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Family Factors and Student Outcomes

Nailing Xia

This document was submitted as a dissertation in December 2009 in partial fulfillment of the requirements of the doctoral degree in public policy analysis at the Pardee RAND Graduate School. The faculty committee that supervised and approved the dissertation consisted of Richard Buddin (Chair), Sheila Nataraj Kirby, and Vi-Nhuan Le.
To my father

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ACKNOWLEDGEMENTS

This work would not have been brought to life without the generous support of my hardworking dissertation committee: Richard Buddin, Sheila Kirby, and Vi-Nhuan Le. Their scholarship, expertise and patience guided me through several drafts of this study. I am especially indebted to Dick, a gracious mentor who demonstrates that rigorous scholarship can be accessible to everyone. I am also grateful to Sheila for her persistent attention, gentle encouragement, and extensive knowledge in helping me navigate the field of education policy. Without the opportunities she provided to “practice” the policy analysis tools on RAND projects, my tenure at RAND would never have been the deeply influential experience that it became. A thank you too is extended to Vi, whose insightful comments are critical to constructing effective measures and crafting analytic methods.

I am thankful to my external reader, Jill Cannon, for her generous contribution of knowledge and time. Ashlesha Datar and Roland Sturm have also kindly given me time and suggestions during the early stage of the dissertation process. A thank you is also owed to Yang Lu and Xiaoyan Li, my friends and colleagues at Pardee RAND Graduate School who always answered my questions, no matter how trivial they might be.

To my parents, Lieqing Xia and Ruifang Ling, thank you for your love, support and understanding during my long years of education. I am also thankful to my husband, Xiaoning Huang, who has always been there for me in good and bad times. Finally, to my newborn son, Xiayang, for bringing joy and determination in the last stage of this dissertation.
# TABLE OF CONTENTS

Acknowledgements ........................................................................................................ iii  
List of Tables .................................................................................................................... ix  
List of Figures .................................................................................................................. xi  
Abstract ......................................................................................................................... xiii  
Executive Summary ....................................................................................................... xv  
Chapter 1. Family Factors and Student Achievement: The Case of U.S. .............. 1  
  Previous Literature on Family Factors and Student Achievement ...................... 2  
  Theoretical Frameworks of Family Process Factors ............................................. 2  
  Empirical Literature on Family Process Factors and Student Achievement ... 5  
  Conceptual Model ........................................................................................................ 7  
  Data ................................................................................................................................ 9  
  Sample and Weights ................................................................................................... 9  
  Measures ....................................................................................................................... 10  
  Descriptive Statistics ................................................................................................. 11  
  Racial/Ethnic Differences ......................................................................................... 17  
  Differences by SES ..................................................................................................... 20  
  Analytic Methods ....................................................................................................... 25  
    Multiple Imputation ................................................................................................. 25  
    Effect Size Calculation ......................................................................................... 26  
    Regression Models .................................................................................................. 26  
    Multiple Testing Issues ......................................................................................... 28  
  Results .......................................................................................................................... 29  
    Baseline and Family Process Models ..................................................................... 29  
    Interaction Models: Black Vs. Non-Black ............................................................. 35  
    Interaction Models: SES ....................................................................................... 38  
  Discussion ..................................................................................................................... 41  
Chapter 2. Family Factors and Nonacademic Outcomes: The case of U.S .......... 44  
  Previous Literature on Family Factors and Nonacademic Outcomes ............. 44  
  Data ................................................................................................................................ 9  
    Measures .................................................................................................................. 49  
    Descriptive Statistics ............................................................................................. 51  
    Racial/Ethnic Differences ...................................................................................... 57  
    Differences by SES ................................................................................................. 59  
  Analytic Methods ....................................................................................................... 64  
    Multiple Imputation ................................................................................................. 64  
    Effect Size Calculation ......................................................................................... 64  
    Regression Models .................................................................................................. 65
Multiple Testing Issues ........................................................................................................... 69
Results .................................................................................................................................. 69
Baseline and Family Process Models .................................................................................... 69
Interaction Models: Black Vs. Non-Black and SES ................................................................. 76
Discussion ............................................................................................................................... 80

Chapter 3. Family Factors and Student Achievement: An International Comparison

Data ......................................................................................................................................... 85
Sample and Weights ................................................................................................................ 86
Measures ................................................................................................................................. 88
Analytic Methods .................................................................................................................. 90
Imputation ............................................................................................................................... 90
Effect Size Calculation .......................................................................................................... 91
Analysis of Data with Plausible Values .................................................................................. 91
International Comparison and Regression Models ............................................................... 93
Multiple Testing Issues .......................................................................................................... 94
Results .................................................................................................................................... 95
Descriptive Statistics .............................................................................................................. 95
Differences in Achievement and Family Factors Across Countries ...................................... 98
Baseline and Family Process Models .................................................................................... 102
Interaction Models ................................................................................................................ 106
Discussion ............................................................................................................................... 109

References .............................................................................................................................. 112

Appendix 1.A. Variables Measuring Family Process Factors in ECLS-K.............................. 132
Appendix 1.B. Scale Items and Reliability Coefficients .......................................................... 136
Appendix 1.C. Descriptive Statistics: Waves 2-5 ................................................................ 138
Appendix 1.D. Family Process Factors by Race/Ethnicity: Waves 2-5 ................................. 142
Appendix 1.E. Correlations Between SES and Reading/Mathematics Test Scores .......... 146
Appendix 1.F. Correlations Between SES and Family Process Factors: Waves 2-5 ............ 147
Appendix 1.G. SES by Family Process Factors: Waves 2-5 .................................................. 148
Appendix 1.H. Coefficients of Unconditional Models .......................................................... 152
Appendix 1.I. Coefficients of Interaction Models .................................................................. 153
Appendix 2.A. Scale Items and Reliability Coefficients ......................................................... 159
Appendix 2.B. Correlations Between SES and Teacher SRS Scale Scores .......................... 161
Appendix 2.C. Coefficients of Unconditional Models ............................................................ 162
Appendix 2.D. Education Production Function and Econometric Estimation Strategies ...... 163
Appendix 2.E. Specification Tests .......................................................................................... 173
Appendix 2.F. OLS Coefficients of Baseline and Family Process Models .......... 187
Appendix 2.G. Tobit Coefficients of Baseline and Family Process Models ........ 192
Appendix 2.H. Tobit Coefficients of Interaction Models .................................. 202
Appendix 3.A. PISA 2006 Countries and Economies ...................................... 218
Appendix 3.B. Variables Measuring Family Process Factors in PISA 2006 ...... 219
Appendix 3.C. Achievement Test Scores by Country ...................................... 220
Appendix 3.D. Coefficients of Unconditional Models ...................................... 221
Appendix 3.E. Coefficients of Interaction Models ........................................... 222
LIST OF TABLES

Table 1. Chapter 1: Family Status Variables in Baseline and Family Process Models................................................................................................................... xv
Table 2. Chapter 1: Family Process Variables of Statistical and Substantive Importance .......................................................................................................... xvi
Table 3. Chapter 2: Family Status Variables in Baseline and Family Process Models............................................................................................................. xvii
Table 4. Chapter 3: Family Status Variables (SES) in Baseline and Family Process Models........................................................................................................ xviii
Table 5. Chapter 3: Family Process Variables of Statistical and Substantive Importance ........................................................................................................ xviii

Table 1.1. Descriptive Statistics: Reading and Mathematics Test Scores .............. 12
Table 1.2. Descriptive Statistics: Continuous Family Process Variables.............. 13
Table 1.3. Descriptive Statistics: Dichotomous Family Process Variables.............. 14
Table 1.4. Descriptive Statistics: Family, Child, and School Characteristics – Continuous........................................................................................................... 16
Table 1.5. Descriptive Statistics: Family, Child, and School Characteristics – Dichotomous........................................................................................................... 17
Table 1.6. Reading and Mathematics Test Scores by Race/Ethnicity..................... 17
Table 1.7. Family Process Factors by Race/Ethnicity ............................................ 19
Table 1.8. Reading and Mathematics Test Scores by SES................................... 20
Table 1.9. Correlations Between SES and Continuous Family Process Factors ...21
Table 1.10. SES by Family Process Factors – Parental Expectations and Beliefs.. 22
Table 1.11. SES by Family Process Factors – Learning Structure ....................... 22
Table 1.12. SES by Family Process Factors – Resource Availability ................. 23
Table 1.13. SES by Family Process Factors – Home Affective Environment ....... 23
Table 1.14. SES by Family Process Factors – Parenting and Disciplinary Practices ....................................................................................................................... 23
Table 1.15. SES by Family Process Factors – Parental Involvement .................... 24
Table 1.16. Coefficients of Baseline and Family Process Models for Reading Achievement ........................................................................................................ 32
Table 1.17. Coefficients of Baseline and Family Process Models for Mathematics Achievement ........................................................................................................ 34
Table 1.18. Coefficients of Interaction Models: Black Vs. Non-Black.................... 37
Table 1.19. Coefficients of Interaction Models: SES ............................................. 39
Table 2.1. Descriptive Statistics: Teacher SRS Scales at Fall Kindergarten and Spring Fifth Grade........................................................................................................... 51
Table 2.2. Descriptive Statistics: Continuous Family Process Variables........... 52
Table 2.3. Descriptive Statistics: Dichotomous Family Process Variables.......... 54
Table 2.4. Descriptive Statistics: Family, Child, and School Characteristics – Continuous........................................................................................................... 55
Table 2.5. Descriptive Statistics: Family, Child, and School Characteristics – Dichotomous........................................................................................................ 56
Table 2.6. Teacher SRS Scale Scores by Race/Ethnicity............................................ 57
Table 2.7. Family Process Factors by Race/Ethnicity ........................................... 58
Table 2.8. Teacher SRS Scale Scores by SES......................................................... 59
Table 2.9. Correlations Between SES and Continuous Family Process Factors ... 60
Table 2.10. SES by Family Process Factors – Parental Expectations and Beliefs.. 61
Table 2.11. SES by Family Process Factors – Learning Structure ....................... 61
Table 2.12. SES by Family Process Factors – Resource Availability .................. 61
Table 2.13. SES by Family Process Factors – Home Affective Environment....... 62
Table 2.14. SES by Family Process Factors – Parenting and Disciplinary Practices .................................................................................................................. 62
Table 2.15. SES by Family Process Factors – Parental Involvement ................. 63
Table 2.16. Tobit Results of Baseline and Family Process Models ..................... 73
Table 2.17. Tobit Results of Interaction Models (Black Vs. Non-Black/SES) ....... 77

Table 3.1. Descriptive Statistics: Test Scores in Mathematics and Science .......... 95
Table 3.2. Descriptive Statistics: Family Process Variables.................................. 96
Table 3.3. Descriptive Statistics: Family and School Characteristics – Continuous .................................................................................................................. 97
Table 3.4. Descriptive Statistics: Student and School Characteristics – Dichotomous................................................................................................................. 97
Table 3.5. Family Factors by Country – Learning Structure ................................ 99
Table 3.6. Family Factors by Country – Resource Availability .......................... 100
Table 3.7. Family Factors by Country – Parental Involvement (Time on Out-of-School Lessons) and Family Status (SES)......................................................... 102
Table 3.8. Coefficients of Baseline and Family Process Models for Mathematics Achievement .................................................................................................. 103
Table 3.9. Coefficients of Baseline and Family Process Models for Science Achievement ..................................................................................................... 105
Table 3.10. Coefficients of Interaction Models .................................................... 107
LIST OF FIGURES

Figure 1.1. Conceptual Model: How Family and School Factors Influence Student Outcomes ................................................................. 8

Figure 3.1. Mathematics and Science Test Scores by Country ..................... 98
ABSTRACT

There is considerable debate about the relative importance of family versus school factors in producing academic and nonacademic student outcomes, and whether and how their impacts vary across different student groups. In addition to critically reviewing and synthesizing earlier work, this study extends the literature by (a) using the ECLS-K, a U.S. longitudinal dataset that follows a nationally representative sample of children from kindergarten through fifth grade to examine the effects of two types of family factors—family process variables (specific things families do) and family status variables (who families are)—on students’ academic achievement and nonacademic outcomes; and (b) using the PISA 2006, a cross-country cross-sectional dataset that assesses academic achievement of 15-year-old students in reading, mathematics, and science literacy to compare U.S. students with their peers in 20 other countries and economies in terms of family factors and academic achievement. Specifically, hierarchical models are estimated to account for the nested structure of the ECLS-K data, and interaction models are used to examine whether and how the relationships between family process factors and student outcomes differ by race and socio-economic status (SES). Using PISA 2006, hierarchical linear models with country fixed effects are estimated in the international comparative analysis of academic effects of family factors.

Findings of this study suggest that family process factors can have significant impacts on both academic and nonacademic outcomes. Results of the U.S. data indicate that even after controlling for demographics and school inputs, student achievement was associated with multiple dimensions of family process factors including parental expectations and beliefs, learning structure, resources availability, home affective environment, parenting and disciplinary practices, and parental involvement. Furthermore, several family process variables (including doing homework more frequently, having home Internet access, and owning a community library card) had higher returns in terms of student achievement for black children or children from low socio-economic families than for their counterparts. Family process factors as a whole hold some value in explaining nonacademic outcomes. Results of the international comparative analysis suggest that U.S. students did not fare as well as their peers in other countries and economies, and that family process variables, especially considered collectively, were important factors in explaining student achievement in an international setting.
EXECUTIVE SUMMARY

This study distinguishes two types of factor factors—family process variables (i.e., specific things families do) and family status variables (i.e., who families are), and examines their respective effects on student outcomes. Each of the three chapters investigates this central research theme from a different angle. Using a U.S. longitudinal dataset, Chapter 1 looks at the effects on academic achievement while Chapter 2 focuses on nonacademic outcomes. Chapter 3 examines the academic effects of family factors in an international setting. While each chapter stands alone as a complete research paper, this summary pulls the findings together in an attempt to answer the overarching research question.

Chapter 1 Findings

Results from the analysis of U.S. data support the notion that family process factors are important predictors of student achievement. Family process variables explained 21 percent of the between-child variation in reading scores and 18 percent of the between-child variation in mathematics scores. As shown in Table 1, the inclusion of the family process variables in the regression models resulted in smaller coefficients of family status variables (in absolute value), suggesting that family process variables collectively explain a good portion of the achievement gaps by race, SES, and family structure. Moreover, the negative association between the single-parent household and student achievement was no longer significant after controlling for family process variables. This result somewhat mirrors the findings in previous literature that family structure (single-parent versus two-parent families) was statistically insignificant after controlling for other family factors such as income, mother’s characteristics, and family resources (Grissmer et al., 1994). Despite the sharp decrease in magnitude, most of these family status variables were still statistically significant and had larger effect sizes than many family process variables.

<table>
<thead>
<tr>
<th>Family Status Variables</th>
<th>Reading</th>
<th>Mathematics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Family Process</td>
</tr>
<tr>
<td>Black</td>
<td>-0.410**</td>
<td>-0.358**</td>
</tr>
<tr>
<td>Hispanic</td>
<td>-0.173**</td>
<td>-0.147**</td>
</tr>
<tr>
<td>Asian</td>
<td>0.443**</td>
<td>0.369**</td>
</tr>
<tr>
<td>Other race</td>
<td>-0.192**</td>
<td>-0.134**</td>
</tr>
<tr>
<td>SES</td>
<td>0.526**</td>
<td>0.337**</td>
</tr>
<tr>
<td>Single-parent household</td>
<td>-0.093**</td>
<td>-0.031</td>
</tr>
<tr>
<td>Other type of household</td>
<td>-0.260**</td>
<td>-0.187**</td>
</tr>
</tbody>
</table>

NOTE: Effect Sizes. * indicates significance at .05 level, ** indicates significance at .01 level.
Student achievement was found to be positively associated with a number of family process variables including high parental expectations and beliefs; higher frequency of doing homework, reading books, and using home computers; access to more resources such as books, newspapers, magazines, dictionaries, encyclopedia, pocket calculators, home Internet availability, and child’s own community library card; fewer negative sentiments from parents towards children and child-rearing; and parental involvement in school events, regular communication with parents of child’s peers, and involvement in artistic or cultural activities outside of school. Consistent with previous literature, student achievement was shown to be negatively associated with frequent help with homework (Milne et al., 1986; Shumow and Miller, 2001; Henderson and Mapp, 2002). In addition, achievement was also found to be negatively related with frequent involvement of children in sports-related activities.

Although statistically significant, many of these family process variables had small effect sizes, suggesting a lack of practical importance in their influence over student achievement. However, several variables showed average or above average effect sizes, suggesting both statistical and substantive importance in their relationship with student achievement (see Table 2).

Table 2. Chapter 1: Family Process Variables of Statistical and Substantive Importance

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>Reading</th>
<th>Mathematics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree expected</td>
<td>3.643**</td>
<td>2.927**</td>
</tr>
<tr>
<td>Belief in reading performance(^1)</td>
<td>13.036**</td>
<td>N/A</td>
</tr>
<tr>
<td>Belief in math performance</td>
<td>N/A</td>
<td>11.634**</td>
</tr>
<tr>
<td>Home Internet access</td>
<td>2.556**</td>
<td>2.479**</td>
</tr>
<tr>
<td>Parents feeling child harder to care</td>
<td>-4.740**</td>
<td>-3.794**</td>
</tr>
<tr>
<td>Frequent help with reading homework</td>
<td>-6.128**</td>
<td>N/A</td>
</tr>
<tr>
<td>Frequent help with math homework</td>
<td>N/A</td>
<td>-5.722**</td>
</tr>
</tbody>
</table>

NOTE: * indicates significance at .05 level, ** indicates significance at .01 level.

Results of the interaction models revealed that in terms of student achievement in reading and mathematics, black children, compared with their non-black peers, had lower returns to a number of family process factors (such as ownership of home computers, number of books available for child use at home, and involvement in artistic or cultural activities). Only child’s ownership of a community library card appeared to have a higher return for blacks than for

\(^1\) The relationship between parental belief about child’s academic performance and student achievement may indicate reverse causality.
their non-black peers, with an effect size of 0.20 for reading and an effect size of 0.22 for mathematics. Moreover, children with low SES background tended to have higher returns to such factors as doing homework more frequently, home Internet access, and child’s ownership of a community library card. All these effect sizes for the interaction terms with SES were small, with an exception of interaction term between home Internet access and SES, which showed an effect size of -0.201 for reading achievement.

Chapter 2 Findings
Chapter 2 examines the relationship between family factors and nonacademic outcomes, and results indicate that family process factors collectively are important predictors of nonacademic outcomes. As shown in Table 3, controlling for family process factors reduced the magnitude of the effects of SES and family structure although most coefficients were still statistically significant. This reduction in coefficient magnitude suggests that while family status factors are important, better family process explains a good portion of the differences in outcomes by SES and family structure. However, there was not much difference in the effects of race between the baseline and family process models.

<table>
<thead>
<tr>
<th>Nonacademic Outcomes</th>
<th>SES</th>
<th>Family Process</th>
<th>Single-Parent HH</th>
<th>Family Process</th>
<th>Other Type HH</th>
<th>Family Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approaches to learning</td>
<td>0.182**</td>
<td>0.123</td>
<td>-0.093**</td>
<td>-0.076**</td>
<td>-0.261**</td>
<td>-0.253**</td>
</tr>
<tr>
<td>Self-control</td>
<td>0.129**</td>
<td>0.097**</td>
<td>-0.091**</td>
<td>-0.083**</td>
<td>-0.186**</td>
<td>-0.152</td>
</tr>
<tr>
<td>Interpersonal skills</td>
<td>0.145**</td>
<td>0.106**</td>
<td>-0.096**</td>
<td>-0.081**</td>
<td>-0.254**</td>
<td>-0.218*</td>
</tr>
<tr>
<td>Externalizing problem behaviors</td>
<td>-0.093**</td>
<td>-0.070**</td>
<td>0.090**</td>
<td>0.084**</td>
<td>0.158*</td>
<td>0.141</td>
</tr>
<tr>
<td>Internalizing problem behaviors</td>
<td>-0.124**</td>
<td>-0.083**</td>
<td>0.164**</td>
<td>0.157**</td>
<td>0.261**</td>
<td>0.251**</td>
</tr>
</tbody>
</table>

NOTE: Effect sizes. * indicates significance at .05 level, ** indicates significance at .01 level. HH stands for household.

While many family process factors were statistically insignificant, several variables were found to be significantly associated with multiple dimensions of nonacademic outcomes even after controlling for demographics and school inputs. Higher parental expectations was associated with all five nonacademic outcomes including higher ratings in approaches to learning, self-control, and interpersonal skills, and fewer internalizing and externalizing problem behaviors. Greater parental involvement in school activities was correlated with higher ratings in approaches to learning, self-control, and interpersonal skills, and fewer internalizing problem behaviors. Moreover, less frequent use of spanking was correlated with higher ratings in approaches to learning, self-control, and
interpersonal skills, and fewer externalizing problem behaviors. Although statistically significant, most of these variables showed small effect sizes.

Interaction models showed that only several variables were statistically significant in both the main effects and interaction terms and that most of these significant variables indicated lower returns to nonacademic outcomes for black or low SES children than for their counterparts. One variable, child’s ownership of a community library card, showed a significantly higher return in terms of self-control for low SES children, but the effect size was small.

Chapter 3 Findings

Results from the analysis of a cross-country dataset are consistent with findings based on the U.S. data in Chapter 1. As shown in Table 4, the effects of SES on student achievement reduced by one third after controlling for family process factors, suggesting the importance of family process factors in explaining achievement collectively. However, SES remained statistically significant in the family process models.

Table 4. Chapter 3: Family Status Variables (SES) in Baseline and Family Process Models

<table>
<thead>
<tr>
<th>Family Status Variables</th>
<th>Mathematics Baseline</th>
<th>Mathematics Family Process</th>
<th>Science Baseline</th>
<th>Science Family Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>SES</td>
<td>0.302**</td>
<td>0.186**</td>
<td>0.290**</td>
<td>0.170**</td>
</tr>
</tbody>
</table>

NOTE: Effect Sizes. * indicates significance at .05 level, ** indicates significance at .01 level.

Several family process variables appeared to be significantly associated with achievement even after controlling for demographics, school inputs, and country fixed effects. Better performance in mathematics and science was associated with ownership of home computers, home Internet access, and number of books at home. Students who reported spending no time on homework or self-study tended to score lower in both subjects than those who reported spending more than zero and less than four hours per week. Performance and time spent on attending out-of-school lessons were inversely related, suggesting the possibility that less able students required more outside help. As shown in Table 5, several family process variables showed average or above average effect sizes.

Table 5. Chapter 3: Family Process Variables of Statistical and Substantive Importance

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>Mathematics Estimate</th>
<th>Mathematics Effect Size</th>
<th>Science Estimate</th>
<th>Science Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time on homework/studying: never</td>
<td>-27.720**</td>
<td>-0.307**</td>
<td>-25.248**</td>
<td>-0.259**</td>
</tr>
<tr>
<td>Number of books at home: 0-25 books</td>
<td>-20.899**</td>
<td>-0.232**</td>
<td>-26.075**</td>
<td>-0.267**</td>
</tr>
<tr>
<td>Number of books at home: 101 or more</td>
<td>21.540**</td>
<td>0.239**</td>
<td>23.091**</td>
<td>0.237**</td>
</tr>
</tbody>
</table>
The international comparison of student achievement indicates that U.S. students scored significantly below the international average in both mathematics and science, which are consistent with findings from existing literature (Baldi et al., 2007; Juvonen et al., 2004; Lemke et al., 2004; Miller et al., 2009; Provasnik, Gonzales, and Miller, 2009). U.S. students ranked above only one country in mathematics and three other countries in science. After controlling for student, family, and school factors, U.S. students still showed significantly lower average scores than 17 jurisdictions in mathematics and 16 jurisdictions in science.

Several family process variables showed differential effects on student achievement between the U.S. and the other two country groups (Western countries and East Asian economies), with most of these differential effects existing between the U.S. and East Asian economies.

**Conclusions and Policy Implications**

Taken together, findings of this study suggest that family process factors can have significant impacts on both academic and nonacademic outcomes. When considered collectively, family process variables appeared to be important factors in explaining student outcomes. Once controlling for family process factors, coefficients of the family status variables became smaller in magnitude. For example, the black-white achievement gap reduced by 13 percent for reading and 15 percent for mathematics based on the U.S. data. The international data showed that the achievement gap by SES reduced by approximately one third after controlling for family process variables. Individually, many family process variables were significantly associated with student achievement and some were associated with nonacademic outcomes, although most had small effect sizes.

Although most family status variables remained to be statistically significant and have relatively large effect sizes even after controlling for family process factors, it is imperative to understand that family status factors are *unchangeable* characteristics of families. In contrast, family process factors are *alterable* features that can be influenced through programs designed to increase parental awareness of the importance of education, to improve parenting skills, and to help low-income families gain access to home and community resources for educational purposes, among other things. As this study points out the importance of family process factors in explaining student outcomes and
achievement gaps, policymakers may consider investing in family process factors as one promising alternative for improving educational outcomes.

Despite the promising findings, there are many unanswered questions with respect to the development of effective policy interventions. Here, two issues are raised in terms of the policy design. First, while many family process variables were found to be significantly associated with student outcomes, it is unclear what are the underlying causes that drive the observed relationships. In most cases, the individual family process variable measured in this study in and of itself probably does not cause positive results, and there is more to what each variable implies. For example, child’s ownership of a community library card was significantly associated with both academic achievement and nonacademic outcomes, and its interaction terms with race (black versus non-black) and SES were shown to be statistically significant as well. However, giving out community library cards to children is unlikely to have much an effect on improving student outcomes. Instead, the ownership of community library cards can imply multiple parental behaviors such as parental encouragement of library visits, parental involvement in getting a card, going to the library together, and signaling the enjoyment of reading. In fact, previous literature found evidence suggesting that parental involvement contributed to better student outcomes but such involvement appeared to be “a manifestation of parental enthusiasm and positive parenting style” (Zellman and Waterman, 1998, p. 370). Thus, intervention programs might be more effective if they focus on such underlying constructs.

