstrate that poor readers are more likely to be found in the same schools, rather than spread across schools. However, readers above the minimum reading levels tend to be more evenly distributed across schools. Thus, in this study, poor readers tended to cluster at a few schools, but readers at other levels were dispersed across many schools.

Number of Books at Home

Apart from variability in general resources across schools and cultures, a striking finding from this study at the level of the family was that number of books in the family accounted for substantial unique variance in reading comprehension. These results are important for those interested in the effects of family environment on literacy practices across countries. There has been an ongoing debate (Lonigan, 1994; Scarborough & Dobrich, 1994) about the extent to which family practices influence reading achievement in preschool children. Measurable effects of family practices on language and reading skills are sometimes relatively small in studies of young children. Moreover, although the early findings of Feitelson and Goldstein (1986) in Israel—that number of books in the home was correlated with early reading achievement in young children—were suggestive of the importance of home environment for reading skills, they were limited in scope because of a possible confound of number of books with parental SES. Studies targeting specific aspects of the home environment in explaining reading performance in older children and adolescents are relatively rare.

Admittedly, this study's findings are limited because they are correlational. However, they fuel previous arguments (e.g., Adams, 1990) that home environment is likely to influence reading performance in various ways, and they extend our understanding of how far in development such effects may be observed. Specifically, our results demonstrate that, apart from country-level GDP and SES measured at the school and family levels, family book ownership explains unique variance in reading achievement and does so in students who are much older than those included in most previous studies. Furthermore, although number of books in the home was strongly associated with maternal educational level, it was independently associated with reading achievement. Although no causation can be demonstrated in this study, these results underscore the potential educational importance for reading achievement, well into secondary school, of parents who have more books at home. The fact that this result was obtained across cultures suggests that home literacy environment is a powerful tool for stimulating literacy skills, not merely in young children from Israel or the United States but in students in many different cultures who have typically attended school for about 9 years.

Reading Enjoyment

In addition to family home environment, our results indicate that a student who enjoys reading will tend to be a better reader relative to someone who does not enjoy reading, and this is true both at the individual and school levels. It is important to note that individual enjoyment of reading predicted an additional 3% of the variance in reading achievement. This association is probably bidirectional, such that those who can easily read and comprehend text also are more likely to enjoy doing so. Furthermore, those who enjoy reading may seek out peers who enjoy reading, and this group culture of enjoyment of reading is positively associated with reading outcomes.

This finding fits particularly well with Maccoby's (1998) conceptualization of gender as, in part, contextual. Girls are more likely to enjoy reading, and a culture of peers who enjoy reading is relatively strongly associated with reading performance itself. Thus, any difference in reading performance between adolescent girls and boys may be substantially attributable to their differential socialization in the relevance and pleasure of reading (e.g., Blackburn, 2003) from peers in addition to their own personal enjoyment of reading, which is presumably well established by adolescence.

Gender

Indeed, our results particularly underscore the importance of conceptualizing context at multiple levels for understanding literacy performance. For example, the percentage of girls within the school affected reading performance, mediated through school mean reading enjoyment. Thus, a valuing of reading activities, which girls often find more enjoyable (e.g., Guthrie & Greaney, 1991) and perform more often (e.g., Elley, 1994) than do boys, may have an effect not only on individual performance but also on group reading achievement. Much of the debate about gender and reading has taken place in English-reading societies (e.g., see Blackburn, 2003, for a review of boys' needs in relation to literacy development). However, our study underscores the importance of gender as context in relation to reading across schools and cultures. These results suggest not only that when a culture of enjoyment of reading pervades a school, both boys and girls may profit in the form of overall higher reading scores but also that a higher concentration of girls in the school may facilitate such enjoyment in the first place.

Given all of these contextual variables included in our study, we return to our initial questions. Are adolescent girls better readers than adolescent boys? Why or why not? In this study, across cultures, girls tended to outscore boys and were more likely to be adequate readers. Part of the reason for this gender difference is the levels of interest in reading. Other variables did not account for the gender difference. After controlling for all other variables, girls still outscored boys in reading by 13 points on average, and gender explained about 1% of the differences in reading achievement. Clearly, our results showed that gender effects are associated with other variables consistent with earlier results (e.g., Wagemaker et al., 1996). Thus, the effects of gender on reading comprehension are not largely attributable to biological influences alone but perhaps also to the valuing of literacy activities to a greater extent among girls than among boys across many societies (Blackburn, 2003; Wagemaker et al., 1996).

However, we also note that in the majority of countries tested, boys who were poor readers tended to outnumber poor readers who were girls by about 2:1. In every country, boys were more likely than girls to be poor readers. Although some of this difference is likely to be attributable to behavioral problems or school culture, the possibility remains that boys, even as they advance into adolescence, are more vulnerable to language- and literacy-related problems for neuropsychological reasons as well (e.g., James, 1992).

Poor reading may develop differently across cultures. For example, the phonological core deficit central to defining dyslexia in Western cultures (e.g., Lyon, Shaywitz, & Shaywitz, 2003) may not apply equally to reading in very different orthographies such as Chinese (e.g., Ho, Chan, Lee, Tsang, & Luan, 2003). However, across cultures, language-related problems tend to be more prevalent in boys (Halpern, 2000). Given that we show impressively larger proportions of boys who are poor readers in most of the countries sampled, researchers might continue to examine whether both cognitive deficits and cultural environments contribute to reading difficulties across countries.