A second issue is to what extent the intervention programs should focus on single factors versus subgroups of factors. For example, the ownership of community library cards and parental involvement in educational activities may be an issue of parents’ availability and willingness to get involved. Other family process variables such as ownership of home computers for child’s use and home Internet access may concern monetary resources. Yet others, such as parental expectations about child’s educational attainment and discipline, may be more about parental attitudes and parenting skills. Each implies a different way of approaching from a policy perspective. Moreover, it is unclear whether investing in one aspect of the factors can lead to spurious effects on other factors. For example, it is possible that an intervention program aiming at promoting positive parenting skills and attitudes towards education might increase parents’ willingness to be involved in their children’s education. Thus, parents who otherwise would not have time might make adjustments to find time for their
children. As current research findings do not provide clear-cut answers to these issues, further research is needed for effective policymaking in this regard.

Future research should also examine the effects of existing parenting programs on changing parental behaviors and student outcomes, and whether and to which extent the effects on student outcomes are mediated through changes in parental behaviors. Previous research revealed that some intervention programs (such as center-based programs with a parenting component) appeared to be effective in improving parenting skills as well as children’s cognitive outcomes, and that some of the program effects on children were mediated through effects on parents (Brooks-Gunn and Markman, 2005; Love et al., 2002; Reynolds, 1994). However, these programs are typically designed for at-risk children in their early years and the development of parenting skills is only one component of the intervention. Recognizing the importance of parental involvement for school-age children, several urban school districts, in recent years, started “parent universities” designed to get parents more involved in their children’s education. As these parent programs are still in their infancy, the effectiveness of such programs are largely unclear and remain as an interesting topic for future research.

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2 Established in 2005, Miami-Dade’s Parent Academy offers more than 100 workshops that have benefited over 120,000 participants. Parent Universities in Philadelphia and Boston were established in 2009 and offer around 30 workshops (Cruz, 2009).
CHAPTER 1. FAMILY FACTORS AND STUDENT ACHIEVEMENT: THE CASE OF U.S.

There is considerable debate about the relative importance of family versus school factors in producing student achievement, and whether and how their impacts vary across different student groups. While studies have shown the importance of family factors in promoting student achievement, decades of education reform in this country have largely focused on raising school and teacher effectiveness. A primary reason for this limited focus lies in the belief that family factors such as race and ethnicity, socio-economic status (SES), household income, and parental education cannot be easily influenced by policy interventions. However, children spend a large portion of their time at home and are inevitably influenced by their families through parental beliefs, expectations, behaviors, and parent-child interactions—factors that might be amenable to change with appropriate interventions.

There is a growing body of literature that distinguishes alterable family process factors from unchangeable family status factors in terms of their influences over academic outcomes (Christenson, 2002; Henderson and Berla, 1994; Fan and Chen, 2001). Empirical findings on the relationship between family process factors and student achievement are generally inconclusive. While some studies found positive evidence (Bradley and Caldwell, 1984; Cohen, 1987; Derrick-Lewis, 2001; Entwisle and Hayduck, 1988; Estrada et al., 1987; Hess et al., 1984; Keith et al., 1993; McWayne et al., 2004; Shumow and Miller, 2001; Singh et al., 1995; Stevenson and Baker, 1987; Thompson, Alexander, and Entwisle, 1988; Williams, 1998), others reported insignificant or even negative effects (Catsambis, 1998; Desimone, 1999; Fan and Chen, 2001; Gaddy, 1986; Gortmaker et al., 1990; Hancox, Milne, and Poulton, 2005; Henderson and Mapp, 2002; Keith et al., 1986; Milne et al., 1986; Sui-Chu and Willms, 1996; Zimmerman and Christakis, 2005).

This chapter uses a national longitudinal dataset to examine how six types of family process factors (i.e., parental expectations and beliefs, learning structure, resource availability, home affective environment, parenting and disciplinary practices, and parental involvement) are related to the academic achievement of young children. It extends previous literature by analyzing a comprehensive set of family process variables and examining whether the relationship between these variables and achievement differs by race and SES. Specifically, this chapter addresses the following research questions:
1. What is the relationship between family process factors and reading and mathematics achievement, after controlling for student and school characteristics?
2. How does the relationship between family process factors and academic achievement differ by family status (specifically, race and SES)?

This chapter is organized as follows: It begins with a literature review that looks at different types of family process factors and their impacts on student achievement. It follows with a conceptual model that underpins the analysis, and a description of the data and methodology. It concludes with findings and discussion on policy implications.

Previous Literature on Family Factors and Student Achievement

Since the 1966 Coleman report, numerous studies have examined the influences of family factors on educational outcomes. However, only recently have researchers started to distinguish two types of family factors: family status factors and family process factors. Family status factors are often referred to as those characteristics that define the families (i.e., who families are). Examples of family status variables include race, income, parental education, social class, and family configurations (Christenson, 2002; Henderson and Mapp, 2002). In contrast, family process factors, defined as the specific things that families do, include parental expectations and beliefs, learning structure, resource availability, home affective environment, parenting and disciplinary practices, and parental involvement, among others (Christenson, Rounds, and Gorney, 1992; Henderson and Mapp, 2002; Fan and Chen, 2001). The following literature review examines prior research on family process factors, and covers theories of family process factors as well as empirical findings of their impacts on student achievement.

Theoretical Frameworks of Family Process Factors

Empirical studies on academic impacts of family process factors typically examine a limited number of factors and/or are mostly based on a more implicit theoretical framework. For the purpose of this chapter, only studies that include a comprehensive list of family process factors in their theoretical frameworks are discussed below. In their review of over 160 studies, Christenson, Rounds, and Gorney (1992) identified five types of family process factors that might influence student outcomes:

- Parental expectations and attributions, with the former defined as “future aspirations or current expectations for children’s academic performance”
(p. 181), and the latter as “parents’ reasons for children’s performance in school” (p. 181);
- Structure for learning, which refers to “structure of the home environment and how the environment can be manipulated to encourage and support children’s academic learning” (pp. 183–184);
- Home affective environment, defined as “emotional environment in the home” (p. 187);
- Discipline, which refers to “parenting methods used to control children’s behavior” (p. 188); and
- Parent involvement, which includes “various activities that allow parents to participate in the educational process at school and at home” (p. 190).

In comparison with other types of family process factors, one particular type – parental involvement – is extensively researched, and various conceptual frameworks of parental involvement exist in the literature. The following are a few conceptual frameworks that are most widely cited.

In examining the effects of parental involvement on eighth-grade student achievement, researchers identified four components of parental involvement: parental aspirations, parent-child communication about school, home structure or environment, and parental participation in school activities (Keith et al., 1993; Singh et al., 1995). Although termed as “parental involvement”, this conceptual framework actually encompasses many aspects of family process factors identified by Christenson, Rounds, and Gorney (1992). Specifically, the four components are defined as follows:

- Parental aspirations refer to parents’ report of their educational aspirations for their child and children’s perceptions of their parents’ educational aspirations for them;
- Parent-child communication about school measures the amount of communication between children and their parents about school and school activities;
- Home structure and environment reflects the degree to which the home environment is structured toward learning and includes measures such as family rules and parental supervision of homework and television viewing; and
- Participation in school activities measures the extent to which parents participate in school activities.

Fantuzzo et al. (2002) developed a parent-report instrument that measures parent involvement across three dimensions: supportive home learning environment,
direct school contact, and inhibited involvement. The supportive home learning environment dimension includes items that describes parental behaviors of promoting learning at home, such as talking with children about school activities and structuring the home environment to support children’s learning. The direct school contact dimension measures parents’ direct involvement in school-based activities and direct communications between parents and school staff. The inhibited involvement dimension reflects barriers to parental involvement in their children’s education, such as time constraints and competing responsibilities (Fantuzzo et al., 2002; McWayne et al., 2004).

Epstein (1987; 1992; Epstein and Hollifield, 1996) suggested six types of parental involvement in schools: parenting skills, school-parent communication, volunteering and supporting schools, home learning activities, shared decision-making and governance of schools, and collaborations with school and community. This typology of parental involvement is widely recognized and many researchers use some variation of this framework (Catsambis, 1998; Fan and Chen, 2001; Henderson and Mapp, 2002).

Marcon (1999) reduced Epstein’s typology of parental involvement to two categories: “communicating with families about school and student progress, and volunteering at the school to support students and school programs” (p. 397). Communicating is viewed as parents being “passive” and reacting to the school, while volunteering requires greater parent initiative and is considered as “active” parental involvement (Marcon, 1999).

In their analysis of achievement among eighth graders, Sui-Chu and Willms (1996) identified four basic types of parental involvement: discussing school activities, monitoring out-of-school activities, contacting school staff, and volunteering and attending school events such as parent-teacher conferences.

Based on Walberg’s research (1984), Williams (1998) outlined a parental involvement framework using an educational productivity model with three types of involvement: “parent effort (contacts with school, expectations of the student, and discussions with the student), instructional support (time student spends on learning outside school), and environmental support (learning at home, parent rating of school quality, knowing students’ friends, and out-of-school activities)” (Henderson and Mapp, 2002, p. 23).

Hoover-Dempsey and Sandler’s (1995) theoretical framework identified important variables to explain three main issues: parents’ decisions to become
involved in their children’s education, their choice of specific types of involvement, and the influence of parental involvement on students’ educational outcomes. Specifically, variables that explain parents’ decisions to become involved encompass parents’ personal construction of the parental role as including participation in their children’s education, parents’ sense of efficacy for helping their children succeed in school, and general opportunities and demands for involvement presented by children and their schools. Once they decide to become involved, parents choose specific forms of involvement based on the combination of “parents’ specific skills and knowledge, the mix of total demands (particularly from employment and family) on their time and energy, and the specific demands and invitations for involvement they receive from their children and their children’s schools” (p. 326). The model also theorizes that parental involvement influences student outcomes primarily through the mechanisms of parental modeling, reinforcement, and instruction.

**Empirical Literature on Family Process Factors and Student Achievement**

Despite the significant amount of research that investigates the relationship between family process factors and student achievement, the field has not produced clear and consistent results. Empirical findings vary based on the different types of family process factors being examined. By far the most important factor that has shown a consistent effect on student achievement is parental expectations for their children’s educational attainment. High parental expectations appear to positively influence children’s academic performance for both young children and adolescents (Catsambis, 1998; Christenson, Rounds, and Gorney, 1992; Cohen, 1987; Hess et al., 1984; Milne et al., 1986; Singh et al., 1995; Thompson, Alexander, and Entwisle, 1988; Williams, 1998).

A number of studies reported that student achievement was also positively associated with several other family process factors, including parental beliefs about children’s academic ability (Entwisle and Hayduk, 1988), the amount of time that students spend on homework (Cooper, 1989; Keith et al., 1986), the number of books child owns (Milne et al., 1986), affective quality of home environment (Bradley and Caldwell, 1984; Estrada et al., 1987; Hess et al., 1984), parent-child discussion about school experiences and academic matters (Keith et al., 1993; Sui-Chu and Willms, 1996), parental involvement in school events (Derrick-Lewis, 2001; Desimone, 1999; McWayne et al., 2004; Reynolds, 1994; Shumow and Miller, 2001; Stevenson and Baker, 1987; Sui-Chu and Willms, 1996; Williams, 1998), parental involvement in children’s learning at home (Derrick-Lewis, 2001; McWayne et al., 2004), and parental involvement in collaboration with the community (Derrick-Lewis, 2001).
On the other hand, some studies have demonstrated the negative effects of excessive parental control such as close supervision of homework (Milne et al., 1986; Shumow and Miller, 2001), frequent contacts with school or parent-teacher conferences (Catsambis, 1998; Desimone, 1999; Sui-Chu and Willms, 1996), and frequent talks with children (Catsambis, 1998). Researchers interpret these negative effects as indicating parents’ efforts to impose controls and to provide help to struggling children (Catsambis, 1998; Fan and Chen, 2001; Shumow and Miller, 2001). Indeed, some studies found that the negative effects of parents’ communication with school decreased or even disappeared after controlling for problem behaviors and/or learning difficulties among students (Catsambis, 1998; Sui-Chu and Willms, 1996; Henderson and Mapp, 2002).

Yet, research on a third group of family process factors indicates mixed results. While a review of literature on home computer use suggested an association between home computer use and “slightly better academic performance” (Subrahmanyam et al., 2000, p. 123), Wenglisky (1998) reported mixed findings depending on the grade levels being examined. Specifically, Wenglisky (1998) found a positive and substantial association between the frequency of home computer use and academic achievement in mathematics for eighth graders, and a negative but negligible association for fourth graders. Television viewing is another family process factor that has yielded inconsistent results in terms of its effect on student achievement. While some studies found negative impact of television viewing on both cognitive development in early childhood and academic achievement in school years (Hancox, Milne, and Poulton, 2005; Zimmerman and Christakis, 2005; Keith et al., 1986), others reported no significant negative effects (Gaddy, 1986; Gortmaker et al., 1990; Keith et al., 1993).

A few studies have examined the differential effects of family process factors on student achievement across different racial/ethnic and/or income groups. Using nationally representative data of eighth graders, Desimone (1999) found a significant difference in the relationship between parental involvement and student achievement based on differences in race/ethnicity and family income. Hill et al. (2004) followed 463 adolescents from seventh grade through eleventh grade and found that parental involvement was positively associated with achievement for African Americans but not for European Americans. Based on a sample of students from one high school in San Francisco, Dornbusch et al. (1987) reported that the correlation between authoritative and permissive parenting styles and achievement was significant for female Hispanic students but
insignificant for all Asian students. Schneider and Lee (1990) interviewed students in sixth and seventh grades from 30 schools and found that Asian students were less influenced by family-school linkages than other students. All four studies focused on older students who were in grades six and above.

In summary, findings of empirical research on the relationship between family process factors and student achievement are mixed and inconclusive. Results differ depending on the type of family process factors in question. Inconsistencies in research findings may also be due to the age differences of the children under investigation, different analytical strategies, and selection and measurement of family process variables (Catsambis, 1998). In terms of analytical methods, many studies suffer from methodological limitations such as small sample sizes, potential omitted variable biases, and/or the use of cross-sectional data for analysis. Moreover, most studies only examine one or two dimensions of family process factors such as parental involvement. Very few studies have assessed the effects of family status and family process factors in the same models, and none was found to examine the differences in relationship between family process factors and student achievement by different racial and SES groups among young children.

Conceptual Model

The model, shown in Figure 1.1, conceptualizes relationships among three types of variables – family process factors, family status factors, and school inputs – and student outcomes. Building on previous research, the conceptual model defines six types of family process factors as follows:

- Parental expectations and beliefs – future aspirations for or current beliefs about children’s academic achievement;
- Learning structure – structure of the home environment and learning routines that encourage and support children’s academic learning;
- Resource availability – home resources as well as community resources available for child use;
- Home affective environment – emotional supportiveness and parent-child interactions;

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3 This study examines family process factors that can have direct impact on children. Factors such as parental involvement in school decision-making and governance are not included because they seek to affect children’s outcomes indirectly through their influence over school policies.
- Parenting and disciplinary practices – family rules, disciplinary practices, and parenting methods used to monitor and discipline children’s behavior; and
- Parental involvement – parental participation in children’s educational activities.

The conceptual model hypothesizes that student outcomes are influenced, directly or indirectly, by family process, family status, and school factors, and that the two types of student outcomes (i.e., academic achievement and nonacademic skills) are interrelated. As depicted in Figure 1, family factors can influence student outcomes through multiple mechanisms (Christenson, Rounds, and Gorney, 1992; Henderson and Mapp, 2002; Epstein, 1995). While family status effects on student outcomes are likely to be mediated through family process variables, they are also thought to have independent effects on student outcomes. For instance, families with higher income are more capable of providing children with resources (such as books, computers, Internet access, and extracurricular activities) to facilitate their learning. On the other hand, family process factors may have an effect on student outcomes through parental choices of schools, and the schools, in turn, can influence the family process variables through school policies and practices aimed at raising the level of parental involvement in school activities. The model also assumes that the effects of family and school factors on student outcomes are mediated through students. For example, few parents take a one-size-fits-all approach for their children and parenting behaviors are likely to vary in response to the different needs of children. This conceptual model underpins analyses in all three chapters. While this conceptual model includes both academic and nonacademic outcomes, this chapter focuses on the academic achievement of young children.

Figure 1.1. Conceptual Model: How Family and School Factors Influence Student Outcomes

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4 While family status factors are correlated with school factors, they are thought to influence student outcomes primarily through family process factors (e.g., parental choices of schools).
Data

This chapter analyzes data from the Early Childhood Longitudinal Study-Kindergarten Class of 1998-1999 (ECLS-K), a longitudinal study of a nationally representative sample of 21,260 students entering kindergarten in 1998-1999. The ECLS-K collects information from students, parents, teachers, and school administrators at six waves: fall of kindergarten, spring of kindergarten, fall of first grade, spring of first grade, spring of third grade, and spring of fifth grade. It contains extensive information on cognitive, social, and health outcomes of children as well as family background, school environment, teaching practices, and community resources. This section describes sample size, weights, and measures used in the analysis.

Sample and Weights
The longitudinal data of kindergarten through fifth grade includes 17,565 children followed up at six waves. This chapter is based on five waves of the

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5 The fall of first grade data is not included in the analysis since the data collection for the fall of first grade was limited to 30 percent of the sample.
data that are assigned a non-zero weight. The resulting sample consists of 8,370 
children, who represent approximately 3,836,496 children nationwide. Since 
the ECLS-K employed multistage probability sample design, weights are used 
throughout the analysis to account for stratification, over-sampling of certain 
population, and non-response adjustments.⁶

Measures
Student achievement is measured by test scores from direct cognitive assessment 
in reading and mathematics calculated using Item Response Theory (IRT) 
procedures. IRT uses patterns of correct, incorrect, and omitted responses to the 
items as well as the difficulty level, discriminating ability, and “guess-ability” of 
each item to place students on a continuous ability scale. IRT scale scores 
represent the probabilities of a student giving correct answers, summed over all 
items in the assessment. As a result, IRT scores are comparable across different 
assessment forms over time. This chapter uses IRT scale scores in reading and 
mathematics. The IRT scale scores in reading can take on any values between 0 
and 186, representing estimates of the number of items students would have 
answered correctly if they had taken all of the 186 questions. Similarly, the IRT 
scale scores in mathematics range from 0 to 153, corresponding to the possible 
number of correct answers students would have made out of the 153 items in the 
mathematics assessment forms.

The six types of family process factors are measured by variables collected from 
parent interviews. Appendix 1.A provides a detailed description of variables 
used to measure family process factors.

- *Parental expectations and beliefs* include variables measuring parents’ 
  expectations regarding child’s educational attainment and their beliefs in 
  terms of child’s performance in reading/mathematics.
- *Learning structure* consists of variables on child’s homework routines as 
  well as other learning routines such as computer use and book reading.
- *Resource availability* measures home and community resources available 
  for child use such as home computer, books, Internet access, newspapers, 
  magazines, dictionaries, and libraries.
- *Home affective environment* includes variables measuring affection, 
  disaffection and negative sentiments, and parent-child interactions.

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⁶ This chapter uses the C1_6FP0 weight for interested readers familiar with the ECLS-K data. The 
C1_6FP0 weight is used for longitudinal analysis of the full sample of children up to fifth grade, 
and is defined to be nonzero with parent interview data present at each wave.
Parenting and disciplinary practices encompasses variables on disciplinary methods and family rules on television viewing. Parental involvement measures parental involvement in school activities, home-based activities, and learning activities outside of school or home.

Family status variables include race, SES, and family structure. Race is measured by a group of four dummies—black, Hispanic, Asian, and other race—with White as the reference category. SES is a composite measure, created using father’s education, mother’s education, father’s occupation, mother’s occupation, and household income. Family structure consists of two dummies—single-parent household and other type of household—with two-parent household as the reference category.

Child characteristics include gender, age at assessment, age-squared, whether or not the child speaks a language other than English as the main language at home, whether or not the child has transferred school, and whether or not the child is diagnosed with or has received therapy services for a disability, and number of siblings. School-level covariates consist of school sector (i.e., whether the school is public or private), school urbanicity, percentage of students eligible for the free lunch program, whether or not the school has 10 percent or more students eligible for reduced-price lunch program, and whether or not 50 percent or more of the students in the school are minority. Two classroom context variables, class size and teacher experience, are also included as covariates.

Descriptive Statistics
Table 1.1 presents the means and standard deviations of the reading and mathematics IRT scale scores measured at the five waves: fall of kindergarten, spring of kindergarten, spring of first grade, spring of third grade, and spring of fifth grade. Evidently, student performance has increased systematically with the grades. From beginning of kindergarten to end of fifth grade, the average

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7 As a result, parental education and income are highly correlated with SES and are not included in the models. Future research may consider use parental education and income as the family status variable instead of SES and examine whether and how family process factors differ by parental education and income.

8 A squared term of the age at assessment is included in the analysis because age-squared is found to be statistically significant in all models. The negative coefficient for the age-squared term indicates that achievement test scores increase at a decreasing rate as a child grows older (see Tables 1.16-1.19).

9 Descriptive statistics included imputed values. See the discussion on multiple imputation procedure presented in the later section of analytic methods.
test score increased nearly 109 points in reading and 90 points in mathematics, suggesting that students on average demonstrated continuous growth in academic achievement over years.

Table 1.1. Descriptive Statistics: Reading and Mathematics Test Scores

<table>
<thead>
<tr>
<th>IRT Scale Scores</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall kindergarten (Wave 1)</td>
<td>28.75</td>
<td>10.04</td>
<td>0</td>
<td>124.28</td>
</tr>
<tr>
<td>Spring kindergarten (Wave 2)</td>
<td>40.23</td>
<td>13.52</td>
<td>0</td>
<td>138.49</td>
</tr>
<tr>
<td>Spring 1st grade (Wave 3)</td>
<td>70.84</td>
<td>22.38</td>
<td>0</td>
<td>186.00</td>
</tr>
<tr>
<td>Spring 3rd grade (Wave 4)</td>
<td>116.70</td>
<td>25.74</td>
<td>21.90</td>
<td>186.00</td>
</tr>
<tr>
<td>Spring 5th grade (Wave 5)</td>
<td>137.60</td>
<td>23.65</td>
<td>54.05</td>
<td>186.00</td>
</tr>
<tr>
<td>Mathematics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall kindergarten (Wave 1)</td>
<td>22.57</td>
<td>8.70</td>
<td>0</td>
<td>86.54</td>
</tr>
<tr>
<td>Spring kindergarten (Wave 2)</td>
<td>32.78</td>
<td>11.42</td>
<td>0</td>
<td>104.18</td>
</tr>
<tr>
<td>Spring 1st grade (Wave 3)</td>
<td>57.20</td>
<td>16.51</td>
<td>0</td>
<td>137.31</td>
</tr>
<tr>
<td>Spring 3rd grade (Wave 4)</td>
<td>91.41</td>
<td>21.60</td>
<td>12.13</td>
<td>153.00</td>
</tr>
<tr>
<td>Spring 5th grade (Wave 5)</td>
<td>112.31</td>
<td>21.78</td>
<td>18.34</td>
<td>153.00</td>
</tr>
</tbody>
</table>

NOTE: Includes imputed values.

The descriptive statistics of family process variables are shown in Tables 1.2 and 1.3. Variables based on scales include family resources, parent-child interactions, disciplinary methods, number of family rules on television viewing, parental involvement in school events, and involvement in artistic or cultural activities. Items that make up the scales and the reliability estimates are provided in Appendix 1.B. For variables that vary across five waves, only measures at kindergarten entry (i.e., wave 1) are reported in the below tables (see Appendix 1.C for other waves).

Table 1.2 provides the means and standard deviations of family process variables that are continuous. On average, children spent over 52 minutes on homework every day. They owned an average of 74 books at home at kindergarten entry, and their families tended to have three out of a total of four family resources (i.e., newspaper, magazine, dictionary or encyclopedia, and pocket calculator). In terms of parent-child interactions, the mean score was 3.7 on a four-item scale, indicating high levels of effective interactions between parents and children. For parenting and disciplinary practices, parents reported using three out of a total of six types of disciplinary methods when their child got angry and hit them.10

10 The variable “disciplinary methods” was created based on results of factor analysis, which aims to find common underlying factors of a group of variables. Since the original variables are dichotomous, tetrachoric correlations were used in the factor analysis. The constructed variable
and they on average reported spanking their child once a month. At kindergarten entry, children were subject to an average of two family rules on television viewing, and typically watched television for approximately two hours on a weekday\(^{11}\) and five hours during a weekend. With respect to parental involvement, parents were involved in four types of school events on average, communicated regularly with an average of two parents whose children were in the same class, and had their child attend one type of artistic or cultural activity outside of school and home at kindergarten entry.

Table 1.2. Descriptive Statistics: Continuous Family Process Variables

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Learning Structure</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time for homework per day (in minutes)</td>
<td>52.64</td>
<td>31.06</td>
<td>0.00</td>
<td>240.00</td>
</tr>
<tr>
<td><em>Resource Availability</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of books child has at home</td>
<td>73.97</td>
<td>60.15</td>
<td>0</td>
<td>869</td>
</tr>
<tr>
<td>Family resources (newspaper, magazine, dictionary/encyclopedia, calculator)</td>
<td>3.25</td>
<td>0.85</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td><em>Home Affective Environment</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parent-child interactions</td>
<td>3.69</td>
<td>0.69</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td><em>Parenting and Disciplinary Practices</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disciplinary methods</td>
<td>2.90</td>
<td>1.46</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Frequency of spanking in a week</td>
<td>0.24</td>
<td>0.64</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Number of family rules on TV viewing</td>
<td>2.26</td>
<td>0.87</td>
<td>0.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekday</td>
<td>1.88</td>
<td>1.30</td>
<td>0.00</td>
<td>15.00</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekend</td>
<td>5.03</td>
<td>3.18</td>
<td>0.00</td>
<td>30.00</td>
</tr>
<tr>
<td><em>Parental Involvement</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental involvement in school events</td>
<td>3.64</td>
<td>1.56</td>
<td>0.00</td>
<td>6.00</td>
</tr>
<tr>
<td>Contact with parents of child’s peers</td>
<td>2.12</td>
<td>2.97</td>
<td>0</td>
<td>38</td>
</tr>
<tr>
<td>Involvement in artistic/cultural activities</td>
<td>0.60</td>
<td>0.93</td>
<td>0.00</td>
<td>5.00</td>
</tr>
</tbody>
</table>

NOTE: Includes imputed values.

Table 1.3 shows the descriptive statistics for the dichotomous family process variables. At kindergarten entry, over 74 percent of children’s parents expected their child to achieve a bachelor’s degree or higher. The percentage of children’s...
parents who believed that their child performed as good as or better than the peers was over 89 percent for reading, and 92 percent for mathematics.

In terms of learning structure variables, approximately 88 percent of children did homework more than two times a week, and over 97 percent of children had a place at home set aside for doing homework. At kindergarten entry, 33 percent of children read books outside of school for once to twice a week or less, and over 34 percent of children read every day. The percentage of children who used home computers three times or more a week was over 27 percent at kindergarten entry, and increased systematically as children progressed through grades (see Appendix 1.C). The proportion of children who owned a home computer shows a similar trend of consistent increase over years. The percentage rose from 54 percent in kindergarten to nearly 82 percent in fifth grade (see Appendix 1.C). Over 78 percent of children had Internet access at home, and almost 73 percent had a library card.

With respect to home affective environment, nearly 82 percent of parents reported having frequent warm and close interactions with child, and almost 88 percent of parents reported that their child liked them. In contrast, fewer than 10 percent of parents reported having to give up more of their life to meet their child’s needs than they ever expected, and only around 1 percent of parents reported feeling their own child was harder to care for than most other children. Approximately 83 percent of parents talked to their child about school on a daily basis.

In terms of parental involvement, over 64 percent of children had family members help them with reading homework for three to four times a week or more, and over 58 percent of children had help for mathematics homework. The percentage of children whose family members performed various home-based activities with them for more than two times a week was 28 percent for working on nature and science projects, 60 percent for playing games or puzzles, 59 percent for playing a sport or exercising together, and 89 percent for household chores. At kindergarten entry, over 53 percent of children’s parents reported visiting the library with the child at least once in the last month.

<table>
<thead>
<tr>
<th>Table 1.3. Descriptive Statistics: Dichotomous Family Process Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family Process Variables</td>
</tr>
<tr>
<td>----------------------------------</td>
</tr>
<tr>
<td>Parental Expectations and Beliefs</td>
</tr>
<tr>
<td>Expecting child to have a bachelor’s degree or higher</td>
</tr>
<tr>
<td>Belief about reading performance as good as or better than peers</td>
</tr>
</tbody>
</table>
Belief about math performance as good as or better than peers 92.44

Learning Structure
- Doing homework more than 2 times a week 87.62
- Place at home set aside for homework 97.67
- Child reading books outside school
  - Infrequent: 1 to 2 times a week or less 33.00
  - Very frequent: every day 34.20
- Home computer use 3 times a week or more 27.68

Resource Availability
- Home computer for child use 54.28
- Home Internet access 78.31
- Community library card for child 72.88

Home Affective Environment
- Parents and child often having warm, close times together 81.95
- Child likes parents 87.71
- Parents sacrificing more to meet child’s needs than expected 9.50
- Parents feeling child harder to care for than most 1.05
- Talk with child about school every day 83.07

Parental Involvement
- Help with reading homework 3 to 4 times a week or more 64.27
- Help with math homework 3 to 4 times a week or more 58.45
- Talking about nature or doing science projects with child more than 2 times a week 28.41
- Playing games or doing puzzles with child more than 2 times a week 59.79
- Playing sports or exercising with child more than 2 times a week 59.05
- Involving child in household chores more than 2 times a week 89.04
- Library visit with child in last month 53.48

NOTE: Includes imputed values.

Table 1.4 presents the means and standard deviations of continuous variables on family, child, and school characteristics at kindergarten entry (see Appendix 1.C for descriptive statistics for other waves). On average, children were aged around 5 years and 8 months, and had an average of 1.4 siblings at kindergarten entry. Their schools had almost 36 percent of students eligible for free lunch, and their classes had an average class size of approximately 21 students. Their teachers had, on average, more than 13 years of teaching experience. In terms of
family status variables, the average SES\textsuperscript{12} was -0.023 at kindergarten entry, about 0.029 standard deviations lower than zero.\textsuperscript{13}

Table 1.4. Descriptive Statistics: Family, Child, and School Characteristics – Continuous

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family Status Factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>-0.023</td>
<td>0.787</td>
<td>-4.75</td>
<td>2.75</td>
</tr>
<tr>
<td>Child Characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age at assessment (in months)</td>
<td>68.44</td>
<td>4.37</td>
<td>46.58</td>
<td>88.75</td>
</tr>
<tr>
<td>Number of siblings</td>
<td>1.43</td>
<td>1.12</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>School Factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent students eligible for free lunch</td>
<td>35.81</td>
<td>27.72</td>
<td>0.00</td>
<td>100</td>
</tr>
<tr>
<td>Class size</td>
<td>20.50</td>
<td>4.54</td>
<td>1</td>
<td>37</td>
</tr>
<tr>
<td>Teacher experience (in years)</td>
<td>13.15</td>
<td>8.65</td>
<td>0</td>
<td>50</td>
</tr>
</tbody>
</table>

NOTE: Includes imputed values.

Table 1.5 provides descriptive statistics for the dichotomous family, child, and school factors, which are reported as the percentages of children with selected characteristics. For variables that vary across five waves, only measures at kindergarten entry (i.e., wave 1) are reported in Table 1.5 (see Appendix 1.C for other waves). Over 42 percent of children were minority, and almost half were female. Nearly 12 percent of children used a language other than English as their main language at home. Over 48 percent transferred school at least once during kindergarten to fifth grade. At kindergarten entry, around 75 percent of children lived in two-parent households, and over 22 percent lived in single-parent households. Approximately 16 percent of children were reported to have a disability at kindergarten entry. In terms of school characteristics, about 85 percent of children were enrolled in public schools at kindergarten entry. Over 32 percent attended schools with 50 percent or more minority students, and more than 37 percent went to schools with 10 percent or more students eligible for

\textsuperscript{12} The SES composite ranges from -4.75 to 2.88 across five waves. It is the average of five measures (i.e., father’s education, mother’s education, father’s occupation, mother’s occupation, and household income), each of which is standardized to have a mean of zero and a standard deviation of one. See Tourangeau et al. (2006) for detailed information on the construction of the SES composite.

\textsuperscript{13} Corresponding to the average SES of -0.023 from the sample, the average annual household income was 50,543 dollars at kindergarten entry, lower than the national average of 51,855 dollars in 1998 (see US Census Bureau, 2001, Historical Income Tables, http://www.census.gov/hhes/www/income/histinc/h06AR.html, retrieved on April 20, 2009). The sample has a median education level of vocational and technical training for both mothers and father.
reduced-price lunch at kindergarten entry. Geographically, schools were mostly located in suburbs and large towns, and another one third were located in central cities.

Table 1.5. Descriptive Statistics: Family, Child, and School Characteristics – Dichotomous

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Family Status Factors</strong></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>57.66</td>
</tr>
<tr>
<td>Black</td>
<td>15.98</td>
</tr>
<tr>
<td>Hispanic</td>
<td>18.86</td>
</tr>
<tr>
<td>Asian</td>
<td>2.68</td>
</tr>
<tr>
<td>Other race</td>
<td>4.83</td>
</tr>
<tr>
<td><strong>Family structure</strong></td>
<td></td>
</tr>
<tr>
<td>Two-parent household</td>
<td>75.18</td>
</tr>
<tr>
<td>Single-parent household</td>
<td>22.55</td>
</tr>
<tr>
<td>Other type of household</td>
<td>2.27</td>
</tr>
<tr>
<td><strong>Child Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>48.54</td>
</tr>
<tr>
<td>Speak non-English at home</td>
<td>11.68</td>
</tr>
<tr>
<td>Transferred school</td>
<td>48.52</td>
</tr>
<tr>
<td>Disability</td>
<td>15.94</td>
</tr>
<tr>
<td><strong>School Factors</strong></td>
<td></td>
</tr>
<tr>
<td>Public</td>
<td>85.13</td>
</tr>
<tr>
<td>50 percent or more being minority</td>
<td>32.57</td>
</tr>
<tr>
<td>10 percent or more with reduced-price lunch</td>
<td>37.20</td>
</tr>
<tr>
<td><strong>School location</strong></td>
<td></td>
</tr>
<tr>
<td>Urban fringe and large town</td>
<td>41.56</td>
</tr>
<tr>
<td>Central city</td>
<td>37.02</td>
</tr>
<tr>
<td>Rural and small town</td>
<td>21.42</td>
</tr>
</tbody>
</table>

NOTE: Includes imputed values.

Racial/Ethnic Differences
Table 1.6 provides average reading and mathematics test scores for different ethnic groups across five waves. Overall, white and Asian students have consistently demonstrated higher achievement scores in both subjects than their black and Hispanic peers for all five waves. The achievement gap widened as students progressed through grades, and became most pronounced in fifth grade with white and Asian students scoring approximately 17 to 24 points higher than blacks and around 8 to 14 points higher than Hispanics. In addition, the average scores in reading and mathematics for blacks in fifth grade were about the same as the scores for whites and Asians in third grade.

Table 1.6. Reading and Mathematics Test Scores by Race/Ethnicity

<table>
<thead>
<tr>
<th>IRT Scale Scores</th>
<th>White</th>
<th>Black</th>
<th>Hispanic</th>
<th>Asian</th>
<th>Other</th>
</tr>
</thead>
</table>

17
Table 1.7 presents ethnic differences in family process factors. For variables that vary across five waves, only measures at kindergarten entry (i.e., wave 1) are shown in Table 1.7 (see Appendix 1.D for other waves). An examination of family process factors reveals ethnic differences between groups. On average, parents of Asian students had the highest percentage of expecting child to achieve a bachelor’s degree or higher. For learning structure, black children spent the most amount of time doing homework every day, whereas white children spent the least amount of time on homework.

With respect to available resources, white children owned over twice as many books as their black and Hispanic peers at home. White and Asian children had the highest percentage of ownership of home computers, with over 64 percent of white children and 63 percent of Asians reporting to have home computers at kindergarten entry. In contrast, only 38 percent of black children and 35 percent of Hispanics had home computers at kindergarten entry. Similarly, around 88 percent of white children and 91 percent of Asians had access to Internet at home, whereas 66 percent of blacks and 60 percent of Hispanics had home Internet access. Moreover, white and Asian children used home computers more frequently than their black and Hispanic peers.

For home affective environment, black and Hispanic parents appeared to demonstrate more warmth. For instance, in comparison with other racial groups, higher percentages of black and Hispanic parents reported that parents and child often spent warm and close time together and that child likes parents.

In terms of parenting and disciplinary practices, parents of black children spanked child twice as often as whites. For television viewing practices, black
children appeared to watch television most often, with average 2.3 hours of television viewing time on a weekday and 7.2 hours during a weekend as reported by their parents at kindergarten entry.

With regard to parental involvement, white parents received highest ratings on involvement in school events and regular communication with parents whose children were in the same class. Moreover, approximately 58 percent of white children and 67 percent of Asian children were reported to have visited library with their parents in the last month, whereas around 48 percent of black children and 46 percent of Hispanic children were reported to have done so at kindergarten entry.

Table 1.7. Family Process Factors by Race/Ethnicity

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>White</th>
<th>Black</th>
<th>Hispanic</th>
<th>Asian</th>
<th>Other Race</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parental Expectations and Beliefs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expecting a bachelor’s degree or higher</td>
<td>0.7252</td>
<td>0.7313</td>
<td>0.8094</td>
<td>0.8923</td>
<td>0.7045</td>
</tr>
<tr>
<td>Belief about reading performance as good as or better than peers</td>
<td>0.8725</td>
<td>0.9431</td>
<td>0.9152</td>
<td>0.9665</td>
<td>0.8651</td>
</tr>
<tr>
<td>Belief about math performance as good as or better than peers</td>
<td>0.9088</td>
<td>0.9504</td>
<td>0.9485</td>
<td>0.9414</td>
<td>0.9211</td>
</tr>
<tr>
<td><strong>Learning Structure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doing homework more than 2 times a week</td>
<td>0.8479</td>
<td>0.9134</td>
<td>0.9422</td>
<td>0.9456</td>
<td>0.7964</td>
</tr>
<tr>
<td>Place set aside for homework</td>
<td>0.9697</td>
<td>0.9931</td>
<td>0.9865</td>
<td>0.9724</td>
<td>0.9705</td>
</tr>
<tr>
<td>Time for homework per day (in minutes)</td>
<td>49.02</td>
<td>62.06</td>
<td>56.96</td>
<td>54.08</td>
<td>47.12</td>
</tr>
<tr>
<td>Child reading books outside school</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrequent: 1 to 2 times a week or less</td>
<td>0.3393</td>
<td>0.2610</td>
<td>0.3810</td>
<td>0.2911</td>
<td>0.2702</td>
</tr>
<tr>
<td>Very frequent: every day</td>
<td>0.3158</td>
<td>0.4394</td>
<td>0.3293</td>
<td>0.3753</td>
<td>0.3628</td>
</tr>
<tr>
<td>Home computer use 3 times a week or more</td>
<td>0.3325</td>
<td>0.2077</td>
<td>0.1615</td>
<td>0.2890</td>
<td>0.2831</td>
</tr>
<tr>
<td><strong>Resource Availability</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home computer for child use</td>
<td>0.6476</td>
<td>0.3810</td>
<td>0.3531</td>
<td>0.6352</td>
<td>0.5166</td>
</tr>
<tr>
<td>Home Internet access</td>
<td>0.8790</td>
<td>0.6572</td>
<td>0.5964</td>
<td>0.9116</td>
<td>0.7131</td>
</tr>
<tr>
<td>Number of books child has at home</td>
<td>94.35</td>
<td>42.32</td>
<td>42.20</td>
<td>50.31</td>
<td>72.60</td>
</tr>
<tr>
<td>Family resources (newspaper, magazine, dictionary/encyclopedia, calculator)</td>
<td>3.45</td>
<td>3.06</td>
<td>2.79</td>
<td>3.29</td>
<td>3.23</td>
</tr>
<tr>
<td>Community library card for child</td>
<td>0.7493</td>
<td>0.7241</td>
<td>0.7048</td>
<td>0.7687</td>
<td>0.5721</td>
</tr>
<tr>
<td><strong>Home Affective Environment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Having warm, close times with child</td>
<td>0.8076</td>
<td>0.8463</td>
<td>0.8317</td>
<td>0.8125</td>
<td>0.8296</td>
</tr>
<tr>
<td>Child likes parents</td>
<td>0.8681</td>
<td>0.9170</td>
<td>0.8796</td>
<td>0.8356</td>
<td>0.8661</td>
</tr>
<tr>
<td>Sacrifice to meet child’s needs</td>
<td>0.0750</td>
<td>0.1272</td>
<td>0.1212</td>
<td>0.1578</td>
<td>0.0901</td>
</tr>
<tr>
<td>Parents feeling child harder to care</td>
<td>0.0117</td>
<td>0.0102</td>
<td>0.0060</td>
<td>0.0035</td>
<td>0.0191</td>
</tr>
<tr>
<td>Parent-child interactions</td>
<td>3.78</td>
<td>3.55</td>
<td>3.57</td>
<td>3.49</td>
<td>3.70</td>
</tr>
<tr>
<td>Talk with child about school every day</td>
<td>0.8559</td>
<td>0.8246</td>
<td>0.7766</td>
<td>0.7152</td>
<td>0.8242</td>
</tr>
</tbody>
</table>
Parenting and Disciplinary Practices

<table>
<thead>
<tr>
<th>Disciplinary methods</th>
<th>3.02</th>
<th>2.63</th>
<th>2.81</th>
<th>2.62</th>
<th>2.84</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of spanking in a week</td>
<td>0.20</td>
<td>0.41</td>
<td>0.22</td>
<td>0.24</td>
<td>0.25</td>
</tr>
<tr>
<td>Number of family rules on TV viewing</td>
<td>2.21</td>
<td>2.34</td>
<td>2.32</td>
<td>2.38</td>
<td>2.23</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekday</td>
<td>1.71</td>
<td>2.26</td>
<td>2.15</td>
<td>1.71</td>
<td>1.84</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekend</td>
<td>4.61</td>
<td>7.17</td>
<td>4.53</td>
<td>4.54</td>
<td>5.12</td>
</tr>
</tbody>
</table>

Parental Involvement

| Parental involvement in school events | 4.01 | 2.94 | 3.18 | 3.17 | 3.55 |
| Contact with parents of child’s peers| 2.37 | 1.31 | 2.07 | 1.91 | 2.19 |
| Help with reading homework 3 to 4 times a week or more | 0.6068 | 0.7616 | 0.6648 | 0.5834 | 0.6250 |
| Help with math homework 3 to 4 times a week or more | 0.5335 | 0.7255 | 0.6253 | 0.5551 | 0.5844 |
| Talking about nature or doing science projects more than 2 times a week | 0.3120 | 0.2098 | 0.2463 | 0.2361 | 0.3707 |
| Playing games or doing puzzles with child more than 2 times a week | 0.6117 | 0.6925 | 0.4824 | 0.5711 | 0.5867 |
| Playing sports or exercising with child more than 2 times a week | 0.6221 | 0.6461 | 0.4667 | 0.4860 | 0.5696 |
| Involving child in household chores more than 2 times a week | 0.9088 | 0.9099 | 0.8182 | 0.8223 | 0.9260 |
| Involvement in artistic/cultural activities | 0.69 | 0.59 | 0.33 | 0.63 | 0.64 |
| Library visit with child in last month | 0.5751 | 0.4757 | 0.4616 | 0.6663 | 0.4626 |

Differences by SES

The correlation between SES and achievement ranged from 0.36 to 0.47 across waves (see Appendix 1.E). To further understand the achievement gaps among different SES groups, SES was grouped by four quartiles, with the first quartile consisting of children from the lowest 25 percent of SES and the fourth quartile for children from the highest 25 percent of SES. As shown in Table 1.8, the achievement gap existed among children with different levels of SES across all five waves. While children in the lowest SES quartile entered kindergarten with an average score of 23.88 points in reading and 18.23 points in mathematics, children in the highest SES quartile scored an average of 35.20 points in reading and 28.59 points in mathematics, approximately 11 points higher than their counterparts in the lowest SES quartile for both reading and mathematics. The gaps widened over time – by the end of fifth grade, children in the highest SES quartile scored nearly 29 points higher in reading and over 25 points higher in mathematics than those in the lowest SES quartile.

Table 1.8. Reading and Mathematics Test Scores by SES

<table>
<thead>
<tr>
<th>IRT Scale Scores</th>
<th>SES – 1st Quartile</th>
<th>SES – 2nd Quartile</th>
<th>SES – 3rd Quartile</th>
<th>SES – 4th Quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1.9 presents correlations between SES and family process variables that are continuous. For variables that vary across five waves, only measures at kindergarten entry are presented in Table 1.9 (see Appendix 1.F for other waves). Among these variables, only resources available for child use at home at kindergarten entry has a correlation of 0.42, and the number of family resources has a correlation of 0.43 with SES.

Table 1.9. Correlations Between SES and Continuous Family Process Factors

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Structure</td>
<td></td>
</tr>
<tr>
<td>Time for homework per day (in minutes)</td>
<td>-0.0316</td>
</tr>
<tr>
<td>Resource Availability</td>
<td></td>
</tr>
<tr>
<td>Number of books child has at home</td>
<td>0.4256</td>
</tr>
<tr>
<td>Family resources (newspaper, magazine, dictionary/encyclopedia, calculator)</td>
<td>0.4310</td>
</tr>
<tr>
<td>Home Affective Environment</td>
<td></td>
</tr>
<tr>
<td>Parent-child interactions</td>
<td>0.1527</td>
</tr>
<tr>
<td>Parenting and Disciplinary Practices</td>
<td></td>
</tr>
<tr>
<td>Disciplinary methods</td>
<td>0.0964</td>
</tr>
<tr>
<td>Frequency of spanking in a week</td>
<td>-0.1239</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekday</td>
<td>-0.2129</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekend</td>
<td>-0.1290</td>
</tr>
<tr>
<td>Parental Involvement</td>
<td></td>
</tr>
<tr>
<td>Contact with parents of child’s peers</td>
<td>0.1707</td>
</tr>
</tbody>
</table>

Tables 1.10-1.15 provide the means and standard deviations of SES for discrete family process variables with different levels. For variables that vary across five waves, only measures at kindergarten entry are presented in Tables 1.10-1.15 and information for other waves is shown in Appendix 1.G. Overall, there appeared to be consistent differences in average SES across different levels of family process variables, and differences seemed to be most noticeable for variables
measuring resource availability. As shown in Table 1.10, children whose parents expected them to obtain a bachelor’s degree or higher had a higher average SES than those whose parents expected lower than a bachelor’s degree at kindergarten entry. Moreover, parents who believed their child’s performance as good as or better than the peers tended to have relatively higher average SES.

Table 1.10. SES by Family Process Factors – Parental Expectations and Beliefs

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>SES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Expecting a bachelor’s degree or higher</td>
<td></td>
</tr>
<tr>
<td>Lower than a bachelor’s degree</td>
<td>-0.4069</td>
</tr>
<tr>
<td>A bachelor’s degree or higher</td>
<td>0.1076</td>
</tr>
<tr>
<td>Belief about reading performance</td>
<td></td>
</tr>
<tr>
<td>Worse than peers</td>
<td>-0.0711</td>
</tr>
<tr>
<td>As good as or better than peers</td>
<td>-0.0630</td>
</tr>
<tr>
<td>Belief about math performance</td>
<td></td>
</tr>
<tr>
<td>Worse than peers</td>
<td>-0.1657</td>
</tr>
<tr>
<td>As good as or better than peers</td>
<td>-0.0555</td>
</tr>
</tbody>
</table>

For learning structure, children who did homework more often had a higher average SES. At kindergarten entry, children who used home computer more frequently tended to have a higher average SES.

Table 1.11. SES by Family Process Factors – Learning Structure

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>SES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Doing homework more than 2 times a week</td>
<td></td>
</tr>
<tr>
<td>1 to 2 times a week or less</td>
<td>-0.1825</td>
</tr>
<tr>
<td>2 times a week or more</td>
<td>-0.0471</td>
</tr>
<tr>
<td>Place set aside for homework</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>-0.0656</td>
</tr>
<tr>
<td>No</td>
<td>0.0090</td>
</tr>
<tr>
<td>Child reading books outside school</td>
<td></td>
</tr>
<tr>
<td>Infrequent: 1 to 2 times a week or less</td>
<td>-0.1104</td>
</tr>
<tr>
<td>Frequent: 3 to 6 times a week</td>
<td>0.0512</td>
</tr>
<tr>
<td>Very frequent: every day</td>
<td>-0.0107</td>
</tr>
<tr>
<td>Home computer use 3 times a week or more</td>
<td></td>
</tr>
<tr>
<td>Infrequent: less than 3 times a week</td>
<td>-0.1310</td>
</tr>
<tr>
<td>Frequent: 3 times a week or more</td>
<td>0.2581</td>
</tr>
</tbody>
</table>

As shown in Table 1.12, children who had access to resources including home computer, home Internet access, and community library card tended to have higher average SES.
Table 1.12. SES by Family Process Factors – Resource Availability

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>SES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Resource Availability</strong></td>
<td><strong>Mean</strong></td>
</tr>
<tr>
<td>Home computer for child use</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0.2779</td>
</tr>
<tr>
<td>No</td>
<td>-0.3810</td>
</tr>
<tr>
<td>Home Internet access</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0.1049</td>
</tr>
<tr>
<td>No</td>
<td>-0.6733</td>
</tr>
<tr>
<td>Community library card for child</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0.0281</td>
</tr>
<tr>
<td>No</td>
<td>-0.3111</td>
</tr>
</tbody>
</table>

With respect to home affective environment, children whose parents displayed affection tended to have higher average SES. Moreover, children whose parents talked to them about school on a daily basis had higher average SES than those whose parents talked to them less frequently.

Table 1.13. SES by Family Process Factors – Home Affective Environment

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>SES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Home Affective Environment</strong></td>
<td><strong>Mean</strong></td>
</tr>
<tr>
<td>Having warm, close times with child</td>
<td></td>
</tr>
<tr>
<td>True</td>
<td>-0.0509</td>
</tr>
<tr>
<td>False</td>
<td>-0.1230</td>
</tr>
<tr>
<td>Child likes parents</td>
<td></td>
</tr>
<tr>
<td>True</td>
<td>-0.0570</td>
</tr>
<tr>
<td>False</td>
<td>-0.1130</td>
</tr>
<tr>
<td>Sacrifice to meet child’s needs</td>
<td></td>
</tr>
<tr>
<td>True</td>
<td>-0.1994</td>
</tr>
<tr>
<td>False</td>
<td>-0.0497</td>
</tr>
<tr>
<td>Parents feeling child harder to care</td>
<td></td>
</tr>
<tr>
<td>True</td>
<td>-0.0280</td>
</tr>
<tr>
<td>False</td>
<td>-0.0643</td>
</tr>
<tr>
<td>Talk with child about school every day</td>
<td></td>
</tr>
<tr>
<td>Less than every day</td>
<td>-0.2122</td>
</tr>
<tr>
<td>Every day</td>
<td>-0.0337</td>
</tr>
</tbody>
</table>

For parenting and disciplinary practices, children who were subject to more family rules on television viewing tended to have higher average SES.