This study had some limitations. First, our samples of students were relatively privileged according to our economic and educational criteria, because extremely impoverished countries such as Haiti did not participate. Also, the students sampled were not fully representative of all students their age. For example, students with lower literacy levels might have been less likely to attend school, and very poor children might not attend school at all (e.g., UNICEF, 2001). Second, all the variables included in this study were correlational. Thus, we cannot interpret the results in a causal way. Indeed, many associations are probably bidirectional. Third, these data apply to 15-year-old students only. We cannot address developmental effects of family, school, or individual students on literacy in this study, which used cross-sectional data. Finally, we measured reading comprehension as a total score. Other studies suggest that different types of reading affect gender differences in reading achievement substantially (Rosen, 2001; Wagemaker et al., 1996). We included only an overall score of reading comprehension to simplify our analyses. Analyzing different types of reading comprehension differently (e.g., document analysis, fictional vs. nonfictional accounts) might yield interesting additional results.

Nevertheless, these results offer some new insights into understanding the link between literacy achievement and gender across countries. In addition to the well-documented advantages of higher education and income levels across societies and families, we have shown the following. First, apart from basic economic concerns, families' number of books in the home accounts for substantial unique variance in reading achievement. This effect was strongly associated with maternal educational level but not with adolescents' gender. Second, enjoyment of reading accounts for unique variance in reading achievement at both the individual and school levels. Furthermore, enjoyment of reading is strongly associated with gender, suggesting that a peer culture of reading encouragement has multiple elements that, both separately and in combination, support reading achievement: Having more female peers and more peers who enjoy reading both interact to promote reading achievement in adolescents. Third, despite these contextual variables, however, girls outscore boys in reading achievement and are more likely to be adequate readers in all countries. Thus, although most of the variance in reading achievement in relation to gender can be explained by the context in which reading is taught and learned, boys may be at somewhat more risk than girls for reading problems across cultures. Such gender differences in reading disabilities might well be attributable to cultural factors not yet explored or perhaps to particular genetic (e.g., Knopik, Alarcon, & DeFries, 1998) or cognitive vulnerabilities in boys.

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APPENDIX A

TABLE A1
Factor Analysis of Socioeconomic Status

Variable	*Factor Loadings*
Father's years of schooling	0.749
Mother's years of schooling	0.725
Highest job status of parents	0.589

Note. Variance explained = 0.478. A fourth random variable was added to enable sufficient degrees of freedom (Holmes-Smith, 1999).

TABLE A2
Goodness of Fit Statistics

RMSEA	χ^2	*df*	*p*
0.01	0.175	1	.676

Note. Cronbach's alpha = .73; reliability coefficient = 0.74 (see Rowe & Rowe, 1997). RMSEA = root mean square error of approximation.

APPENDIX B

TABLE B1
Correlation and Covariance Matrix

Variable	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1. Reading score	*11822*	7.436	2.986	26.344	650.211	480.983	123.843	101.494	71.294	21.109	2.263	–19.388
2. Girls	0.137	*0.250*	0.049	–0.004	–0.094	0.138	–0.037	0.013	0.024	0.121	0.028	–0.014
3. % 15-year-old girls per school	0.125	0.441	*0.049*	–0.004	0.138	0.138	0.013	0.013	0.015	0.028	0.028	–0.006
4. Log (GDP per capita)	0.406	–0.014	–0.031	*0.356*	2.022	2.019	0.530	0.529	0.255	–0.076	–0.076	–0.043
5. Highest job status among parents	0.361	–0.011	0.038	0.204	*275.056*	78.895	29.538	15.189	10.553	0.962	0.326	–0.964
6. Highest job status—school mean	0.498	0.031	0.070	0.381	0.536	*78.910*	15.189	15.191	6.063	0.327	0.327	–0.749
7. Mother's years of schooling	0.316	–0.021	0.016	0.246	0.493	0.474	*13.033*	4.946	2.291	0.046	–0.048	–0.200
8. Mother's years of schooling—school mean	0.420	0.012	0.027	0.399	0.412	0.769	0.616	*4.947*	1.456	–0.048	–0.048	–0.172
9. Amount of books	0.416	0.031	0.043	0.271	0.403	0.433	0.402	0.415	*2.488*	0.249	0.018	–0.109
10. Reading enjoyment	0.207	0.258	0.133	–0.136	0.062	0.039	0.014	–0.023	0.168	*0.882*	0.116	–0.012
11. Reading enjoyment—school mean	0.061	0.162	0.367	–0.374	0.058	0.108	–0.039	–0.064	0.034	0.362	*0.116*	0.002
12. Poor reader (reading level 0)	–0.587	–0.091	–0.088	–0.239	–0.191	–0.277	–0.183	–0.255	–0.228	–0.044	0.024	*0.092*

Note. The lower left triangle, middle diagonal, and upper right triangle of this matrix contain the correlations, variances (in italics), and covariances, respectively. GDP = gross domestic product.