Table 1.14. SES by Family Process Factors – Parenting and Disciplinary Practices

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>SES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parenting and Disciplinary Practices</strong></td>
<td><strong>Mean</strong></td>
</tr>
<tr>
<td>Number of family rules on TV viewing</td>
<td></td>
</tr>
<tr>
<td>No rule</td>
<td>-0.3291</td>
</tr>
</tbody>
</table>
As shown in Table 1.15, children whose parents were more involved in their life tended to have higher average SES. Parental involvement in school events, home activities, and library visits indicates parents’ time commitment to children’s education whereas participation in artistic and cultural activities probably reflects parents’ ability to pay more than time availability. However, children whose parents reported helping them with homework more often had lower average SES than their peers.

### Table 1.15. SES by Family Process Factors – Parental Involvement

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>Mean</th>
<th>S.D.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parental Involvement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental involvement in school events</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No involvement</td>
<td>-0.9198</td>
<td>1.0845</td>
<td>-4.75</td>
<td>2.50</td>
</tr>
<tr>
<td>Involvement in one event</td>
<td>-0.5762</td>
<td>0.6509</td>
<td>-4.75</td>
<td>2.57</td>
</tr>
<tr>
<td>Involvement in two events</td>
<td>-0.3626</td>
<td>0.7005</td>
<td>-4.47</td>
<td>2.55</td>
</tr>
<tr>
<td>Involvement in three events</td>
<td>-0.1385</td>
<td>0.6803</td>
<td>-4.75</td>
<td>2.67</td>
</tr>
<tr>
<td>Involvement in four events</td>
<td>0.1000</td>
<td>0.7373</td>
<td>-4.18</td>
<td>2.67</td>
</tr>
<tr>
<td>Involvement in five events</td>
<td>0.2654</td>
<td>0.7240</td>
<td>-3.61</td>
<td>2.75</td>
</tr>
<tr>
<td>Involvement in six events</td>
<td>0.3693</td>
<td>0.6892</td>
<td>-2.05</td>
<td>2.69</td>
</tr>
<tr>
<td>Help with reading homework</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 2 times a week</td>
<td>0.0445</td>
<td>0.7942</td>
<td>-2.94</td>
<td>2.58</td>
</tr>
<tr>
<td>3 to 4 times a week or more</td>
<td>-0.1241</td>
<td>0.7168</td>
<td>-3.05</td>
<td>2.68</td>
</tr>
<tr>
<td>Help with math homework</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 2 times a week</td>
<td>0.0026</td>
<td>0.7623</td>
<td>-3.05</td>
<td>2.64</td>
</tr>
<tr>
<td>3 to 4 times a week or more</td>
<td>-0.1111</td>
<td>0.7370</td>
<td>-2.90</td>
<td>2.68</td>
</tr>
<tr>
<td>Talking about nature or doing science projects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 times a week or less</td>
<td>-0.1113</td>
<td>0.7447</td>
<td>-2.94</td>
<td>2.68</td>
</tr>
<tr>
<td>More than 2 times a week</td>
<td>0.0557</td>
<td>0.7491</td>
<td>-3.05</td>
<td>2.64</td>
</tr>
<tr>
<td>Playing games or doing puzzles with child</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 times a week or less</td>
<td>-0.0997</td>
<td>0.7586</td>
<td>-2.77</td>
<td>2.62</td>
</tr>
<tr>
<td>More than 2 times a week</td>
<td>-0.0398</td>
<td>0.7428</td>
<td>-3.05</td>
<td>2.68</td>
</tr>
<tr>
<td>Playing sports or exercising with child</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 times a week or less</td>
<td>-0.1112</td>
<td>0.7519</td>
<td>-2.90</td>
<td>2.64</td>
</tr>
<tr>
<td>More than 2 times a week</td>
<td>-0.0311</td>
<td>0.7465</td>
<td>-3.05</td>
<td>2.68</td>
</tr>
<tr>
<td>Involving child in household chores</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 times a week or less</td>
<td>-0.1748</td>
<td>0.8212</td>
<td>-3.05</td>
<td>2.58</td>
</tr>
<tr>
<td>More than 2 times a week</td>
<td>-0.0502</td>
<td>0.7393</td>
<td>-2.94</td>
<td>2.68</td>
</tr>
<tr>
<td>Involvement in artistic/cultural activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No involvement</td>
<td>-0.1916</td>
<td>0.7450</td>
<td>-4.75</td>
<td>2.67</td>
</tr>
<tr>
<td>Involvement in one activity</td>
<td>0.1546</td>
<td>0.7443</td>
<td>-4.47</td>
<td>2.64</td>
</tr>
<tr>
<td>Involvement in two activities</td>
<td>0.3205</td>
<td>0.7913</td>
<td>-4.47</td>
<td>2.67</td>
</tr>
<tr>
<td>Involvement in three activities</td>
<td>0.4950</td>
<td>0.7360</td>
<td>-1.11</td>
<td>2.75</td>
</tr>
<tr>
<td>Involvement in four activities</td>
<td>0.6937</td>
<td>0.8885</td>
<td>-2.56</td>
<td>2.41</td>
</tr>
<tr>
<td>Involvement in five activities</td>
<td>0.8753</td>
<td>0.7171</td>
<td>-1.10</td>
<td>1.74</td>
</tr>
<tr>
<td>Library visit with child in last month</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0.1329</td>
<td>0.7579</td>
<td>-4.47</td>
<td>2.75</td>
</tr>
<tr>
<td>No</td>
<td>-0.2030</td>
<td>0.7814</td>
<td>-4.75</td>
<td>2.69</td>
</tr>
</tbody>
</table>

**Analytic Methods**

*Multiple Imputation*
Approximately 24 percent of the sample has missing values in one or more of the variables measuring achievement and family factors across the five waves of the data. While the sample has missing values in most of the variables used for analysis, many of these variables are only missing for a small percentage of the total observations. The percentages of missing values are no more than 2.4 percent for family process and status variables, and range from 1.6 to 7.8 percent for achievement test scores in reading and mathematics.

While it is possible to exclude cases that have a missing value for any variables required for the analysis, such an approach may produce biased estimates if individuals with complete data differ systematically from the target population. This approach would also fail to take full advantage of the partially complete cases, thus leading to inefficient use of the collected information (Carlin et al., 2003; Le et al., 2006; Schafer, 1999).

To address the missing data problem, this chapter follows a multiple imputation procedure, which generates several complete datasets with missing values replaced by a random sample of plausible values. Specifically, 10 sets of complete data are imputed, and the results from analyzing these datasets are combined to produce overall estimates in a manner that accounts for the missing-data uncertainty as well as sampling variation (Carlin et al., 2003; Le et al., 2006; Royston, 2005; Schafer, 1999). Categorical and dichotomous variables are treated as continuous during the imputation process, and then rounded back to discrete numbers for analysis.\(^{14}\)

\(^{14}\) The break point for rounding is 0.5, with values of 0.5 and more being rounded up and values less than 0.5 being rounded down.
Several variables were collected either during the first wave (i.e., fall of kindergarten) or during the second wave (i.e., spring of kindergarten). For these variables, values collected in one wave are used for the other wave, under the assumption that these variables were unlikely to change between fall and spring of kindergarten.

**Effect Size Calculation**
Because of the large sample size, variables can achieve statistical significance even when they are of little substantive significance. To understand the practical importance of the variables, results are also shown in terms of effect sizes, which can be interpreted as the change in standard deviations (SDs) of the dependent variable associated with one-unit change in an independent variable. Following the methods by Von Secker and Lissitz (1999), effect sizes are calculated by dividing each coefficient by the pooled within-child standard deviations from the unconditional models.

For context, the observed effect sizes are compared to the typical effect size of past educational interventions as reported by Hill et al. (2008). Hill et al. (2007) synthesized 76 meta-analyses of past studies of educational intervention programs in kindergarten through grade 12, and found that the mean effect sizes ranged from 0.20 to 0.30 across different interventions, achievement outcomes, and grade levels. Specifically, the mean effect size for the elementary grades was 0.23, the mean effect size for the middle grades was 0.27, and the mean effect size for the grades of high school was 0.24. Using these effect sizes as benchmarks, effect sizes less than or equal to 0.20 SD (in absolute value) are interpreted as “small,” effect sizes between 0.20 and 0.30 SD as “average,” and effect sizes of 0.30 SD or more as “above average.”

**Regression Models**
Given the nested structure of the data, this chapter estimates hierarchical models with three levels:

---

15 For example, parental expectations of their child’s educational attainment was measured in the first wave (i.e., fall of kindergarten), third wave (i.e., spring of first grade), fourth wave (i.e., spring of third grade), and fifth wave (i.e., spring of fifth grade). In the analysis, values collected in the first wave are used for the second wave, under the assumption that parents tended to have the same level of educational expectations for their child in fall and spring of kindergarten.

16 Unconditional models partition the variance in achievement into between-school, between-student, and within-student components. Age at assessment, a proxy for time, is included in the unconditional models as the only independent variable to account for the longitudinal structure of the data. Results of the unconditional models are shown in Appendix 1.H.
\[
Y_{ij} = \alpha_{ij} + \lambda_{ij} FP_{ij} + \rho_{ij} X_{ij} + \varepsilon_{ij} \tag{1.1}
\]
\[
\alpha_{ij} = \gamma_{j} + \theta_{j} FP_{ij} + \delta_{j} FS_{ij} + \beta_{j} C_{ij} + u_{ij} \tag{1.2}
\]
\[
\gamma_{j} = \mu + \pi S_{j} + v_{j} \tag{1.3}
\]

where \( i, j \) and \( t \) index individual students, schools, and time periods respectively. \( Y_{ij} \) is the outcome of interest (i.e., student achievement), \( FP_{ij} \) is a vector of variables measuring family process factors that vary across time, \( FP_{ij} \) is a vector of variables measuring time-invariant family process factors, \( FS_{ij} \) is a vector of variables measuring family status factors, \( X_{ij} \) is a vector of time-varying child characteristics, \( C_{ij} \) is a vector of time-invariant child-level covariates, and \( S_{j} \) is a vector of school factors.

As shown in equation 1.1, the Level-1 model estimates the relationship between student achievement and time-varying child-specific variables including family process factors and child characteristics. The coefficients of the time-varying child-specific variables \( \lambda_{ij} \) and \( \rho_{ij} \) are assumed to be fixed across all students, but the intercept \( \alpha_{ij} \) is allowed to vary across students and modeled with a random component \( u_{ij} \) in equation 1.2. The error term \( \varepsilon_{ij} \) in equation 1.1 is assumed to be normally distributed with zero mean and standard deviation \( \sigma_{\varepsilon} \). Equation 1.2 models \( \alpha_{ij} \) as a function of time-invariant child-specific variables including family process factors, family status factors, and other child-level covariates. Coefficients \( \theta_{j}, \delta_{j} \) and \( \beta_{j} \) are assumed to be fixed across all schools, but the intercept \( \gamma_{j} \), modeled in equation 1.3, is allowed to vary across schools. \( u_{ij} \) is the random effect term for each student, with an assumed normal distribution of zero mean and standard deviation \( \sigma_{u} \). Equation 1.3 estimates \( \gamma_{j} \) as a function of school-level variables. The intercept \( \mu \) quantifies the average outcome for all schools and coefficients \( \pi \) estimate effects of school-level factors on the outcome variable \( Y_{ij} \). \( v_{j} \) is the random effect term for each school, with an assumed normal distribution of zero mean and standard deviation \( \sigma_{v} \). Error terms \( \varepsilon_{ij}, u_{ij}, v_{j} \) and \( v_{i} \) are assumed to be independent from each other.

Two separate models are estimated to address the research questions. The model presented above (hereinafter, referred to as the family process model) estimates the relationship between family factors and achievement in reading and mathematics, which addresses the first research question. Baseline models that regress student achievement as a function of family status variables, child characteristics, and school covariates are also estimated. A comparison of results from the family process model with the baseline model reveals whether and how

\(^{17}\) Time and age at assessment were highly correlated (\( r = 0.96 \)). Thus, age at assessment is used as a proxy for time in the models.
the effects of race and SES change once family process variables are added into the estimation. For the second research question, interaction terms between family process and family status variables are added to the family process model to analyze whether the relationship between family process factors and achievement differ by family status variables. Specifically, two interaction models are estimated: one for interactions between family process variables and race (i.e., black versus non-black),\(^\text{18}\) and the other for interactions between family process variables and SES.

*Multiple Testing Issues*

The regression models include a comprehensive list of independent variables and statistical tests are performed to test the null hypothesis of whether each of the coefficients is equal to zero. Given the number of tests performed, one concern is the increase in the rate of false positives (also known as type I error). In other words, the issue is that, through multiple testing, the study would reject the null hypothesis of zero coefficients too often and falsely infer that there are more statistically significant effects than there actually are. To guard against this issue of multiple inferences, this study adopts Benjamini and Hochberg’s (1995) approach to control for the false discovery rate, i.e., the expected proportion of falsely rejected hypotheses.\(^\text{19}\) In doing so, families of tests are defined by the different regression model discussed previously. For example, the baseline

\(^{18}\) Hispanic versus non-Hispanic can be another comparison for the interaction model of race/ethnicity since the effects of family process factors are likely to differ across different minority groups. However, this study focuses on the black population because historically they had larger achievement gaps, relative to whites, than did Hispanics as shown by the National Assessment of Educational Progress (NAEP). Moreover, Hispanic is an ethnicity instead of a race. Previous literature points out that the Hispanic population is a diverse group along several dimensions such as national origin, family immigration history, and linguistic and cultural characteristics and that achievement gaps vary considerably among Hispanic subgroups (Reardon and Galindo, 2009). Thus, a simple comparison between the Hispanic and non-Hispanic groups may not capture the full picture. A possible breakdown, for example, is as follows: (a) black, non-Hispanic origins, (b) black, Hispanic origins; (c) white, non-Hispanic origins; and (d) white, Hispanic origins. But ECLS-K has a very small sample size for the group of blacks with Hispanic origins. Of the 8,370 children included in the final sample for analysis, only 32 children (equivalent of 0.38 percent) are blacks with Hispanic origins. Such a small sample size makes it difficult to detect any meaningful effects for the group. While not the focus of this study, the Hispanic/non-Hispanic comparison can be an avenue for future research with proper use of over-sampling of the target population.

\(^{19}\) Benjamini and Hochberg (1995) showed that controlling for the false discovery rate is a more powerful test than the more conservative Bonferonni approach of controlling for the family-wise error rate. See Newson et al. (2003) and Karoly et al. (2008) for more discussion on application of multiple-test procedures.
model using reading achievement as the dependent variable is considered one family of test while the baseline model with mathematics achievement as the outcome variable is another family of test. The false discovery rate is set at 0.05 level. In general, results in this chapter that are statistically significant at the 0.01 level based on single inference remain significant according to the Benjamini and Hochberg multiple-test procedure. In most cases, coefficients that are statistically significant at the 0.05 level also remain significant after accounting for multiple testing. Results shown in the next section indicate significance based on the multiple-test procedure.

Results

Baseline and Family Process Models

Tables 1.16 and 1.17 present results of the baseline and family process models for reading and mathematics achievement respectively. The baseline models indicated significant associations between student achievement and family status factors including race, SES, and family structure. In comparison with white children, blacks on average scored 0.4 SD lower in reading and 0.9 SD lower in mathematics, and Hispanics scored almost 0.2 SD lower in reading and over 0.3 SD lower in mathematics. In contrast, Asian children had an average score of approximately 0.45 SD higher than whites in both reading and mathematics. For every 1 SD increase in SES, average achievement was expected to increase by over 0.5 SD for reading and almost 0.6 SD for mathematics. Children from single-parent households had an average achievement score of 0.09 SD lower in reading and 0.07 SD lower in mathematics than those from two-parent households.

Based on the results of the family process models, a number of family process variables were shown to be significantly associated with student achievement, and several had moderate to large effect sizes. Parental expectations and beliefs were positively related with both reading and mathematics achievement. On average, children whose parents expected them to obtain a bachelor’s degree or higher scored approximately 0.3 SD higher in both reading and mathematics than those whose parents expected less than a bachelor’s degree. Children whose parents believed their child’s academic performance to be better than or as good as the peers had an average achievement score of 1.1 SD higher in

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20 Multiple-test procedures are not conducted for random effects parameters.
21 Preliminary analyses were run on the non-imputed data, and results largely remain the same with respect to the statistical significance of the family factors.
reading and 1.2 SD higher in mathematics than those whose parents believed their child’s performance to be worse than the peers.22

With respect to learning structure, better achievement in reading and mathematics was associated with higher frequencies of doing homework, reading books, and using home computers. However, the amount of time that students spent on homework every day was negatively associated with achievement, probably indicating that children with academic difficulties tended to need more time to complete homework. Although statistically significant, all these variables measuring learning structure at home showed small effect sizes (i.e., with an effect size less than or equal to 0.2 SD in absolute value).

Unsurprisingly, children with access to more resources scored higher in reading and mathematics achievement tests. Specifically, higher test scores in both subjects were associated with home Internet access, more books available for child use at home, community library card for child, and other resources such as newspapers, magazines, dictionaries, encyclopedia, and pocket calculators. Ownership of home computers for child use appeared to be correlated with higher reading scores, but had an insignificant effect on mathematics. The effect size for home Internet access was 0.21 for reading and 0.3 for mathematics, indicating that children with access to Internet at home scored on average 0.21 SD higher in reading and 0.3 SD higher in mathematics than children without Internet access. Effect sizes for other variables of resource availability were small.

In terms of affective quality of home environment, achievement in both reading and mathematics was negatively associated with parents’ negative sentiments towards children and child-rearing (i.e., parents’ feeling of giving up more of life to meet child’s needs than ever expected, and parents feeling their own child harder to care for than most other children). Moreover, the effect size for parents’ feeling of their child hard to care was approximately -0.4 for both reading and mathematics, indicating that children whose parents felt their child hard to care tended to score 0.4 SD lower in both subjects. However, the relationship between achievement and parent-child affection (i.e., parents and children often having warm and close times together, and parents’ feelings that child likes them) was statistically insignificant. Parent-child interaction was positively associated with reading achievement, but had an insignificant impact on mathematics achievement. In contrast, frequent parent-child communication

22 The relationship between parental belief about child’s academic performance and student achievement may indicate reverse causality.
about school was negatively related with mathematics achievement, but had an insignificant impact on reading scores. However, none of these variables showed effect size larger than 0.2 (in absolute value) except for the variable measuring parents’ feeling their child hard to care as reported above.

With regard to parenting and disciplinary practices, more family rules on television watching practices had insignificant effects on student achievement. However, the number of hours that children spent on watching television on a weekday was negatively associated with mathematics achievement scores, and the number of hours that children spent on television during a weekend was positively correlated with both reading and mathematics achievement. Moreover, children tended to score higher in reading if their parents used multiple disciplinary methods in case of children’s misbehaviors. Frequency of spanking appeared to be negatively related with mathematics achievement. However, effect sizes for all these variables were small.

Finally, consistent with previous literature, a number of variables measuring parental involvement in school events, home learning, and outside-school activities were found to be significantly associated with achievement. Specifically, children had better performance in both reading and mathematics if their parents were more involved in school events and communicated regularly with parents whose children were in the same class. Children who attended artistic or cultural activities outside of school also tended to score higher in reading and mathematics. The relationship between home-based activities and achievement varied depending on the subject and activity being examined. For reading achievement, higher scores were positively associated with activities such as parents talking about nature or working on science projects with their child, and were negatively correlated with household chores, sports, and exercising. Better performance in mathematics was positively associated with activities such as parents playing games or puzzles with their child, whereas it was negatively correlated with sports and exercising. Moreover, frequent help with child’s homework was associated with lower achievement scores in both subjects, suggesting the possibility that children with academic difficulties needed parents’ help with homework more often. Effect sizes for these variables were all small (i.e., less than or equal to 0.2 SD in absolute value) with the exception of help with homework. Children who had parents help them with homework for three to four times a week or more scored almost 0.5 SD lower in reading and over 0.6 SD lower in mathematics than those who had help less frequently.
Table 1.16. Coefficients of Baseline and Family Process Models for Reading Achievement

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline</th>
<th></th>
<th>Family Process</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>S.E.</td>
<td>Size</td>
<td>Estimate</td>
</tr>
<tr>
<td>Parental Expectations and Beliefs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree expected</td>
<td>3.643**+</td>
<td>0.230</td>
<td>0.294</td>
<td></td>
</tr>
<tr>
<td>Belief in reading performance</td>
<td>13.036**+</td>
<td>0.419</td>
<td>1.054</td>
<td></td>
</tr>
<tr>
<td>Learning Structure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doing homework more than 2 times a week</td>
<td>1.753**+</td>
<td>0.405</td>
<td>0.142</td>
<td></td>
</tr>
<tr>
<td>Place set aside for homework</td>
<td>-1.272</td>
<td>0.722</td>
<td>-0.103</td>
<td></td>
</tr>
<tr>
<td>Time for homework per day</td>
<td>-0.009**+</td>
<td>0.004</td>
<td>-0.001</td>
<td></td>
</tr>
<tr>
<td>Frequency of reading books – Infrequent</td>
<td>-2.471**+</td>
<td>0.198</td>
<td>-0.200</td>
<td></td>
</tr>
<tr>
<td>Frequency of reading books – Every day</td>
<td>2.387**+</td>
<td>0.176</td>
<td>0.193</td>
<td></td>
</tr>
<tr>
<td>Home computer use 3 times a week or more</td>
<td>1.061**+</td>
<td>0.193</td>
<td>0.086</td>
<td></td>
</tr>
<tr>
<td>Resource Availability</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home computer for child use</td>
<td>0.814**+</td>
<td>0.253</td>
<td>0.066</td>
<td></td>
</tr>
<tr>
<td>Home Internet access</td>
<td>2.556**+</td>
<td>0.368</td>
<td>0.207</td>
<td></td>
</tr>
<tr>
<td>Number of books child has at home</td>
<td>0.006**+</td>
<td>0.001</td>
<td>0.0005</td>
<td></td>
</tr>
<tr>
<td>Family resources</td>
<td>0.942**+</td>
<td>0.170</td>
<td>0.076</td>
<td></td>
</tr>
<tr>
<td>Community library card for child</td>
<td>1.123**+</td>
<td>0.300</td>
<td>0.091</td>
<td></td>
</tr>
<tr>
<td>Home Affective Environment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Having warm, close times with child</td>
<td>-0.593</td>
<td>0.344</td>
<td>-0.048</td>
<td></td>
</tr>
<tr>
<td>Child likes parents</td>
<td>0.263</td>
<td>0.390</td>
<td>0.021</td>
<td></td>
</tr>
<tr>
<td>Sacrifice to meet child’s needs</td>
<td>-1.285**+</td>
<td>0.439</td>
<td>-0.104</td>
<td></td>
</tr>
<tr>
<td>Parents feeling child harder to care</td>
<td>-4.740**+</td>
<td>1.396</td>
<td>-0.383</td>
<td></td>
</tr>
<tr>
<td>Parent-child interactions</td>
<td>0.514**+</td>
<td>0.187</td>
<td>0.042</td>
<td></td>
</tr>
<tr>
<td>Talk with child about school every day</td>
<td>-0.653</td>
<td>0.339</td>
<td>-0.053</td>
<td></td>
</tr>
<tr>
<td>Parenting and Disciplinary Practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disciplinary methods</td>
<td>0.202**+</td>
<td>0.086</td>
<td>0.016</td>
<td></td>
</tr>
<tr>
<td>Frequency of spanking in a week</td>
<td>-0.381</td>
<td>0.221</td>
<td>-0.031</td>
<td></td>
</tr>
<tr>
<td>Number of family rules on TV viewing</td>
<td>0.148</td>
<td>0.107</td>
<td>0.012</td>
<td></td>
</tr>
<tr>
<td>Hours of TV viewing on a weekday</td>
<td>-0.070</td>
<td>0.079</td>
<td>-0.006</td>
<td></td>
</tr>
<tr>
<td>Hours of TV viewing on a weekend</td>
<td>0.071**+</td>
<td>0.033</td>
<td>0.006</td>
<td></td>
</tr>
<tr>
<td>Parental Involvement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental involvement in school events</td>
<td>0.186**+</td>
<td>0.071</td>
<td>0.015</td>
<td></td>
</tr>
<tr>
<td>Contact with parents of child’s peers</td>
<td>0.105**+</td>
<td>0.026</td>
<td>0.009</td>
<td></td>
</tr>
<tr>
<td>Frequency of help with reading homework</td>
<td>-6.128**+</td>
<td>0.263</td>
<td>-0.495</td>
<td></td>
</tr>
<tr>
<td>Frequency of talking about nature/science</td>
<td>0.554*</td>
<td>0.272</td>
<td>0.045</td>
<td></td>
</tr>
<tr>
<td>Frequency of playing games/puzzles</td>
<td>0.265</td>
<td>0.262</td>
<td>0.021</td>
<td></td>
</tr>
<tr>
<td>Frequency of playing sports or exercising</td>
<td>-2.202**+</td>
<td>0.260</td>
<td>-0.178</td>
<td></td>
</tr>
<tr>
<td>Frequency of involving child in chores</td>
<td>-1.541**+</td>
<td>0.376</td>
<td>-0.125</td>
<td></td>
</tr>
<tr>
<td>Involvement in artistic/cultural activities</td>
<td>0.946**+</td>
<td>0.092</td>
<td>0.076</td>
<td></td>
</tr>
<tr>
<td>Library visit with child in last month</td>
<td>0.098</td>
<td>0.177</td>
<td>0.008</td>
<td></td>
</tr>
<tr>
<td>Family Status Factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>-5.078**+</td>
<td>0.545</td>
<td>-0.410</td>
<td>-4.434**+</td>
</tr>
<tr>
<td>Hispanic</td>
<td>-2.146**+</td>
<td>0.473</td>
<td>-0.173</td>
<td>-1.818**+</td>
</tr>
<tr>
<td>Asian</td>
<td>5.482**+</td>
<td>0.668</td>
<td>0.443</td>
<td>4.559**+</td>
</tr>
</tbody>
</table>
Other race & -2.375**‡ 0.631 -0.192 -1.664**‡ 0.586 -0.134 \\
SES & 6.510*** 0.182 0.526 4.166*** 0.185 0.337 \\
Single-parent household & -1.147**‡ 0.298 -0.093 -0.384 0.286 -0.031 \\
Other type of household & -3.221**‡ 0.868 -0.260 -2.317**‡ 0.830 -0.187 \\

Child Characteristics 

Female & 3.896**‡ 0.256 0.315 1.795**‡ 0.246 0.145 \\
Age at assessment & 4.767*** 0.034 0.385 4.620*** 0.033 0.373 \\
Age at assessment squared & -0.015**‡ 0.0002 -0.001 -0.014**‡ 0.0002 -0.001 \\
Speak non-English at home & -3.122**‡ 0.521 -0.252 -2.879**‡ 0.494 -0.233 \\
Transferred school & 0.064 0.338 0.005 0.612 0.314 0.050 \\
Disability & -4.047**‡ 0.236 -0.327 -3.003**‡ 0.231 -0.243 \\
Number of siblings & -1.582**‡ 0.111 -0.128 -1.452**‡ 0.106 -0.117 \\

School Factors 

Public & -3.115**‡ 0.430 -0.252 -1.987**‡ 0.396 -0.161 \\
50 percent or more being minority & -0.360 0.422 -0.029 -0.268 0.392 -0.022 \\
10 percent or more with reduced-price lunch & -1.110*** 0.341 -0.090 -1.011*** 0.320 -0.082 \\
Percent students eligible for free lunch & -0.054**‡ 0.007 -0.004 -0.044**‡ 0.007 -0.004 \\
Central city & 0.320 0.366 0.026 0.271 0.336 0.022 \\
Rural and small town & -3.239**‡ 0.445 -0.262 -1.725**‡ 0.405 -0.139 \\
Class size & 0.132**‡ 0.026 0.011 0.095**‡ 0.025 0.008 \\
Teacher experience (in years) & 0.023**‡ 0.010 0.002 0.024**‡ 0.010 0.002 \\
Intercept & -226.345*** 1.721 --- -237.962*** 2.101 --- \\

Random-Effects Parameters 

School-level random effects – sigma & 4.566** 0.224 --- 4.028** 0.204 --- \\
Child-level random effects – sigma & 13.988** 0.127 --- 12.426** 0.122 --- \\
Within-child variability – sigma & 12.255** 0.059 --- 12.123** 0.058 ---

NOTE: * indicates significance at .05 level, ** indicates significance at .01 level. ‡ indicates significance at .05 false discovery rate.

A comparison between the baseline and family process models indicates the importance of family process factors in predicting student achievement. After controlling for family process variables, the between-school and between-child random effects decreased for both reading and mathematics. Family process variables explained approximately 22 percent of the between-school variation, 21 percent of the between-child variation, and 2 percent of the within-child variation in reading, as well as 8 percent of the between-school variation, 18 percent of the between-child variation, and 1 percent of the within-child variation in mathematics.23 In comparison with baseline models, coefficients of

23 Following the methods by Singer (1998), percentages of the between-school and between-child variation explained by family process variables were obtained by examining the reduction in the school-level and child-level random effects term with and without the inclusion of family process skills in the models. Similarly, percentage of the within-child variation explained by family process variables was based on the change in the residual term between the baseline and family process models (also see Le et al., 2006).
family status variables in family process models were smaller in magnitude, suggesting that the achievement gaps by race, SES, and family structure were less pronounced once controlling for family process variables. For example, the effect size for SES decreased from 0.5 in the baseline model to 0.3 in the family process model for reading, and from 0.6 to 0.4 for mathematics. Moreover, the negative effect of single-parent household on achievement was no longer significant once family process variables were included in the models. Despite the sharp decrease in magnitude, most of these family status variables were still statistically significant and had larger effect sizes than many family process variables.

Table 1.17. Coefficients of Baseline and Family Process Models for Mathematics Achievement

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline Effect</th>
<th>Family Process Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>S.E.</td>
</tr>
<tr>
<td>Parental Expectations and Beliefs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree expected</td>
<td>2.927**†</td>
<td>0.178</td>
</tr>
<tr>
<td>Belief in math performance</td>
<td>11.634**†</td>
<td>0.410</td>
</tr>
<tr>
<td>Learning Structure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doing homework more than 2 times a week</td>
<td>1.117**†</td>
<td>0.360</td>
</tr>
<tr>
<td>Place set aside for homework</td>
<td>-1.139</td>
<td>0.629</td>
</tr>
<tr>
<td>Time for homework per day</td>
<td>-0.009†</td>
<td>0.004</td>
</tr>
<tr>
<td>Frequency of reading books – Infrequent</td>
<td>-1.519**†</td>
<td>0.153</td>
</tr>
<tr>
<td>Frequency of reading books – Every day</td>
<td>0.959**†</td>
<td>0.136</td>
</tr>
<tr>
<td>Home computer use 3 times a week or more</td>
<td>0.529**†</td>
<td>0.153</td>
</tr>
<tr>
<td>Resource Availability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home computer for child use</td>
<td>0.326</td>
<td>0.196</td>
</tr>
<tr>
<td>Home Internet access</td>
<td>2.479**†</td>
<td>0.320</td>
</tr>
<tr>
<td>Number of books child has at home</td>
<td>0.004**†</td>
<td>0.001</td>
</tr>
<tr>
<td>Family resources</td>
<td>0.893**†</td>
<td>0.145</td>
</tr>
<tr>
<td>Community library card for child</td>
<td>1.103**†</td>
<td>0.254</td>
</tr>
<tr>
<td>Home Affective Environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Having warm, close times with child</td>
<td>-0.388</td>
<td>0.303</td>
</tr>
<tr>
<td>Child likes parents</td>
<td>0.077</td>
<td>0.338</td>
</tr>
<tr>
<td>Sacrifice to meet child’s needs</td>
<td>-1.618**†</td>
<td>0.375</td>
</tr>
<tr>
<td>Parents feeling child harder to care</td>
<td>-3.794**†</td>
<td>1.329</td>
</tr>
<tr>
<td>Parent-child interactions</td>
<td>0.280</td>
<td>0.161</td>
</tr>
<tr>
<td>Talk with child about school every day</td>
<td>-1.613**†</td>
<td>0.294</td>
</tr>
<tr>
<td>Parenting and Disciplinary Practices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disciplinary methods</td>
<td>0.132</td>
<td>0.075</td>
</tr>
<tr>
<td>Frequency of spanking in a week</td>
<td>-0.788**†</td>
<td>0.194</td>
</tr>
<tr>
<td>Number of family rules on TV viewing</td>
<td>-0.002</td>
<td>0.085</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekday</td>
<td>-0.150†</td>
<td>0.061</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekend</td>
<td>0.052*</td>
<td>0.025</td>
</tr>
<tr>
<td>Parental Involvement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School Factors</td>
<td>Estimate</td>
<td>SE</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>----------</td>
<td>-----</td>
</tr>
<tr>
<td>Contact with parents of child’s peers</td>
<td>0.068**</td>
<td>0.021</td>
</tr>
<tr>
<td>Frequency of help with math homework</td>
<td>-5.722**</td>
<td>0.223</td>
</tr>
<tr>
<td>Frequency of talking about nature/science</td>
<td>-0.014</td>
<td>0.236</td>
</tr>
<tr>
<td>Frequency of playing games/puzzles</td>
<td>0.786**</td>
<td>0.230</td>
</tr>
<tr>
<td>Frequency of playing sports or exercising</td>
<td>-1.455**</td>
<td>0.225</td>
</tr>
<tr>
<td>Frequency of involving child in chores</td>
<td>-0.481</td>
<td>0.330</td>
</tr>
<tr>
<td>Involvement in artistic/cultural activities</td>
<td>0.653**</td>
<td>0.072</td>
</tr>
<tr>
<td>Library visit with child in last month</td>
<td>-0.221</td>
<td>0.141</td>
</tr>
<tr>
<td>Percent eligible</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>-8.601**</td>
<td>0.461</td>
</tr>
<tr>
<td>Hispanic</td>
<td>-3.163**</td>
<td>0.405</td>
</tr>
<tr>
<td>Frequency of involving child in chores</td>
<td>-3.715**</td>
<td>0.529</td>
</tr>
<tr>
<td>Single-parent household</td>
<td>-0.657**</td>
<td>0.240</td>
</tr>
<tr>
<td>Other race</td>
<td>-3.715**</td>
<td>0.529</td>
</tr>
<tr>
<td>SES</td>
<td>5.492**</td>
<td>0.148</td>
</tr>
<tr>
<td>Number of siblings</td>
<td>-2.553**</td>
<td>0.708</td>
</tr>
<tr>
<td>Child Characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>-2.051**</td>
<td>0.222</td>
</tr>
<tr>
<td>Age at assessment</td>
<td>3.567**</td>
<td>0.027</td>
</tr>
<tr>
<td>Age at assessment squared</td>
<td>-0.011**</td>
<td>0.001</td>
</tr>
<tr>
<td>Speak non-English at home</td>
<td>-1.486**</td>
<td>0.445</td>
</tr>
<tr>
<td>Dismissed</td>
<td>-0.548</td>
<td>0.293</td>
</tr>
<tr>
<td>Disability</td>
<td>-3.482**</td>
<td>0.185</td>
</tr>
<tr>
<td>Number of siblings</td>
<td>-0.660**</td>
<td>0.092</td>
</tr>
<tr>
<td>School Factors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public</td>
<td>-0.559</td>
<td>0.358</td>
</tr>
<tr>
<td>50 percent or more being minority</td>
<td>-0.056</td>
<td>0.319</td>
</tr>
<tr>
<td>10 percent or more with reduced-price lunch</td>
<td>-0.079</td>
<td>0.216</td>
</tr>
<tr>
<td>Percent students eligible for free lunch</td>
<td>-0.039**</td>
<td>0.005</td>
</tr>
<tr>
<td>Central city</td>
<td>0.225</td>
<td>0.312</td>
</tr>
<tr>
<td>Rural and small town</td>
<td>-3.182**</td>
<td>0.371</td>
</tr>
<tr>
<td>Class size</td>
<td>0.122**</td>
<td>0.020</td>
</tr>
<tr>
<td>Teacher experience (in years)</td>
<td>-0.017**</td>
<td>0.008</td>
</tr>
<tr>
<td>Intercept</td>
<td>-167.793**</td>
<td>1.322</td>
</tr>
</tbody>
</table>

Interaction Models: Black Vs. Non-Black

Table 1.18 presents results of the interaction models that included interaction terms between a dummy for black versus non-black and family process variables that had statistically significant coefficients in the family process models. Only
family process variables and interaction terms are shown in the table (see Appendix 1.I for the complete results including family status variables, child characteristics, school factors, and random effect terms). Several family process variables appeared to be statistically significant for both main effects terms and interaction terms, indicating that black children had different returns to these family process inputs as compared to their non-black peers. In terms of both reading and mathematics achievement, blacks appeared to have significantly lower returns to certain family process variables including ownership of a home computer, number of books available for child use at home, and involvement in artistic or cultural activities outside of school. For reading achievement only, blacks had lower returns to such family process inputs reading books more frequently, using home computers more frequently, and more disciplinary methods. For mathematics achievement, blacks had lower returns to inputs including parents’ belief about child’s mathematics performance, parents’ sentiment of feeling to have given up more of life to meet child’s needs than ever expected, and regular communication with parents whose children are in the same class. However, black children appeared to have higher returns to child’s ownership of a community library card than their non-black peers for both reading and mathematics achievement.

While many of these interaction terms were statistically significant, the magnitude of the coefficients was relatively small. Among variables that were statistically significant for both main effects terms and interaction terms, four variables had average or above average effect sizes for interaction terms. Specifically, the effect size for the interaction term between the dummy of black versus non-black and ownership of home computers was -0.3 for mathematics achievement, indicating that for mathematics achievement black children had a return to ownership of home computers 0.3 SD lower than their non-black peers. The effect size for the interaction term of parental belief about their child’s performance in mathematics was -0.3 for mathematics achievement, indicating that for mathematics achievement black children had a return to parental belief about their child’s performance in mathematics 0.3 SD lower than non-black children. The effect size for the interaction term of child’s ownership of a community library card was 0.22 for mathematics achievement, indicating that for mathematics achievement black children had a return to child’s ownership of a community library card 0.22 SD higher than non-black children. The effect size for the interaction term of parents’ sentiment of feeling to have given up more of life to meet child’s needs than ever expected was -0.29 for reading achievement and -0.33 for mathematics achievement.
Table 1.18. Coefficients of Interaction Models: Black Vs. Non-Black

<table>
<thead>
<tr>
<th>Variable</th>
<th>Reading</th>
<th>Mathematics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate S.E. Effect Size</td>
<td>Estimate S.E. Effect Size</td>
</tr>
<tr>
<td>Parental Expectations and Beliefs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree expected</td>
<td>3.466**† 0.246 0.280</td>
<td>2.787**† 0.189 0.297</td>
</tr>
<tr>
<td>Belief in reading performance</td>
<td>12.992**† 0.433 1.050</td>
<td></td>
</tr>
<tr>
<td>Belief in math performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning Structure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doing homework more than 2 times a week</td>
<td>1.565**† 0.420 0.126</td>
<td>0.931† 0.374 0.099</td>
</tr>
<tr>
<td>Place set aside for homework</td>
<td>-1.350 0.724 -0.109 -1.243* 0.631 -0.132</td>
<td></td>
</tr>
<tr>
<td>Time for homework per day</td>
<td>-0.012**† 0.004 -0.001 -0.012**† 0.004 -0.001</td>
<td></td>
</tr>
<tr>
<td>Frequency of reading books – Infrequent</td>
<td>-2.441**† 0.209 -0.197</td>
<td>-1.504**† 0.161 -0.160</td>
</tr>
<tr>
<td>Frequency of reading books – Every day</td>
<td>2.584**† 0.184 0.209</td>
<td>1.005**† 0.143 0.107</td>
</tr>
<tr>
<td>Home computer use 3 times a week or more</td>
<td>1.196**† 0.199 0.097</td>
<td>0.636**† 0.158 0.068</td>
</tr>
<tr>
<td>Resource Availability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home computer for child use</td>
<td>1.208**† 0.267 0.098</td>
<td>0.828**† 0.208 0.088</td>
</tr>
<tr>
<td>Home Internet access</td>
<td>2.797**† 0.398 0.226</td>
<td>2.844**† 0.349 0.303</td>
</tr>
<tr>
<td>Number of books child has at home</td>
<td>0.006**† 0.001 0.0005</td>
<td>0.004**† 0.001 0.0004</td>
</tr>
<tr>
<td>Family resources</td>
<td>1.056**† 0.180 0.085</td>
<td>1.063**† 0.153 0.113</td>
</tr>
<tr>
<td>Community library card for child</td>
<td>0.949**† 0.318 0.077</td>
<td>0.965**† 0.268 0.103</td>
</tr>
<tr>
<td>Home Affective Environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Having warm, close times with child</td>
<td>-0.627 0.345 -0.051 -0.406 0.305 -0.043</td>
<td></td>
</tr>
<tr>
<td>Child likes parents</td>
<td>0.196 0.391 0.016 0.004 0.340 0.0004</td>
<td></td>
</tr>
<tr>
<td>Sacrifice to meet child’s needs</td>
<td>-0.670 0.482 -0.054 -1.048† 0.411 -0.112</td>
<td></td>
</tr>
<tr>
<td>Parents feeling child harder to care</td>
<td>-4.920**† 1.486 -0.398 -4.083**† 1.351 -0.434</td>
<td></td>
</tr>
<tr>
<td>Parent-child interactions</td>
<td>0.584**† 0.204 0.047</td>
<td>0.360* 0.175 0.038</td>
</tr>
<tr>
<td>Talk with child about school every day</td>
<td>-0.849**† 0.359 -0.069</td>
<td>-1.702**† 0.315 -0.181</td>
</tr>
<tr>
<td>Parenting and Disciplinary Practices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disciplinary methods</td>
<td>0.249**† 0.092 0.020</td>
<td>0.127 0.081 0.013</td>
</tr>
<tr>
<td>Frequency of spanking in a week</td>
<td>-0.066 0.246 -0.005 -0.402 0.213 -0.043</td>
<td></td>
</tr>
<tr>
<td>Number of family rules on TV viewing</td>
<td>0.152 0.107 0.012 0.0002 0.085 0.00003</td>
<td></td>
</tr>
<tr>
<td>Hours of TV viewing on a weekday</td>
<td>0.025 0.085 0.002 -0.070 0.067 -0.007</td>
<td></td>
</tr>
<tr>
<td>Hours of TV viewing on a weekend</td>
<td>0.036 0.036 0.003 0.028 0.028 0.003</td>
<td></td>
</tr>
<tr>
<td>Parental Involvement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental involvement in school events</td>
<td>0.227**† 0.076 0.018</td>
<td>0.245**† 0.062 0.026</td>
</tr>
<tr>
<td>Contact with parents of child’s peers</td>
<td>0.106**† 0.027 0.009</td>
<td>0.070**† 0.021 0.007</td>
</tr>
<tr>
<td>Frequency of help with reading homework</td>
<td>-6.219**† 0.275 -0.503</td>
<td></td>
</tr>
<tr>
<td>Frequency of help with math homework</td>
<td></td>
<td>-5.739**† 0.236 -0.611</td>
</tr>
<tr>
<td>Frequency of talking about nature/science</td>
<td>0.627**† 0.283 0.051</td>
<td>-0.049 0.248 -0.005</td>
</tr>
<tr>
<td>Frequency of playing games/puzzles</td>
<td>0.221 0.274 0.018 0.800**† 0.242 0.085</td>
<td></td>
</tr>
<tr>
<td>Frequency of playing sports or exercising</td>
<td>-2.167**† 0.273 -0.175 -1.460**† 0.236 -0.155</td>
<td></td>
</tr>
<tr>
<td>Frequency of involving child in chores</td>
<td>-1.486**† 0.393 -0.120</td>
<td>-0.422 0.341 -0.045</td>
</tr>
<tr>
<td>Involvement in artistic/cultural activities</td>
<td>1.107**† 0.096 0.089</td>
<td>0.794**† 0.075 0.084</td>
</tr>
<tr>
<td>Library visit with child in last month</td>
<td>0.161 0.177 0.013 -0.169 0.141 -0.018</td>
<td></td>
</tr>
<tr>
<td>Interaction Terms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black*Degree expected</td>
<td>1.138 0.705 0.092 0.725 0.545 0.077</td>
<td></td>
</tr>
</tbody>
</table>

37
Table 1.19 provides results of the interaction models that included interaction terms between SES and family process variables that had statistically significant coefficients in family process models. Only family process variables and interaction terms are shown in the table (see Appendix 1.1 for the complete results including family status variables, child characteristics, school factors, and random effect terms). A number of family process variables appeared to be statistically significant for both main effects terms and interaction terms, indicating that children from different socio-economic background tended to have different returns to certain family process inputs. For both reading and mathematics achievement, children with low SES appeared to have significantly higher returns to several family process variables including frequency of doing homework, amount of time spent on homework, home Internet access,
community library card for child use, and frequent talk with child about school, but lower returns to other family process variables including frequency of reading books, ownership of a home computer, parental involvement in school events, and involvement in artistic or cultural activities outside of school. For reading achievement only, children with low SES tended to have higher returns to such variables as more family resources, more frequent help with reading homework, and more involvement of child in household chores than their peers with high SES. For mathematics achievement, children with low SES had lower returns to variables including parents’ belief about their child’s mathematics performance being at least as good as other children and less frequent spanking of child. While most of these statistically significant interaction terms showed small effect sizes (i.e., less than or equal to 0.2 SD in absolute value), one variable showed average effect size for the interaction term. Specifically, the effect size for the interaction term between SES and home Internet access was -0.201 for reading achievement, indicating that for reading achievement children from low SES families had a return to home Internet access 0.201 SD higher than their peers from high SES families.

Table 1.19. Coefficients of Interaction Models: SES

<table>
<thead>
<tr>
<th>Variable</th>
<th>Reading Effect Size</th>
<th>Mathematics Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate S.E.</td>
<td>Estimate S.E.</td>
</tr>
<tr>
<td>Parental Expectations and Beliefs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree expected</td>
<td>3.822**† 0.250 0.309</td>
<td>2.949**† 0.194 0.314</td>
</tr>
<tr>
<td>Belief in reading performance</td>
<td>12.994**† 0.421 1.050</td>
<td>11.609**† 0.413 1.235</td>
</tr>
<tr>
<td>Belief in math performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning Structure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doing homework more than 2 times a week</td>
<td>1.721**† 0.405 0.139</td>
<td>1.107**† 0.361 0.118</td>
</tr>
<tr>
<td>Place set aside for homework</td>
<td>-1.307 0.722 -0.106</td>
<td>-1.238* 0.630 -0.132</td>
</tr>
<tr>
<td>Time for homework per day</td>
<td>-0.008* 0.004 -0.001</td>
<td>-0.009† 0.004 -0.001</td>
</tr>
<tr>
<td>Frequency of reading books – Infrequent</td>
<td>-2.581**† 0.199 -0.209</td>
<td>-1.545**† 0.153 -0.164</td>
</tr>
<tr>
<td>Frequency of reading books – Every day</td>
<td>2.211**† 0.178 0.179</td>
<td>0.915**† 0.138 0.097</td>
</tr>
<tr>
<td>Home computer use 3 times a week or more</td>
<td>1.082**† 0.204 0.087</td>
<td>0.543**† 0.162 0.058</td>
</tr>
<tr>
<td>Resource Availability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home computer for child use</td>
<td>1.321**† 0.263 0.107</td>
<td>0.747**† 0.204 0.079</td>
</tr>
<tr>
<td>Home Internet access</td>
<td>1.813**† 0.416 0.147</td>
<td>2.278**† 0.364 0.242</td>
</tr>
<tr>
<td>Number of books child has at home</td>
<td>0.005**† 0.001 0.0004</td>
<td>0.003**† 0.001 0.0004</td>
</tr>
<tr>
<td>Family resources</td>
<td>0.887**† 0.175 0.072</td>
<td>0.952**† 0.150 0.101</td>
</tr>
<tr>
<td>Community library card for child</td>
<td>1.119**† 0.301 0.090</td>
<td>1.110**† 0.255 0.118</td>
</tr>
<tr>
<td>Home Affective Environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Having warm, close times with child</td>
<td>-0.562 0.344 -0.045</td>
<td>-0.383 0.304 -0.041</td>
</tr>
<tr>
<td>Child likes parents</td>
<td>0.291 0.391 0.024</td>
<td>0.055 0.339 0.006</td>
</tr>
<tr>
<td>Sacrifice to meet child’s needs</td>
<td>-1.226**† 0.438 -0.099</td>
<td>-1.513**† 0.377 -0.161</td>
</tr>
<tr>
<td>Parents feeling child harder to care</td>
<td>-5.095**† 1.397 -0.412</td>
<td>-4.116**† 1.332 -0.438</td>
</tr>
<tr>
<td>Parent-child interactions</td>
<td>0.267</td>
<td>0.195</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>Talk with child about school every day</td>
<td>-0.762*+</td>
<td>0.339</td>
</tr>
</tbody>
</table>

### Parenting and Disciplinary Practices

<table>
<thead>
<tr>
<th>Disciplinary methods</th>
<th>0.171*</th>
<th>0.086</th>
<th>0.014</th>
<th>0.120</th>
<th>0.075</th>
<th>0.013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of spanking in a week</td>
<td>-0.159</td>
<td>0.223</td>
<td>-0.013</td>
<td>-0.581**+</td>
<td>0.195</td>
<td>-0.062</td>
</tr>
<tr>
<td>Number of family rules on TV viewing</td>
<td>0.156</td>
<td>0.107</td>
<td>0.013</td>
<td>0.008</td>
<td>0.085</td>
<td>0.001</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekday</td>
<td>-0.071</td>
<td>0.079</td>
<td>-0.006</td>
<td>-0.132*</td>
<td>0.062</td>
<td>-0.014</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekend</td>
<td>0.070*</td>
<td>0.033</td>
<td>0.006</td>
<td>0.046</td>
<td>0.026</td>
<td>0.005</td>
</tr>
</tbody>
</table>

### Parental Involvement

| Parental involvement in school events | 0.215**+ | 0.072 | 0.017 | 0.219**+ | 0.058 | 0.023 |
| Contact with parents of child’s peers | 0.098**+ | 0.027 | 0.008 | 0.069**+ | 0.022 | 0.007 |
| Frequency of help with reading homework | -5.994**+ | 0.265 | -0.484 | |
| Frequency of help with math homework | -5.690**+ | 0.226 | -0.606 | |
| Frequency of talking about nature/science | 0.514 | 0.277 | 0.042 | 0.039 | 0.240 | 0.004 |
| Frequency of playing games/puzzles | 0.264 | 0.263 | 0.021 | 0.854**+ | 0.232 | 0.091 |
| Frequency of playing sports or exercising | -2.226**+ | 0.262 | -0.180 | -1.538**+ | 0.227 | -0.164 |
| Frequency of involving child in chores | -1.505**+ | 0.377 | -0.122 | -0.429 | 0.331 | -0.046 |
| Involvement in artistic/cultural activities | 0.734**+ | 0.096 | 0.059 | 0.521**+ | 0.075 | 0.055 |
| Library visit with child in last month | 0.203 | 0.177 | 0.016 | -0.141 | 0.141 | -0.015 |

### Interaction Terms

| SES*Degree expected | 0.196 | 0.342 | 0.016 | -0.037 | 0.270 | -0.004 |
| SES*Belief in reading performance | 0.411 | 0.521 | 0.033 | |
| SES*Belief in math performance | 1.459**+ | 0.485 | 0.155 | |
| SES*Doing homework > 2 times a week | -1.827**+ | 0.475 | -0.148 | -1.357**+ | 0.399 | -0.144 |
| SES*Time for homework per day | -0.009* | 0.005 | -0.001 | -0.015**+ | 0.004 | -0.002 |
| SES*Reading books – Infrequent | -0.518* | 0.251 | -0.042 | -0.448**+ | 0.194 | -0.048 |
| SES*Reading books – Every day | 1.484**+ | 0.218 | 0.120 | 0.524**+ | 0.169 | 0.056 |
| SES*Home computer use ≥ 3 times a week | 0.044 | 0.254 | 0.004 | 0.050 | 0.201 | 0.005 |
| SES*Home computer for child use | 2.070**+ | 0.354 | 0.167 | 1.744**+ | 0.279 | 0.186 |
| SES*Home Internet access | -2.489**+ | 0.491 | -0.201 | -1.457**+ | 0.405 | -0.155 |
| SES*Number of books child has at home | 0.0003 | 0.001 | 0.00002 | 0.0002 | 0.001 | 0.00002 |
| SES*Family resources | -0.667**+ | 0.197 | -0.054 | -0.212 | 0.166 | -0.023 |
| SES*Community library card for child | -1.382**+ | 0.331 | -0.112 | -1.207**+ | 0.279 | -0.128 |
| SES*Sacrifice to meet child’s needs | 0.382 | 0.474 | 0.031 | 0.279 | 0.409 | 0.030 |
| SES*Parents feeling child harder to care | -0.524 | 1.608 | -0.042 | -2.310 | 1.422 | -0.246 |
| SES*Parent-child interactions | -0.636**+ | 0.209 | -0.051 | -0.349* | 0.177 | -0.037 |
| SES*Talk with child about school every day | -1.065**+ | 0.399 | -0.086 | -0.839**+ | 0.334 | -0.089 |
| SES*Disciplinary methods | -0.104 | 0.099 | -0.008 | 0.058 | 0.084 | 0.006 |
| SES*Frequency of spanking in a week | 1.069**+ | 0.241 | 0.086 | 0.946**+ | 0.204 | 0.101 |
| SES*Hours of TV viewing on a weekday | -0.014 | 0.101 | -0.001 | 0.147 | 0.078 | 0.016 |
| SES*Hours of TV viewing on a weekend | -0.047 | 0.042 | -0.004 | -0.064* | 0.033 | -0.007 |
| SES*Parental involvement in school events | 0.362**+ | 0.087 | 0.029 | 0.332**+ | 0.069 | 0.035 |
| SES*Contact with parents of child’s peers | -0.009 | 0.030 | -0.001 | -0.041 | 0.024 | -0.004 |
| SES*Frequent help with reading homework | -0.711**+ | 0.302 | -0.057 | |
| SES*Frequent help with math homework | -0.021 | 0.254 | -0.002 | |
| SES*Frequency of talking about nature/science | -0.010 | 0.320 | -0.001 | -0.465 | 0.272 | -0.049 |
| SES*Frequency of playing games/puzzles | 0.707**+ | 0.303 | 0.057 | -0.121 | 0.259 | -0.013 |
Discussion

Previous research on the academic effects of family process factors has shown inconsistent results. The effects vary depending on the type of factors being examined. This chapter analyzes a comprehensive list of family factors using a nationally representative sample of young children who progressed from kindergarten through fifth grade. Results support the notion that family process factors are important predictors of student achievement. Family process variables explained 21 percent of the between-child variation in reading scores and 18 percent of the between-child variation in mathematics scores. The inclusion of the family process variables in the regression models resulted in smaller coefficients of family status variables (in absolute value), suggesting that family process variables collectively explain a good portion of the achievement gaps by race, SES, and family structure. Moreover, the negative association between the single-parent household and student achievement was no longer significant after controlling for family process variables. This result somewhat mirrors the findings in previous literature that family structure (single-parent versus two-parent families) was statistically insignificant after controlling for other family factors such as income, mother’s characteristics, and family resources (Grissmer et al., 1994). Despite the sharp decrease in magnitude, most of these family status variables were still statistically significant and had larger effect sizes than many family process variables.

Student achievement was found to be positively associated with a number of family process variables including high parental expectations and beliefs; higher frequency of doing homework, reading books, and using home computers; access to more resources such as books, newspapers, magazines, dictionaries, encyclopedia, pocket calculators, home Internet availability, and child’s own community library card; fewer negative sentiments from parents towards children and child-rearing; and parental involvement in school events, regular communication with parents of child’s peers, and involvement in artistic or cultural activities outside of school. Consistent with previous literature, student achievement was shown to be negatively associated with frequent help with homework (Milne et al., 1986; Shumow and Miller, 2001; Henderson and Mapp,
2002). In addition, achievement was also found to be negatively related with frequent involvement of children in sports-related activities.

Although statistically significant, many of these family process variables had small effect sizes, suggesting a lack of practical importance in their influence over student achievement. However, several variables showed average or above average effect sizes. They include parental expectations about their child’s educational attainment, parental beliefs about their child’s academic performance, home Internet access, parents’ feeling of their child hard to care, and frequent help with homework. These variables were shown to have both statistical and substantive importance in their relationship with student achievement.

Interestingly, results from variables measuring television viewing practices revealed a positive relationship between longer hours of television viewing during weekends and higher achievement in both reading and mathematics, but a negative relationship between hours of television viewing during weekdays and achievement in mathematics. This finding suggests the possibility that the impact of television viewing on student achievement may largely depend on the actual viewing practices such as the content of the television programs and whether or not television viewing crowds out other activities. However, further research in this area is beyond the scope of this study.

Results of the interaction models revealed that in terms of student achievement in reading and mathematics, black children, compared with their non-black peers, had lower returns to a number of family process factors (such as ownership of home computers, number of books available for child use at home, and involvement in artistic or cultural activities). Only child’s ownership of a community library card appeared to have a higher return for blacks than for their non-black peers. Children with low SES background tended to have higher returns to such factors as doing homework more frequently, home Internet access, and child’s ownership of a community library card. While effect sizes for most of these interaction terms were small, two variables showed average effect sizes (i.e., between 0.2 and 0.3 SD in absolute value). They are the interaction term between the dummy of black versus non-black and child’s ownership of a community library card for mathematics achievement and the interaction term between SES and home Internet access for reading achievement.

Taken together, findings of this chapter suggest that family process factors can have significant impacts on student achievement even after controlling for
demographics and school inputs. Furthermore, certain family process variables can have higher returns to achievement for black children or children from low SES families. As family process factors are alterable features defined as the specific things that families do, they can be influenced through programs designed to increase parental awareness of the importance of education, to improve parenting skills, and to help low-income families gain access to home and community resources for educational purposes, among other things. In the quest for improving children’s academic outcomes, policymakers may consider investing in family process factors as one possible alternative to the popular approach of increasing school and teacher effectiveness.

Indeed, previous studies have demonstrated the effectiveness of intervention programs targeted at parents of young children to alter parental behaviors (Brooks-Gunn and Markman, 2005; Love et al., 2002; Olds et al., 1999; Reynolds, 1994; Sweet and Appelbaum, 2004). Some intervention programs (such as center-based programs with a parenting component) appear to be effective in enhancing parenting skills as well as children’s cognitive outcomes, with evidence indicating that some of the program effects on children being mediated through effects on parents (Brooks-Gunn and Markman, 2005; Love et al., 2002; Reynolds, 1994).24 While most of these programs are typically designed for at-risk children in their early years, future programs may consider targeting school-age children and expanding services from focusing on the development of parenting skills to improving the full range of family process factors.

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24 In contrast, other interventions (such as home-visiting programs), despite the effectiveness in changing parenting styles, generally lack evidence showing positive effects on children’s academic outcomes due to variations in program quality such as service intensity and delivery (Brooks-Gunn and Markman, 2005; Olds et al., 1999; Sweet and Appelbaum, 2004).
CHAPTER 2. FAMILY FACTORS AND NONACADEMIC OUTCOMES: 
THE CASE OF U.S.

It has been widely recognized that the development of nonacademic skills is important to the success of school life for young children. National Education Goals Panel, for example, identified five dimensions of nonacademic skills including physical well-being and motor development, social and emotional development, approaches to learning, language development, and cognition and general knowledge as indicators of children ready for school (Kagan, Moore, and Bredekamp, 1995; Le et al., 2006; Pianta, 2002). While some researchers have suggested that the family characteristics are as the dominant forces in shaping the development of children’s nonacademic skills (Feinstein, 2000; Heckman, Stixrud, and Orzua, 2006), less is known about the extent to which different family factors influence nonacademic outcomes.

This chapter distinguishes family status factors (such as race and SES) from family process factors (including parental expectations and beliefs, learning structure, resource availability, home affective environment, parenting and disciplinary practices, and parental involvement), and examines their relationships with nonacademic outcomes among young children using a national longitudinal dataset. It extends previous literature by analyzing a comprehensive set of family process variables and examining whether their relationships with nonacademic outcomes differ by race and SES. Specifically, this chapter addresses the following research questions:

1. What is the relationship between family process factors and nonacademic outcomes, after controlling for student and school characteristics?
2. How does the relationship between family process factors and nonacademic outcomes differ by family status (specifically, race and SES)?

This chapter is organized as follows: It begins with a literature review that examines the family impacts on nonacademic outcomes. It then presents details of the data and methodology, including a description of the sample and weights, measures of nonacademic outcomes, family factors, and school characteristics used in the study, imputation procedure, and regression models. It concludes with findings and discussion on policy implications.

Previous Literature on Family Factors and Nonacademic Outcomes
Recent theories underscore the importance of family factors in influencing the development of nonacademic skills and educational success. Home environment, together with school, are recognized as two of the most influential systems for young children in particular (Bronfenbrenner, 1986, 1994, 1999; Christenson, 2000; Fantuzzo et al., 2002; Grusec and Goodnow, 1994; Hart et al., 1997; McWayne et al., 2004; Wentzel, 1999). Researchers posit that through ongoing interactions among family members, parents socialize children in a way that promotes internalization of specific social and educational goals. This socialization experience fostered in the context of the family provides children with structure and behavioral expectations that serve as the foundation for the development of social functioning and success in school (Fantuzzo et al., 2002; Hart et al., 1997; Wentzel, 1999; McWayne et al., 2004; Wentzel, 1999). By engaging in educational activities with their children at home, parents communicate expectations for achievement, integrate school curriculum goals at home, and promote children’s motivation and interest in learning (Christenson and Sheridan, 2001; McWayne et al., 2004). By participating in school activities, parents establish relationships with teachers, school administrators, and other parents, and learn about school policies and behavioral expectations, which can increase parents’ ability to shape their children’s school behavior (Epstein, 1987; Epstein and Sanders, 2002; Hill et al., 2004; Yonezawa, 2000).

Indeed, significant relationships between specific family process factors and specific nonacademic outcomes for a variety of student populations have been documented. For preschool children, research on school readiness suggests that family process factors are one of the dominant contributing forces of children’s nonacademic skill development (Connell and Prinz, 2002; Estrada et al., 1987; Feistein, 2000; Le et al., 2006; Pianta, Nimetz, and Bennett, 1997; Pianta, Smith, and Reeve, 1991). In general, greater parental involvement was found to positively affect school readiness and adaptation to elementary school (Parker, Boak, et al., 1999; Parker, Piotrkowski, et al., 1997; Petrie and Davidson, 1995; Reynolds et al., 1996). Parent-child interactions characterized by more positive emotions, reduced criticism, and a less controlling or directive approach were associated with higher ratings of school readiness indicators at school entry (Connell and Prinz, 2002; Estrada et al., 1987; Pianta, Nimetz, and Bennett, 1997; Pianta, Smith, and Reeve, 1991). Connell and Prinz (2002) examined the role of parent-child interaction quality on the development of school readiness and social skills among 47 low-income, African American children in kindergarten, and found that “parent-child interactions characterized as structured and responsive to the child’s needs and emotions were positively related to school
readiness, social skills, and receptive communication skills development after accounting for demographic characteristics and childcare exposures” (p. 177).

A growing body of literature evaluating the school readiness of children enrolled in Head Start provides evidence of links between family process factors and nonacademic outcomes for disadvantaged children. In general, nonacademic skills of Head Start children were found to be influenced by parental beliefs and expectations, parental involvement, parent-child interactions and home learning environment (Fantuzzo et al., 2002; Galper, Wigfield, and Seefeldt, 1997; Mantzicopoulos, 1997; Parker, Boak, et al., 1999; Parker, Piotrkowski, et al., 1997; Taylor and Machida, 1994). Galper, Wigfield, and Seefeldt (1997) examined achievement and attitudes of 155 kindergarten children who participated in Head Start program as well as their parents’ beliefs and expectations, and found that parents’ beliefs about how well their children were doing were related to children’s own beliefs and attitudes toward school. Moreover, parental involvement in school and home-based learning activities were found to be positively related to classroom behavior, school adjustment, children’s self-efficacy, and children’s general level of compliance with adults in the home and neighborhood setting (Fantuzzo et al., 2002; Mantzicopoulos, 1997; Parker, Piotrkowski, et al., 1997; Taylor and Machida, 1994). Parker, Boak, et al. (1999) examined the associations between the parent-child relationship, home learning environment, and school readiness (i.e., cognitive development, behavioral development, and adaption to the classroom) among Head Start children, and found that changes in the parent-child relationship and home learning environment were related to improvements in several behavioral outcomes such as independence, creativity, and curiosity. On the other hand, “increased parental aggravation and strictness over time had a negative impact on a child’s distractibility and hostility in the classroom and predicted a decrease in associative vocabulary skills” (Parker, Boak, et al., 1999, p. 413). Using a sample of 526 preschool children enrolled in a large urban Head Start program, Fantuzzo et al. (2002) found that a supportive home-learning environment was significantly associated with children’s interactive play with peers and parents’ direct contact with school was related to lower levels of disruptive peer-play behaviors among children.

For elementary school children, parental beliefs about children’s competence were found to affect children’s beliefs about their own competence (Alexander and Entwisle, 1988; Galper, Wigfield, and Seefeldt, 1997; Wigfield et al., 1997), and parental expectations impacted children’s expectations for their own performance and children’s interest and motivation in school and learning
activities (Alexander and Entwisle, 1988; Galper, Wigfield, and Seefeldt, 1997; McWayne et al., 2004; Morrow and Young, 1997; Wigfield et al., 1997). Moreover, the quality of parent-child relationships was found to be positively correlated with school behaviors such as work habits and tolerance of frustration (Hill, 2001; Pianta, Nimetz, and Bennett, 1997; Taylor, Hinton, and Wilson, 1995). McWayne et al. (2004) reported that certain types of parental involvement, including actively promoting learning at home, having direct and regular contact with school, participating in their children’s school functions, regular monitoring of their children’s progress, and experiencing fewer barriers to involvement, were associated with better social skills, higher levels of self-regulation, and positive engagement with peers and adults among low-income minority kindergarten children. Le et al. (2006) examined a national representative sample of 7,874 children from kindergarten through fifth grade and found that positive home background factors, such as more parental involvement in school, were positively related to children’s attitudes toward learning, self-control, and interpersonal skills, and negatively predictive of internalizing and externalizing problem behaviors.

Similar associations between family process factors and nonacademic outcomes were documented for adolescents as well. Parsons, Adler, and Kaczala (1982) examined a sample of fifth- through eleventh-grade students and found that parental beliefs about their children’s mathematics ability had a strong influence on children’s own mathematics ability beliefs. Hill et al. (2004) reported that parental involvement in educational activities during the seventh grade was correlated with fewer behavioral problems in the eighth grade. Using a nationally representative data of eighth graders, McNeal (1999) examined the relationship between student behaviors (i.e., truancy and dropping out of school) and several family process factors, including parent-child discussion, involvement in parent-teacher organizations, and parental monitoring. The author found that involvement in parent-teacher organizations and parental monitoring were associated with lower rates of truancy and dropping out of school, and that parent-child discussion was associated with less truant behavior. Similarly, increased communication between home and school was found to be associated with fewer disruptive behaviors, more on-task behavior, and improved school behavior by increasing the clarity of rules and reinforcement of appropriate school behavior at home (Gottfredson, Gottfredson, and Hybl, 1993; Hill et al., 2004; Leach and Tan, 1996).

Several studies have documented differences in family process factors among different racial/ethnic, income, and/or SES (Conger et al., 1994; Hill, 2001; Kohl et
al., 2000; Le et al., 2006; McLoyd, 1990; Reynolds et al., 1996; Rimm-Kaufman, Pianta, and Cox, 2000), but less is known about whether and how the effect of family process factors on nonacademic outcomes varies with these family status variables (i.e., race, income, and SES). One study (McNeal, 1999) that examined this differential effect using a national sample of eighth graders found greater influence of parental involvement on student behaviors for higher-SES and white students. Parent-child discussion was found to be significantly more effective in reducing truant behaviors for higher-SES students than for their lower-SES peers. Parental involvement in parent-teacher organizations was significantly more effective in reducing the likelihood of dropping out of school for higher-SES students. The beneficial effects of parent-child discussion on lower rates of truancy and dropping out of school were significant for white students, but insignificant for blacks, Hispanics, and Asians. These findings provide evidence for differential effects of family process factors on nonacademic outcomes across different SES and racial/ethnic groups.

Many studies have documented the linkage between nonacademic outcomes and family status factors including race/ethnicity, income, and SES. The school readiness literature has conclusively indicated the existence of gaps in nonacademic skills by race and income at school entry (Brooks-Gunn and Markman-Pithers, 2005; Cannon and Karoly, 2007; Magnuson and Waldfogel, 2005; Rimm-Kaufman, Pianta, and Cox, 2000). Heckman and his colleagues found significant gaps in nonacademic skills for children from different racial/ethnic and income groups as early as age four (Carneiro and Heckman, 2003; Carneiro, Cunha, and Heckman, 2003; Cunha et al., 2006; Heckman, Stixrud, and Urzua, 2006).

While the body of literature has consistently shown the links between family process factors and nonacademic outcomes across a variety of student populations, most of the studies suffered from methodological limitations, including small sample size, use of non-representative and/or cross-sectional data, and potential omitted variable bias. Moreover, most studies failed to take into account the multiple dimensions of family process factors, and examined only one or two family process factors in their analyses. Few studies assessed the effects of family status and family process factors in the same model, and none was found to examine the differences in relationship between family process factors and nonacademic outcomes by different racial and SES groups among young children.
This chapter extends previous literature by analyzing a comprehensive set of family process variables using a nationally representative data of children from kindergarten to fifth grade and examining whether their relationships with nonacademic outcomes differ by race and SES. A conceptual model, described in Chapter 1, underpins the analysis. The conceptual model specifies six types of family process factors (i.e., parental expectations and beliefs, learning structure, resource availability, home affective environment, parenting and disciplinary practices, and parental involvement), and hypothesizes their relationships with family status factors, school factors, and student outcomes.

Data

As in Chapter 1, this chapter analyzes data from the Early Childhood Longitudinal Study-Kindergarten Class of 1998-1999 (ECLS-K), a longitudinal study of a nationally representative sample of 21,260 students entering kindergarten in 1998-1999. Since the ECLS-K employed multistage probability sample design, weights are used throughout the analysis to account for stratification, over-sampling of certain population, and non-response adjustments. After excluding observations with zero weights, the resulting sample consists of 8,370 children, who represent approximately 3,836,496 children nationwide.

Measures

A variety of measures from the ECLS-K are used in the analysis. Independent variables including family process factors, family status factors, child characteristics, and school factors are measured by the same set of variables as in Chapter 1. The dependent variables, nonacademic outcomes, are measured

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25 See Chapter 1 for definitions.

26 This chapter uses the C1_6FP0 weight for interested readers familiar with the ECLS-K data. The C1_6FP0 weight is used for longitudinal analysis of the full sample of children up to fifth grade, and is defined to be nonzero with parent interview data present at each wave.

27 As explained in the next section, regression analysis in this chapter uses two waves of the data (i.e., fall of kindergarten, and spring of fifth grade), and time-varying independent variables (including family process factors, family status factors, child characteristics, and school factors) are based on measures taken at spring of fifth grade. However, analysis in Chapter 1 uses five waves of the data (i.e., fall of kindergarten, spring of kindergarten, spring of first grade, spring of third grade, and spring of fifth grade). It reports measures taken at fall of kindergarten in the main text and includes measures taken at the other four waves in appendices. In addition, multiple imputation procedures are conducted separately in the two papers because they have different dependent variables and utilize different waves of data. As a result, descriptive
using the teacher Social Rating Scale (SRS), which includes the following measures (Tourangeau et al., 2006, pp. 2–23):

- The approaches to learning scale measures behaviors that affect the ease with which children can benefit from the learning environment. It includes six items that rate the child’s attentiveness, task persistence, eagerness to learn, learning independence, flexibility, and organization.
- The four self-control items rate the child’s ability to control behavior by respecting the property rights of others, controlling their temper, accepting peer ideas for group activities, and responding appropriately to pressure from peers.
- The interpersonal skills scale has five items that indicate the child’s skill in forming and maintaining friendship; getting along with people who are different; comforting or helping other children; expressing feelings, ideas, and opinions in positive ways; and showing sensitivity to the feelings of others.
- The externalizing problem behaviors scale includes five acting out behavior items that rate the frequency with which a child argues, fights, gets angry, acts impulsively, and disturbs ongoing activities.
- The internalizing problem behavior scale measures the presence of anxiety, loneliness, low self-esteem, and sadness.

All five scales use a four-point metric with values ranging from one to four. Higher scores indicate children possessing or demonstrating more of those skills or traits: specifically, 1 = “never”; 2 = “sometimes”; 3 = “often”; and 4 = “very often”. Therefore, a higher rating for the first three scales (i.e., approaches to learning, self-control, and interpersonal skills) indicates a higher level of development in these nonacademic skills. In contrast, a higher score on the latter two scales (i.e., externalizing problem behaviors, and internalizing problem behavior) reflects more frequent behaviors that interfere with children’s learning and development process.

Each SRS scale comprises multiple items, and the student’s score on each scale is the mean rating of the items included in the scale. As a result, ratings of the five scales can take on non-integer values even though the items within each scale are rated on a discrete metric.
The teacher SRS scales were collected at five waves: fall of kindergarten, spring of kindergarten, spring of first grade, spring of third grade, and spring of fifth grade. Although items are largely the same across different waves, the teacher SRS scale is not comparable across years. Students were generally assigned to different teachers as they advanced in grade, and teachers may have different interpretations on the meaning of the items at different time points. Therefore, these scores cannot be used to derive change scores over years.

Descriptive Statistics

Table 2.1 presents descriptive statistics for the five teacher SRS scales at kindergarten entry and fifth grade. On average, children had relatively high levels of development in learning approaches, self-control, and interpersonal skills, and few internalizing and externalizing problem behaviors at both kindergarten entry and fifth grade. The table also presents the percentages of observations with minimum or maximum values for each nonacademic variable (i.e., the percentage of children who received a rating of 1 or 4 on the scale).

<table>
<thead>
<tr>
<th>SRS Scale Scores</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Min</th>
<th>Max</th>
<th>Percent at Min</th>
<th>Percent at Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approaches to Learning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall kindergarten</td>
<td>2.92</td>
<td>0.67</td>
<td>1</td>
<td>4</td>
<td>0.09</td>
<td>8.81</td>
</tr>
<tr>
<td>Spring 5th grade</td>
<td>3.02</td>
<td>0.68</td>
<td>1</td>
<td>4</td>
<td>0.14</td>
<td>10.05</td>
</tr>
<tr>
<td>Self-Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall kindergarten</td>
<td>3.09</td>
<td>0.62</td>
<td>1</td>
<td>4</td>
<td>0.13</td>
<td>11.46</td>
</tr>
<tr>
<td>Spring 5th grade</td>
<td>3.20</td>
<td>0.61</td>
<td>1</td>
<td>4</td>
<td>0.11</td>
<td>13.77</td>
</tr>
<tr>
<td>Interpersonal Skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall kindergarten</td>
<td>2.98</td>
<td>0.63</td>
<td>1</td>
<td>4</td>
<td>0.07</td>
<td>9.09</td>
</tr>
<tr>
<td>Spring 5th grade</td>
<td>3.04</td>
<td>0.65</td>
<td>1</td>
<td>4</td>
<td>0.05</td>
<td>9.98</td>
</tr>
<tr>
<td>Externalizing Problem Behaviors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall kindergarten</td>
<td>1.63</td>
<td>0.64</td>
<td>1</td>
<td>4</td>
<td>26.19</td>
<td>0.87</td>
</tr>
<tr>
<td>Spring 5th grade</td>
<td>1.69</td>
<td>0.60</td>
<td>1</td>
<td>4</td>
<td>14.30</td>
<td>0.10</td>
</tr>
<tr>
<td>Internalizing Problem Behaviors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall kindergarten</td>
<td>1.53</td>
<td>0.51</td>
<td>1</td>
<td>4</td>
<td>24.31</td>
<td>0.19</td>
</tr>
<tr>
<td>Spring 5th grade</td>
<td>1.68</td>
<td>0.55</td>
<td>1</td>
<td>4</td>
<td>12.61</td>
<td>0.34</td>
</tr>
</tbody>
</table>

NOTE: Includes imputed values.

28 Descriptive statistics included imputed values. See the discussion on multiple imputation procedure presented in the later section of analytic methods.

29 For example, at kindergarten entry, 0.09 percent of children received a rating of 1 (i.e., the minimum score) on the approaches to learning scale, and 8.8 percent of children received a rating of 4 (i.e., the maximum score) on the same scale.
The descriptive statistics\(^{30}\) of family process variables are shown in Tables 2.2 and 2.3. Variables based on scales include family resources, parent-child interactions, disciplinary methods, number of family rules on television viewing, parental involvement in school events, and involvement in artistic or cultural activities. Items that make up the scales and the reliability estimates are provided in Appendix 2.A.

Table 2.2 provides the means and standard deviations of family process variables that are continuous. On average, children spent over 52 minutes on homework every day. They owned an average of 101 books at home, and their families tended to have three out of a total of four types of family resources (i.e., newspaper, magazine, dictionary or encyclopedia, and pocket calculator). The mean score of parent-child interactions was 3.7 on a four-item scale, indicating high levels of effective interactions between parents and children. In terms of parenting and disciplinary practices, parents reported using three out of a total of six types of disciplinary methods when their child got angry and hit them,\(^{31}\) and, on average, they reported spanking their child once a month. For television viewing practices, children were subject to an average of two family rules on television viewing, and typically watched television for approximately two hours on a weekday and six hours during a weekend. With respect to parental involvement, parents were involved in four types of school events on average, communicated regularly with an average of three parents whose children were in the same class, and had their child attend one type of artistic or cultural activity outside of school and home.

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Structure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{30}\) Descriptive statistics reported in Tables 2.2-2.5 include both time-varying and time-invariant variables. Time-varying independent variables are reported using measures taken at spring of fifth grade. Time-invariant variables are averaged across the waves with available data.

\(^{31}\) The variable “disciplinary methods” was created based on results of factor analysis, which aims to find common underlying factors of a group of variables. Since the original variables are dichotomous, tetrachoric correlations were used in the factor analysis. The constructed variable “disciplinary methods” measures the number of different constructive methods that parents have used to discipline their child. It describes parents’ tendency to engage in a range of constructive disciplinary methods. While engaging in more disciplinary methods may not necessarily indicate better parenting skills, a single-item scale that purports to measure a specific aspect of parental child-rearing behaviors may not be reliable. As a result, the six items were combined to create this scale using factor analysis.
<table>
<thead>
<tr>
<th>Time for homework per day (in minutes)</th>
<th>52.66</th>
<th>31.05</th>
<th>0.00</th>
<th>240.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource Availability</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of books child has at home</td>
<td>101.48</td>
<td>147.35</td>
<td>0.00</td>
<td>5000</td>
</tr>
<tr>
<td>Family resources (newspaper, magazine, dictionary/encyclopedia, calculator)</td>
<td>3.25</td>
<td>0.85</td>
<td>0.00</td>
<td>4</td>
</tr>
<tr>
<td>Home Affective Environment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parent-child interactions</td>
<td>3.69</td>
<td>0.69</td>
<td>0.00</td>
<td>4</td>
</tr>
<tr>
<td>Parenting and Disciplinary Practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disciplinary methods</td>
<td>2.90</td>
<td>1.46</td>
<td>0.00</td>
<td>6</td>
</tr>
<tr>
<td>Frequency of spanking in a week</td>
<td>0.24</td>
<td>0.64</td>
<td>0.00</td>
<td>10</td>
</tr>
<tr>
<td>Number of family rules on TV viewing</td>
<td>2.39</td>
<td>0.79</td>
<td>0.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekday</td>
<td>2.19</td>
<td>1.29</td>
<td>0.00</td>
<td>13.00</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekend</td>
<td>5.56</td>
<td>3.41</td>
<td>0.00</td>
<td>24.00</td>
</tr>
<tr>
<td>Parental Involvement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental involvement in school events</td>
<td>3.99</td>
<td>1.49</td>
<td>0.00</td>
<td>6.00</td>
</tr>
<tr>
<td>Contact with parents of child’s peers</td>
<td>2.64</td>
<td>3.45</td>
<td>0.00</td>
<td>40</td>
</tr>
<tr>
<td>Involvement in artistic/cultural activities</td>
<td>1.03</td>
<td>1.12</td>
<td>0.00</td>
<td>5.00</td>
</tr>
</tbody>
</table>

NOTE: Includes imputed values.

Table 2.3 shows descriptive statistics of dichotomous family process variables. On average, around 73 percent of children’s parents expected their child to have a bachelor’s degree or higher. The percentage of children’s parents who believed that their child performed as good as or better than their peers was over 89 percent for reading, and over 92 percent for mathematics.

For learning structure, approximately 88 percent of children did homework more than two times a week, and over 97 percent of children had a place at home set aside for doing homework. Nearly 23 percent of children read books outside of school for once to twice a week or less, and over 45 percent of children read every day. Over half of the sample used home computers three times or more a week.

In terms of resource availability, the proportion of children who owned a home computer was nearly 82 percent, and over 78 percent of children had Internet access at home. Almost 73 percent of children had their own community library card.

With respect to home affective environment, nearly 82 percent of parents reported frequent warm and close interactions with child, and almost 88 percent of parents reported that their child liked them. In contrast, fewer than 10 percent of parents reported having to give up more of their life to meet their child’s needs than they ever expected, and only around 1 percent of parents reported
feeling their own child was harder to care for than most other children. Approximately 83 percent of children’s parents talked to their child about school on a daily basis.

In terms of parental involvement, over 64 percent of children had family members help them with reading homework for three to four times a week or more, and over 58 percent of children had help for mathematics homework. The percentage of children whose family members performed various home-based activities with them for more than two times a week was 28 percent for working on nature and science projects, 60 percent for playing games or puzzles, 59 percent for playing a sport or exercising together, and 89 percent for household chores. Over 49 percent of children’s parents reported visiting the library with the child at least once in the last month.

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parental Expectations and Beliefs</strong></td>
<td></td>
</tr>
<tr>
<td>Expecting child to have a bachelor’s degree or higher</td>
<td>72.75</td>
</tr>
<tr>
<td>Belief about reading performance as good as or better than peers</td>
<td>89.40</td>
</tr>
<tr>
<td>Belief about math performance as good as or better than peers</td>
<td>92.44</td>
</tr>
<tr>
<td><strong>Learning Structure</strong></td>
<td></td>
</tr>
<tr>
<td>Doing homework more than 2 times a week</td>
<td>87.62</td>
</tr>
<tr>
<td>Place at home set aside for homework</td>
<td>97.68</td>
</tr>
<tr>
<td>Child reading books outside school</td>
<td></td>
</tr>
<tr>
<td>Infrequent: 1 to 2 times a week or less</td>
<td>22.82</td>
</tr>
<tr>
<td>Very frequent: every day</td>
<td>45.35</td>
</tr>
<tr>
<td>Home computer use 3 times a week or more</td>
<td>51.71</td>
</tr>
<tr>
<td><strong>Resource Availability</strong></td>
<td></td>
</tr>
<tr>
<td>Home computer for child use</td>
<td>81.98</td>
</tr>
<tr>
<td>Home Internet access</td>
<td>78.30</td>
</tr>
<tr>
<td>Community library card for child</td>
<td>72.88</td>
</tr>
<tr>
<td><strong>Home Affective Environment</strong></td>
<td></td>
</tr>
<tr>
<td>Parents and child often having warm, close times together</td>
<td>82.00</td>
</tr>
<tr>
<td>Child likes parents</td>
<td>87.72</td>
</tr>
<tr>
<td>Parents sacrificing more to meet child’s needs than expected</td>
<td>9.51</td>
</tr>
<tr>
<td>Parents feeling child harder to care for than most</td>
<td>1.05</td>
</tr>
<tr>
<td>Talk with child about school every day</td>
<td>83.05</td>
</tr>
<tr>
<td><strong>Parental Involvement</strong></td>
<td></td>
</tr>
<tr>
<td>Help with reading homework 3 to 4 times a week or more</td>
<td>64.35</td>
</tr>
<tr>
<td>Help with math homework 3 to 4 times a week or more</td>
<td>58.46</td>
</tr>
<tr>
<td>Talking about nature or doing science projects with child more than 2 times a week</td>
<td>28.41</td>
</tr>
<tr>
<td>Playing games or doing puzzles with child more than 2 times a week</td>
<td>59.79</td>
</tr>
<tr>
<td>Playing sports or exercising with child more than 2 times a week</td>
<td>59.05</td>
</tr>
</tbody>
</table>
Table 2.4 presents the means and standard deviations of continuous variables representing family, child, and school characteristics. On average, children were aged around 11 years and 3 months at the fifth-grade assessment, and had an average of 1.5 siblings in spring of fifth grade. Their schools had over 37 percent of students eligible for free lunch, and their classes had an average class size of approximately 23 students. Their teachers had, on average, more than 13 years of teaching experience. In terms of family status variables, the average SES\textsuperscript{32} was -0.09 in fifth grade, about 0.11 standard deviations lower than zero.\textsuperscript{33}

Table 2.4. Descriptive Statistics: Family, Child, and School Characteristics – Continuous

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family Status Factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>-0.090</td>
<td>0.783</td>
<td>-2.48</td>
<td>2.54</td>
</tr>
<tr>
<td>Child Characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age at assessment (in months)</td>
<td>134.63</td>
<td>4.26</td>
<td>118.08</td>
<td>151.87</td>
</tr>
<tr>
<td>Number of siblings</td>
<td>1.54</td>
<td>1.11</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>School Factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent students eligible for free lunch</td>
<td>37.48</td>
<td>27.25</td>
<td>0.00</td>
<td>100</td>
</tr>
<tr>
<td>Class size</td>
<td>22.98</td>
<td>4.93</td>
<td>5</td>
<td>40</td>
</tr>
<tr>
<td>Teacher experience (in years)</td>
<td>13.75</td>
<td>8.74</td>
<td>0</td>
<td>43.49</td>
</tr>
</tbody>
</table>

NOTE: Includes imputed values.

Table 2.5 provides descriptive statistics of the dichotomous variables on family, child, and school factors, which are reported as the percentages of children with selected characteristics. Over 42 percent of children were minority, and almost half were female. Nearly 12 percent of children used a language other than English as their main language at home. Over 48 percent transferred school at

\textsuperscript{32} The SES composite ranges from -2.48 to 2.54 in fifth grade. It is the average of five measures (i.e., father’s education, mother’s education, father’s occupation, mother’s occupation, and household income), each of which is standardized to have a mean of zero and a standard deviation of one. See Tourangeau et al. (2006) for detailed information on the construction of the SES composite.

\textsuperscript{33} As reported in previous paper, the sample has an average SES of -0.023 at kindergarten entry, which corresponds to an average annual household income of 50,543 dollars, lower than the national average of 51,855 dollars in 1998 (see US Census Bureau, 2001, Historical Income Tables, http://www.census.gov/hhes/www/income/histinc/h06AR.html, retrieved on April 20, 2009). The sample has a median education level of vocational and technical training for both mothers and father at kindergarten entry.
least once during kindergarten to fifth grade. In fifth grade, more than 69 percent of children lived in two-parent households, and nearly 28 percent lived in single-parent households. Approximately 20 percent of children were reported to have a disability in fifth grade. In terms of school characteristics, about 90 percent of children were enrolled in public schools in fifth grade. Over 34 percent attended schools with 50 percent or more minority students, and around 36 percent went to schools with 10 percent or more students eligible for reduced-price lunch in fifth grade. Geographically, schools were mostly located in suburbs and large towns, and another one third were located in central cities.

Table 2.5. Descriptive Statistics: Family, Child, and School Characteristics – Dichotomous

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Family Status Factors</strong></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>57.65</td>
</tr>
<tr>
<td>Black</td>
<td>15.97</td>
</tr>
<tr>
<td>Hispanic</td>
<td>18.86</td>
</tr>
<tr>
<td>Asian</td>
<td>2.68</td>
</tr>
<tr>
<td>Other race</td>
<td>4.83</td>
</tr>
<tr>
<td><strong>Family structure</strong></td>
<td></td>
</tr>
<tr>
<td>Two-parent household</td>
<td>69.53</td>
</tr>
<tr>
<td>Single-parent household</td>
<td>27.80</td>
</tr>
<tr>
<td>Other type of household</td>
<td>2.67</td>
</tr>
<tr>
<td><strong>Child Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>48.54</td>
</tr>
<tr>
<td>Speak non-English at home</td>
<td>11.70</td>
</tr>
<tr>
<td>Transferred school</td>
<td>48.52</td>
</tr>
<tr>
<td>Disability</td>
<td>20.12</td>
</tr>
<tr>
<td><strong>School Factors</strong></td>
<td></td>
</tr>
<tr>
<td>Public</td>
<td>89.68</td>
</tr>
<tr>
<td>50 percent or more being minority</td>
<td>34.68</td>
</tr>
<tr>
<td>10 percent or more with reduced-price lunch</td>
<td>36.34</td>
</tr>
<tr>
<td><strong>School location</strong></td>
<td></td>
</tr>
<tr>
<td>Urban fringe and large town</td>
<td>42.97</td>
</tr>
<tr>
<td>Central city</td>
<td>34.77</td>
</tr>
<tr>
<td>Rural and small town</td>
<td>22.26</td>
</tr>
</tbody>
</table>

NOTE: Includes imputed values.

---

Disability is a composite variable, created to indicate whether a child had a disability diagnosed by a professional, received therapy services, or participated in a program for children with disabilities. The disability conditions include anxiety or depression, inattention, inability to communicate, difficulty in hearing and understanding speech, and vision-related problems. See Tourangeau et al. (2006) for detailed information on the construction of the disability composite.
Racial/Ethnic Differences

Table 2.6 presents average teacher SRS scales for different ethnic groups at kindergarten entry and fifth grade. Overall, white and Asian children had relatively higher levels of development in learning approaches, self-control, and interpersonal skills in comparison with their black peers. In terms of internalizing and externalizing problem behaviors, Asian children were rated as demonstrating the fewest problem behaviors among all ethnic groups.

Table 2.6. Teacher SRS Scale Scores by Race/Ethnicity

<table>
<thead>
<tr>
<th>SRS Scale Scores</th>
<th>White</th>
<th>Black</th>
<th>Hispanic</th>
<th>Asian</th>
<th>Other Race</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approaches to Learning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall kindergarten</td>
<td>3.04</td>
<td>2.80</td>
<td>2.99</td>
<td>3.18</td>
<td>2.90</td>
</tr>
<tr>
<td>Spring 5th grade</td>
<td>3.07</td>
<td>2.77</td>
<td>3.02</td>
<td>3.44</td>
<td>2.97</td>
</tr>
<tr>
<td>Self-Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall kindergarten</td>
<td>3.14</td>
<td>2.90</td>
<td>3.09</td>
<td>3.26</td>
<td>2.99</td>
</tr>
<tr>
<td>Spring 5th grade</td>
<td>3.24</td>
<td>2.97</td>
<td>3.24</td>
<td>3.52</td>
<td>3.14</td>
</tr>
<tr>
<td>Interpersonal Skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall kindergarten</td>
<td>3.04</td>
<td>2.82</td>
<td>2.97</td>
<td>3.03</td>
<td>2.96</td>
</tr>
<tr>
<td>Spring 5th grade</td>
<td>3.07</td>
<td>2.82</td>
<td>3.10</td>
<td>3.33</td>
<td>2.99</td>
</tr>
<tr>
<td>Externalizing Problem Behaviors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall kindergarten</td>
<td>1.60</td>
<td>1.79</td>
<td>1.56</td>
<td>1.41</td>
<td>1.79</td>
</tr>
<tr>
<td>Spring 5th grade</td>
<td>1.66</td>
<td>1.94</td>
<td>1.62</td>
<td>1.36</td>
<td>1.73</td>
</tr>
<tr>
<td>Internalizing Problem Behaviors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall kindergarten</td>
<td>1.53</td>
<td>1.50</td>
<td>1.55</td>
<td>1.47</td>
<td>1.58</td>
</tr>
<tr>
<td>Spring 5th grade</td>
<td>1.70</td>
<td>1.67</td>
<td>1.65</td>
<td>1.54</td>
<td>1.67</td>
</tr>
</tbody>
</table>

Table 2.7 presents ethnic differences in family process factors. On average, parents of Asian students had the highest percentage of expecting child to achieve a bachelor’s degree or higher, while black parents had the lowest percentage among all races. For learning structure, black children spent the most amount of time doing homework per day, whereas white children spent the least amount of time on homework.

With respect to available resources, white children owned almost twice as many books as their black and Hispanic peers at home. White and Asian children had the highest percentage of ownership of home computers, with over 90 percent of white children and 93 percent of Asians reporting that they had home computers in fifth grade. In contrast, only 69 percent of black children and 68 percent of Hispanics had home computers in fifth grade. Similarly, around 88 percent of white children and 91 percent of Asians had access to Internet at home compared with 66 percent of blacks and 60 percent of Hispanics.
In terms of parenting and disciplinary practices, parents of black children spanked child twice as often as white parents. With respect to television viewing practices, black children appeared to watch television most often, with average 2.7 hours of television viewing time on a weekday and 7.1 hours during a weekend as reported by their parents in fifth grade.

With regard to parental involvement, white parents received highest ratings on involvement in school events and regular communication with other parents whose children were in the same class. Moreover, approximately 65 percent of Asian children were reported to have visited the library with their parents in the last month, in comparison with approximately 50 percent of children in all other ethnic groups.

Table 2.7. Family Process Factors by Race/Ethnicity

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>White</th>
<th>Black</th>
<th>Hispanic</th>
<th>Asian</th>
<th>Other Race</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parental Expectations and Beliefs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expecting a bachelor’s degree or higher</td>
<td>71.62%</td>
<td>69.56%</td>
<td>76.76%</td>
<td>93.43%</td>
<td>69.66%</td>
</tr>
<tr>
<td>Belief about reading performance as good as or better than peers</td>
<td>87.25%</td>
<td>94.32%</td>
<td>91.53%</td>
<td>96.51%</td>
<td>86.51%</td>
</tr>
<tr>
<td>Belief about math performance as good as or better than peers</td>
<td>90.87%</td>
<td>95.07%</td>
<td>94.85%</td>
<td>94.15%</td>
<td>92.11%</td>
</tr>
<tr>
<td><strong>Learning Structure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doing homework more than 2 times a week</td>
<td>84.78%</td>
<td>91.34%</td>
<td>94.22%</td>
<td>94.56%</td>
<td>79.64%</td>
</tr>
<tr>
<td>Place set aside for homework</td>
<td>96.97%</td>
<td>99.31%</td>
<td>98.65%</td>
<td>97.24%</td>
<td>97.09%</td>
</tr>
<tr>
<td>Time for homework per day (in minutes)</td>
<td>49.05</td>
<td>62.05</td>
<td>56.98</td>
<td>54.14</td>
<td>47.01</td>
</tr>
<tr>
<td>Child reading books outside school</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrequent: 1 to 2 times a week or less</td>
<td>22.58%</td>
<td>23.94%</td>
<td>21.88%</td>
<td>10.04%</td>
<td>32.75%</td>
</tr>
<tr>
<td>Very frequent: every day</td>
<td>43.40%</td>
<td>49.13%</td>
<td>47.14%</td>
<td>60.03%</td>
<td>40.95%</td>
</tr>
<tr>
<td>Home computer use 3 times a week or more</td>
<td>58.58%</td>
<td>45.19%</td>
<td>36.62%</td>
<td>65.42%</td>
<td>42.75%</td>
</tr>
<tr>
<td><strong>Resource Availability</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home computer for child use</td>
<td>90.63%</td>
<td>69.17%</td>
<td>67.86%</td>
<td>93.38%</td>
<td>69.89%</td>
</tr>
<tr>
<td>Home Internet access</td>
<td>87.91%</td>
<td>65.55%</td>
<td>59.69%</td>
<td>91.17%</td>
<td>71.32%</td>
</tr>
<tr>
<td>Number of books child has at home</td>
<td>125.20</td>
<td>64.16</td>
<td>63.29</td>
<td>90.15</td>
<td>97.11</td>
</tr>
<tr>
<td>Family resources (newspaper, magazine,</td>
<td>3.45</td>
<td>3.06</td>
<td>2.79</td>
<td>3.29</td>
<td>3.23</td>
</tr>
<tr>
<td>dictionary/encyclopedia, calculator)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community library card for child</td>
<td>74.93%</td>
<td>72.41%</td>
<td>70.48%</td>
<td>76.90%</td>
<td>57.22%</td>
</tr>
<tr>
<td><strong>Home Affective Environment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Having warm, close times with child</td>
<td>80.81%</td>
<td>84.62%</td>
<td>83.19%</td>
<td>81.36%</td>
<td>83.31%</td>
</tr>
<tr>
<td>Child likes parents</td>
<td>86.82%</td>
<td>91.60%</td>
<td>87.97%</td>
<td>83.57%</td>
<td>86.95%</td>
</tr>
<tr>
<td>Sacrifice to meet child’s needs</td>
<td>7.51%</td>
<td>12.66%</td>
<td>12.13%</td>
<td>15.79%</td>
<td>9.18%</td>
</tr>
<tr>
<td>Parents feeling child harder to care</td>
<td>1.17%</td>
<td>1.02%</td>
<td>0.60%</td>
<td>0.35%</td>
<td>1.91%</td>
</tr>
</tbody>
</table>
Parental interpersonal demonstrated SES.

**Parental Involvement**

<table>
<thead>
<tr>
<th>Behavior</th>
<th>SES 1</th>
<th>SES 2</th>
<th>SES 3</th>
<th>SES 4</th>
<th>SES 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent-child interactions</td>
<td>3.78</td>
<td>3.55</td>
<td>3.57</td>
<td>3.48</td>
<td>3.70</td>
</tr>
<tr>
<td>Talk with child about school every day</td>
<td>85.60%</td>
<td>82.45%</td>
<td>77.64%</td>
<td>71.36%</td>
<td>82.23%</td>
</tr>
</tbody>
</table>

**Parenting and Disciplinary Practices**

<table>
<thead>
<tr>
<th>Practice</th>
<th>SES 1</th>
<th>SES 2</th>
<th>SES 3</th>
<th>SES 4</th>
<th>SES 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disciplinary methods</td>
<td>3.02</td>
<td>2.63</td>
<td>2.81</td>
<td>2.62</td>
<td>2.83</td>
</tr>
<tr>
<td>Frequency of spanking in a week</td>
<td>0.20</td>
<td>0.41</td>
<td>0.22</td>
<td>0.24</td>
<td>0.25</td>
</tr>
<tr>
<td>Number of family rules on TV viewing</td>
<td>2.33</td>
<td>2.52</td>
<td>2.47</td>
<td>2.48</td>
<td>2.33</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekday</td>
<td>2.06</td>
<td>2.70</td>
<td>2.19</td>
<td>1.75</td>
<td>2.27</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekend</td>
<td>5.16</td>
<td>7.11</td>
<td>5.49</td>
<td>5.00</td>
<td>5.68</td>
</tr>
</tbody>
</table>

**Differences by SES**

As shown in Appendix 2.B, the correlations between SES and SRS scale scores for approaches to learning, self-control, and interpersonal skills were, respectively, 0.18, 0.11, and 0.15 in fall of kindergarten. In the spring of fifth grade, the correlations increased for all three skills, ranging from 0.18 for self-control to 0.24 for approaches to learning. The SRS scale scores for externalizing and internalizing problem behaviors were negatively correlated with SES, ranging from -0.08 to -0.15 in kindergarten and fifth grade (see Appendix 2.B). To further understand the achievement gaps among different SES groups, SES was grouped by four quartiles, with the first quartile consisting of children from the lowest 25 percent of SES and the fourth quartile for children from the highest 25 percent of SES. As shown in Table 2.8, children in the lowest SES quartile consistently demonstrated lower levels of approaches to learning, self-control, and interpersonal skills, as well as more externalizing and internalizing problem behaviors than their peers in the highest SES quartile in both kindergarten and fifth grade.

**Table 2.8. Teacher SRS Scale Scores by SES**

<table>
<thead>
<tr>
<th>Activity</th>
<th>SES 1</th>
<th>SES 2</th>
<th>SES 3</th>
<th>SES 4</th>
<th>SES 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parental involvement in school events</td>
<td>4.21</td>
<td>3.62</td>
<td>3.65</td>
<td>3.94</td>
<td>3.88</td>
</tr>
<tr>
<td>Contact with parents of child’s peers</td>
<td>2.98</td>
<td>2.12</td>
<td>2.08</td>
<td>2.30</td>
<td>2.58</td>
</tr>
<tr>
<td>Help with reading homework 3 to 4 times a week or more</td>
<td>60.67%</td>
<td>76.74%</td>
<td>66.48%</td>
<td>58.32%</td>
<td>62.33%</td>
</tr>
<tr>
<td>Help with math homework 3 to 4 times a week</td>
<td>53.35%</td>
<td>72.56%</td>
<td>62.68%</td>
<td>55.20%</td>
<td>58.28%</td>
</tr>
<tr>
<td>Talking about nature or doing science projects more than 2 times a week</td>
<td>31.20%</td>
<td>20.98%</td>
<td>24.63%</td>
<td>23.59%</td>
<td>37.06%</td>
</tr>
<tr>
<td>Playing games or doing puzzles with child more than 2 times a week</td>
<td>61.17%</td>
<td>69.25%</td>
<td>48.24%</td>
<td>57.01%</td>
<td>58.68%</td>
</tr>
<tr>
<td>Playing sports or exercising with child more than 2 times a week</td>
<td>62.21%</td>
<td>64.61%</td>
<td>46.67%</td>
<td>48.66%</td>
<td>56.97%</td>
</tr>
<tr>
<td>Involving child in household chores more than 2 times a week</td>
<td>90.88%</td>
<td>91.00%</td>
<td>81.82%</td>
<td>82.14%</td>
<td>92.58%</td>
</tr>
<tr>
<td>Involvement in artistic/cultural activities</td>
<td>1.10</td>
<td>1.01</td>
<td>0.80</td>
<td>1.31</td>
<td>0.98</td>
</tr>
<tr>
<td>Library visit with child in last month</td>
<td>47.62%</td>
<td>49.49%</td>
<td>52.17%</td>
<td>64.60%</td>
<td>45.37%</td>
</tr>
</tbody>
</table>

59
Table 2.9 presents correlations between SES and family process variables that are continuous. Among these variables, the number of family resources had a relatively high correlation with SES (0.42).

Table 2.9. Correlations Between SES and Continuous Family Process Factors

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Learning Structure</strong></td>
<td></td>
</tr>
<tr>
<td>Time for homework per day (in minutes)</td>
<td>-0.0207</td>
</tr>
<tr>
<td><strong>Resource Availability</strong></td>
<td></td>
</tr>
<tr>
<td>Number of books child has at home</td>
<td>0.2594</td>
</tr>
<tr>
<td>Family resources (newspaper, magazine, dictionary/encyclopedia, calculator)</td>
<td>0.4184</td>
</tr>
<tr>
<td><strong>Home Affective Environment</strong></td>
<td></td>
</tr>
<tr>
<td>Parent-child interactions</td>
<td>0.1636</td>
</tr>
<tr>
<td><strong>Parenting and Disciplinary Practices</strong></td>
<td></td>
</tr>
<tr>
<td>Disciplinary methods</td>
<td>0.0849</td>
</tr>
<tr>
<td>Frequency of spanking in a week</td>
<td>-0.1325</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekday</td>
<td>-0.2446</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekend</td>
<td>-0.1410</td>
</tr>
<tr>
<td><strong>Parental Involvement</strong></td>
<td></td>
</tr>
<tr>
<td>Contact with parents of child’s peers</td>
<td>0.2423</td>
</tr>
</tbody>
</table>

Tables 2.10-2.15 provide the means and standard deviations of SES for discrete family process variables with different levels. Overall, there appeared to be consistent differences in average SES across different levels of family process variables, and the differences seemed to be most noticeable for variables measuring resource availability. As shown in Table 2.10, children whose parents
expected them to obtain a bachelor’s degree or higher had a higher average SES than those whose parents expected lower than a bachelor’s degree in fifth grade. Moreover, parents who believed their child’s performance as good as or better than the peers tended to have relatively higher average SES.

Table 2.10. SES by Family Process Factors – Parental Expectations and Beliefs

<table>
<thead>
<tr>
<th>Family Process Variables – Parental Expectations and Beliefs</th>
<th>SES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Expecting a bachelor’s degree or higher</td>
<td></td>
</tr>
<tr>
<td>Lower than a bachelor’s degree</td>
<td>0.0581</td>
</tr>
<tr>
<td>A bachelor’s degree or higher</td>
<td>-0.4837</td>
</tr>
<tr>
<td>Belief about reading performance</td>
<td></td>
</tr>
<tr>
<td>Worse than peers</td>
<td>-0.1500</td>
</tr>
<tr>
<td>As good as or better than peers</td>
<td>-0.0824</td>
</tr>
<tr>
<td>Belief about math performance</td>
<td></td>
</tr>
<tr>
<td>Worse than peers</td>
<td>-0.2318</td>
</tr>
<tr>
<td>As good as or better than peers</td>
<td>-0.0790</td>
</tr>
</tbody>
</table>

For learning structure, children who did homework more often had a higher average SES. In spring of fifth grade, children who used home computer more frequently tended to have a higher average SES.

Table 2.11. SES by Family Process Factors – Learning Structure

<table>
<thead>
<tr>
<th>Family Process Variables – Learning Structure</th>
<th>SES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Doing homework more than 2 times a week</td>
<td></td>
</tr>
<tr>
<td>1 to 2 times a week or less</td>
<td>0.0744</td>
</tr>
<tr>
<td>2 times a week or more</td>
<td>-0.1969</td>
</tr>
<tr>
<td>Place set aside for homework</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>-0.0917</td>
</tr>
<tr>
<td>No</td>
<td>0.0003</td>
</tr>
<tr>
<td>Child reading books outside school</td>
<td></td>
</tr>
<tr>
<td>Infrequent: 1 to 2 times a week or less</td>
<td>-0.0427</td>
</tr>
<tr>
<td>Frequent: 3 to 6 times a week</td>
<td>-0.0140</td>
</tr>
<tr>
<td>Very frequent: every day</td>
<td>-0.2879</td>
</tr>
<tr>
<td>Home computer use 3 times a week or more</td>
<td></td>
</tr>
<tr>
<td>Infrequent: less than 3 times a week</td>
<td>-0.3154</td>
</tr>
<tr>
<td>Frequent: 3 times a week or more</td>
<td>0.1214</td>
</tr>
</tbody>
</table>

As shown in Table 2.12, children who had access to resources including home computers, home Internet access, and community library card tended to have a higher average SES.

Table 2.12. SES by Family Process Factors – Resource Availability

<table>
<thead>
<tr>
<th>Learning Structure</th>
<th>SES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
With respect to home affective environment, children whose parents displayed affection tended to have higher average SES. Moreover, children whose parents talked to them about school every day had higher average SES than those whose parents talked to them less frequently.

Table 2.13. SES by Family Process Factors – Home Affective Environment

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>SES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Having warm, close times with child</td>
<td></td>
</tr>
<tr>
<td>True</td>
<td>-0.0756</td>
</tr>
<tr>
<td>False</td>
<td>-0.1531</td>
</tr>
<tr>
<td>Child likes parents</td>
<td></td>
</tr>
<tr>
<td>True</td>
<td>-0.0814</td>
</tr>
<tr>
<td>False</td>
<td>-0.1476</td>
</tr>
<tr>
<td>Sacrifice to meet child’s needs</td>
<td></td>
</tr>
<tr>
<td>True</td>
<td>-0.2589</td>
</tr>
<tr>
<td>False</td>
<td>-0.0717</td>
</tr>
<tr>
<td>Parents feeling child harder to care</td>
<td></td>
</tr>
<tr>
<td>True</td>
<td>-0.1353</td>
</tr>
<tr>
<td>False</td>
<td>-0.0890</td>
</tr>
<tr>
<td>Talk with child about school every day</td>
<td></td>
</tr>
<tr>
<td>Less than every day</td>
<td>-0.2387</td>
</tr>
<tr>
<td>Every day</td>
<td>-0.0591</td>
</tr>
</tbody>
</table>

For parenting and disciplinary practices, children who were subject to two or more family rules on television viewing tended to have higher average SES than those with fewer family rules.

Table 2.14. SES by Family Process Factors – Parenting and Disciplinary Practices

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>SES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Number of family rules on TV viewing</td>
<td></td>
</tr>
<tr>
<td>No rule</td>
<td>-0.2109</td>
</tr>
</tbody>
</table>
As shown in Table 2.15, children whose parents were more involved in their life tended to have higher average SES. However, children whose parents reported helping them with homework more often had lower average SES than other children.

**Table 2.15. SES by Family Process Factors – Parental Involvement**

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>SES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Parental Involvement in school events</td>
<td></td>
</tr>
<tr>
<td>No involvement</td>
<td>-0.8214</td>
</tr>
<tr>
<td>Involvement in one event</td>
<td>-0.6467</td>
</tr>
<tr>
<td>Involvement in two events</td>
<td>-0.5367</td>
</tr>
<tr>
<td>Involvement in three events</td>
<td>-0.2842</td>
</tr>
<tr>
<td>Involvement in four events</td>
<td>-0.0890</td>
</tr>
<tr>
<td>Involvement in five events</td>
<td>0.1244</td>
</tr>
<tr>
<td>Involvement in six events</td>
<td>0.3102</td>
</tr>
<tr>
<td>Help with reading homework</td>
<td></td>
</tr>
<tr>
<td>Less than 2 times a week</td>
<td>0.0194</td>
</tr>
<tr>
<td>3 to 4 times a week or more</td>
<td>-0.1499</td>
</tr>
<tr>
<td>Help with math homework</td>
<td></td>
</tr>
<tr>
<td>Less than 2 times a week</td>
<td>-0.0057</td>
</tr>
<tr>
<td>3 to 4 times a week or more</td>
<td>-0.1491</td>
</tr>
<tr>
<td>Talking about nature or doing science projects</td>
<td></td>
</tr>
<tr>
<td>2 times a week or less</td>
<td>-0.1369</td>
</tr>
<tr>
<td>More than 2 times a week</td>
<td>0.0298</td>
</tr>
<tr>
<td>Playing games or doing puzzles with child</td>
<td></td>
</tr>
<tr>
<td>2 times a week or less</td>
<td>-0.1103</td>
</tr>
<tr>
<td>More than 2 times a week</td>
<td>-0.0755</td>
</tr>
<tr>
<td>Playing sports or exercising with child</td>
<td></td>
</tr>
<tr>
<td>2 times a week or less</td>
<td>-0.1267</td>
</tr>
<tr>
<td>More than 2 times a week</td>
<td>-0.0637</td>
</tr>
<tr>
<td>Involving child in household chores</td>
<td></td>
</tr>
<tr>
<td>2 times a week or less</td>
<td>-0.2036</td>
</tr>
<tr>
<td>More than 2 times a week</td>
<td>-0.0755</td>
</tr>
<tr>
<td>Involvement in artistic/cultural activities</td>
<td></td>
</tr>
<tr>
<td>No involvement</td>
<td>-0.3069</td>
</tr>
<tr>
<td>Involvement in one activity</td>
<td>-0.0714</td>
</tr>
<tr>
<td>Involvement in two activities</td>
<td>0.1135</td>
</tr>
<tr>
<td>Involvement in three activities</td>
<td>0.3297</td>
</tr>
<tr>
<td>Involvement in four activities</td>
<td>0.3420</td>
</tr>
<tr>
<td>Involvement in five activities</td>
<td>0.6577</td>
</tr>
<tr>
<td>Library visit with child in last month</td>
<td></td>
</tr>
</tbody>
</table>

63
<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>-0.0464</td>
<td>0.8030</td>
<td>-2.48</td>
<td>2.54</td>
</tr>
<tr>
<td>No</td>
<td>-0.1312</td>
<td>0.7616</td>
<td>-2.48</td>
<td>2.54</td>
</tr>
</tbody>
</table>

**Analytic Methods**

*Multiple Imputation*

Approximately 48 percent of the sample has missing values in one or more of the variables used in the analysis. While the sample has missing values in most of the variables used for analysis, many of these variables are only missing for a small percentage of the total observations. The percentages of missing values are no more than 0.7 percent for family process variables, and range from 1.6 to 10.4 percent for the five teacher SRS scales of nonacademic outcomes measured in fall of kindergarten and spring of fifth grade.

Multiple imputation procedure is followed to address this missing data problem. Specifically, 10 sets of complete data are imputed, and the results from analyzing these datasets are combined to produce overall estimates in a manner that accounts for the missing-data uncertainty as well as sampling variation (Carlin et al., 2003; Le et al., 2006; Royston, 2005; Schafer, 1999). Categorical variables are treated as continuous during the imputation process, and then rounded back to discrete numbers for analysis.\(^{35}\)

*Effect Size Calculation*

Because of the large sample size, variables can achieve statistical significance even when they are of little substantive significance. To understand the practical importance of the variables, results are also shown in terms of effect sizes, which can be interpreted as the change in standard deviations (SDs) of the dependent variable associated with one-unit change in an independent variable. Following the methods by Von Secker and Lissitz (1999), effect sizes are calculated by dividing each coefficient by the pooled within-school standard deviations from the unconditional models.\(^{36}\)

For context, the observed effect sizes are compared to the typical effect size of past educational interventions as reported by Hill et al. (2008). Hill et al. (2007) synthesized 76 meta-analyses of past studies of educational intervention

\(^{35}\) The break point for rounding is 0.5, with values of 0.5 and more being rounded up and values less than 0.5 being rounded down.

\(^{36}\) Unconditional models partition the variance in nonacademic outcomes into between- and within-school components. Results of the unconditional models are shown in Appendix 2.C.
programs in kindergarten through grade 12, and found that the mean effect sizes ranged from 0.20 to 0.30 across different interventions, achievement outcomes, and grade levels. Specifically, the mean effect size for the elementary grades was 0.23, the mean effect size for the middle grades was 0.27, and the mean effect size for the grades of high school was 0.24. Using these effect sizes as benchmarks, effect sizes less than or equal to 0.20 SD (in absolute value) are interpreted as “small,” effect sizes between 0.20 and 0.30 SD as “average,” and effect sizes of 0.30 SD or more as “above average.”

Regression Models
Since the teacher SRS scales are not comparable across years, this chapter uses two waves of the data (i.e., fall of kindergarten, and spring of fifth grade) and estimates two-level hierarchical models with Level-1 equation being a lag model combined with tobit analysis:

\[ N_{ij}^* = \gamma_j + \alpha_j N_{jk} + \theta_j F_{ij} + \delta_j F_{ij} + \beta_j C_{ij} + \varepsilon_{ij} \]  \hspace{1cm} (2.1)

\[ \gamma_j = \mu + \pi S_j + \nu_j \]  \hspace{1cm} (2.2)

where \( i, j, 5, \) and \( k \) index individual students, schools, spring of fifth grade, and fall of kindergarten respectively. \( N_{ij}^* \) is the teacher SRS scales of nonacademic outcomes measured in the spring of fifth grade, and \( N_{jk} \) is the measure of nonacademic outcomes at the baseline (fall of kindergarten). \( F_{ij} \) is a vector of variables measuring family process factors, \( F_{ij} \) is a vector of variables measuring family status factors, \( C_{ij} \) is a vector of child-level covariates, and \( S_j \) is a vector of school factors.

As shown in equation 2.1, the Level-1 model estimates the relationship between nonacademic outcomes and child-specific variables including family process factors, family status factors, and other child-level covariates. The coefficients of the child-specific variables \( \alpha_j, \theta_j, \delta_j \) and \( \beta_j \) are assumed to be fixed across all schools, but the intercept \( \gamma_j \) is allowed to vary across schools and modeled with a random component \( \nu_j \) in equation 2.2. The error term \( \varepsilon_{ij} \) in equation 2.1 is assumed to be normally distributed with zero mean and standard deviation \( \sigma_{e} \). Equation 2.2 models \( \gamma_j \) as a function of school-level variables. The intercept \( \mu \) quantifies the average outcome for all schools and coefficients \( \pi \) estimate effects of school-level factors on the outcome variable \( N_{ij}^* \). \( \nu_j \) is the random effect term for each school, with an assumed normal distribution of zero mean and standard deviation \( \sigma_{\nu} \). Error terms \( \varepsilon_{ij} \) and \( \nu_j \) are assumed to be independent from each other.
When measures are comparable across waves in panel data, all waves of outcome variable can be regressed on independent variables and a time-invariant individual term can be used to eliminate any time-invariant omitted variable bias. However, in cases where outcome variable is incomparable across waves, such strategy is inappropriate and only one wave of data should be included as dependent variable. If only one wave of data (typically current-period data) are used for both dependent and independent variables (referred to as levels model), omitted variable bias can arise from failure of controlling for historical educational inputs. To help control for bias, the lag model includes a lag term (i.e., outcome variable measured at the baseline) as a proxy for historical educational inputs. As shown in equation 2.1, measures taken at fifth grade are used for teacher SRS scale (i.e., dependent variable) and time-varying independent variables. Teacher SRS scale measured at kindergarten entry (i.e., the lag term) is also included in the right-hand side of the equation as the covariates. Since the coefficient of the lag term ($\alpha$) can take on any values, the model essentially allows $\alpha$ to adjust for the incomparability of the teacher SRS scales across years (Allison, 1990; Betts, Zau, and King, 2005; Carbonaro, 2006; Chaplin and Puma, 2003; Sass, 2006; Todd and Wolpin, 2004).38

OLS regression gives a best linear unbiased estimator (BLUE) when dependent variable is continuous and follows normal distribution. In this case, the dependent variable (i.e., teacher SRS scales) is continuous between 1 and 4, but is limited at both ends (i.e., cannot take on any values outside the range of 1 to 4). Clearly, teacher SRS scales cannot follow a normal distribution. Using OLS may lead to heteroscedasticity problem. Moreover, predictions based on OLS estimates may result in predicted values of dependent variable falling out of the specified range (Wooldridge, 2006). To solve these problems, a non-linear version of the lag model is used in equation 2.1, i.e., lag model combined with tobit analysis. Tobit analysis is typically used to deal with the censoring of the continuous dependent variable at one or both ends by modeling the underlying index of the observed dependent variable.39 In this case, the observed dependent

---

37 The fixed effects model is used if the individual-specific term is assumed to be fixed. And the random effects model is used if the individual-specific term is assumed to be randomly distributed.

38 See appendix 2.D for detailed explanation on the lag model including its advantage of addressing data incomparability across waves, assumptions and limitations, and comparisons with alternative econometric models.

39 In cases where there are not many censored observations at both ends, results from a tobit analysis will simply revert to the OLS analysis, assuming that dependent variable follows a normal distribution reasonably well.
variable $N_{ij5}$ is restricted to the value range of 1 to 4, and $N^*_{ij5}$ in equation 2.1 is the underlying index of observed fifth-grade nonacademic outcomes which can take on values outside the range of 1 to 4. The estimation of tobit analysis uses cumulative density function to estimate the likelihood of observations taking on values of 1 or 4 for teacher SRS scales and the probability density function to estimate the likelihood of observations with values between 1 and 4.40

Tobit analysis rely crucially on the normality assumption of the underlying index (in this case, $N^*_{ij5}$). Given the nature of the nonacademic outcomes, it is reasonable to believe that a large number of children will be rated in the middle range of 2-3.5 while fewer children will receive a rating at the two ends. Thus, it is likely that the index function of nonacademic outcomes should follow a normal distribution. Histograms of the observed teacher SRS scales does support this conjecture, with data of the middle range follows the normal distribution reasonably well.

A specification test proposed by Wooldridge (2006) is also conducted to verify the appropriateness of tobit analysis in this case. Specifically, two separate specification tests are conducted. One test uses the sample of observations with values of teacher SRS scales lower than 4 (i.e., excluding observations with values of 4). Teacher SRS scales are recoded into binary variables: the recoded variable equal 0 if the observed teacher SRS scale is at the boundary (i.e., equal to 1), and equals 1 otherwise. Then the recoded binary variables are used as dependent variable in the probit analysis. Results from the probit analysis are compared with results from the tobit analysis that uses the same sample and independent variables. Since very few observations have values of 1 for approaches to learning, self-control and interpersonal skills, this specification test is only conducted for externalizing and internalizing problem behaviors. The second test is similar in nature – only the sample is limited to the observations with values of teacher SRS scales higher than 1 (i.e., excluding observations with values of 1), and teacher SRS scales are recoded to equal 1 for values at the boundary (i.e., equal to 4), and equals 0 otherwise. Since very few observations have values of 4 for externalizing and internalizing problem behaviors, this second specification test is only conducted for approaches to learning, self-control and interpersonal skills. According to Wooldridge (2006), if the tobit analysis is appropriate, coefficients of the two analyses should show similar patterns of significance and sign. Moreover, probit coefficients should be close to

40 Since the teacher SRS scales are discrete variables in nature, interval regressions in Stata are conducted for the tobit analysis.
the tobit coefficients divided by the residual standard deviation of the tobit estimation.\textsuperscript{41} As shown in Appendix 2.E, a comparison of the probit results with the tobit results does not reveal any problematic signs that may suggest the inappropriateness of tobit analysis. Coefficients that are statistically significant in both probit and tobit regressions all have the same sign and are not dramatically different in magnitude.\textsuperscript{42} Therefore, the specification tests suggest the appropriateness of using tobit analysis in this case.

Since the specification test is only performed at one boundary as a result of the limited observations at the other boundary, tobit regressions that model the censoring at one boundary are estimated to compare with the tobit regressions modeling the censoring at both ends.\textsuperscript{43} Results of the one-end tobit regressions (shown in Appendix 2.E) are very similar to results of the two-end tobit regressions (shown in Appendix 2.G), thus indicating that results are robust regardless of whether or not tobit regressions take into account the censoring at the boundary with limited observations.

It is worthwhile to point out that Tobit coefficients reflect the change in the underlying index of the dependent variable ($N_{ij5}^*$) in response to one-unit change in the independent variable. In comparison, OLS coefficients reflect the change in the observed values ($N_{ij5}$).\textsuperscript{44} Since the research questions require modeling the mean of the underlying index, not just the mean of the observed data, Tobit coefficients are not rescaled to the observed value metric. Instead, they are reported to reflect the change in the underlying index.

Two separate models are estimated to address the research questions. The model presented above (hereinafter, referred to as the family process model) estimates the relationship between family factors and each of the five nonacademic outcomes, which addresses the first research question. Baseline models that regress nonacademic outcomes as a function of family status variables, child characteristics, and school covariates are also estimated. A comparison of results from the family process model with the baseline model reveals whether and how the effects of race and SES change once family process variables are added into

\textsuperscript{41} As pointed out by Wooldridge (2006), these will never be identical due to sampling error.
\textsuperscript{42} Differences in coefficients are all smaller than 0.12.
\textsuperscript{43} Specifically, one-end tobit regressions that model the censoring at the higher boundary only (i.e., value of 4) are estimated for approaches to learning, self-control and interpersonal skills, and one-end tobit regression that model the censoring at the lower boundary only (i.e., value of 1) are estimated for externalizing and internalizing problem behaviors.
\textsuperscript{44} Results of OLS regressions are shown in Appendix 2.F for reference.
the estimation. For the second research question, interaction terms between family process and family status variables are added to the family process model to analyze whether the relationship between family process factors and nonacademic outcomes differ by family status variables. Specifically, two interaction models are estimated: one for interactions between family process variables and race (i.e., black versus non-black), and the other for interactions between family process variables and SES.

Multiple Testing Issues
The regression models include a comprehensive list of independent variables and statistical tests are performed to test the null hypothesis of whether each of the coefficients is equal to zero. Given the number of tests performed, one concern is the increase in the rate of false positives (also known as type I error). In other words, the issue is that, through multiple testing, the study would reject the null hypothesis of zero coefficients too often and falsely infer that there are more statistically significant effects than there actually are. To guard against this issue of multiple inferences, this study adopts Benjamini and Hochberg’s (1995) approach to control for the false discovery rate, i.e., the expected proportion of falsely rejected hypotheses. In doing so, families of tests are defined by the different regression model discussed previously. For example, the baseline model using approaches to learning as the dependent variable is considered one family of test while the baseline model with self-control as the outcome variable is another family of test. The false discovery rate is set at 0.05 level. In general, results in this chapter that are statistically significant at the 0.01 level based on single inference remain significant according to the Benjamini and Hochberg multiple-test procedure. In some cases, coefficients that are statistically significant at the 0.05 level also remain significant after accounting for multiple testing. Results shown in the next section indicate significance based on the multiple-test procedure.

Results

Baseline and Family Process Models
Table 2.16 presents results of the baseline and family process models. Only variables that are statistically significant are presented with actual values for

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45 Benjamini and Hochberg (1995) showed that controlling for the false discovery rate is a more powerful test than the more conservative Bonferonni approach of controlling for the family-wise error rate. See Newson et al. (2003) and Karoly et al. (2008) for more discussion on application of multiple-test procedures.

46 Multiple-test procedures are not conducted for random effects parameters.
effect sizes (see Appendix 2.G for the complete results including all coefficients, effect sizes, and standard errors). The baseline models indicated significant associations between children’s nonacademic outcomes and family status factors including race, SES, and family structure. Specifically, SES was positively associated with approaches to learning, self-control, and interpersonal skills, and negatively associated with both externalizing and internalizing problem behaviors, indicating that children from higher SES families tended to demonstrate higher levels of academic skills and fewer problem behaviors. In comparison with white children, blacks, on average, were rated as demonstrating significantly lower levels of approaches to learning, self-control, and interpersonal skills, and more externalizing problem behaviors. In contrast, Asians showed significantly higher levels of the three nonacademic skills and fewer externalizing problem behaviors. Children from single-parent households had lower average ratings in approaches to learning, self-control, and interpersonal skills, but more externalizing and internalizing problem behaviors than those from two-parent households. While most of these variables had small effect sizes, blacks and Asians showed average effect sizes in terms of approaches to learning, self-control, and externalizing problem behaviors.

Based on the results of the family process models, a number of family process variables were shown to be significantly associated with the five nonacademic outcomes. However, only one variable showed average effect size. Specifically, children whose parents believed their child’s academic performance in mathematics to be better than or as good as the peers received an average teacher rating of approaches to learning 0.21 SD higher than those whose parents believed their child’s performance to be worse than others. Effect sizes for other statistically significant variables were small (i.e., less than or equal to 0.2 SD in absolute value).

With respect to parental expectations of child’s future educational attainment were positively correlated with teacher ratings of children’s approaches to learning, self-control, and interpersonal skills, and negatively associated with externalizing and internalizing problem behaviors. Parental beliefs about child’s performance in reading was positively associated with approaches to learning and negatively associated with internalizing problem behaviors, but was insignificant with self-control, interpersonal skills, and externalizing problem behaviors. Parental beliefs about child’s current academic performance in mathematics were positively correlated with teacher ratings of children’s approaches to learning, self-control, and interpersonal skills, and negatively associated with internalizing problem behaviors.
In terms of learning structure, reading books more often was associated with higher rating in approaches to learning. Children who spent more time on homework per day were rated as demonstrating more internalizing problem behaviors. Since children who spent more time on homework tended to be those who were doing less well in school, they were more likely to receive less favorable ratings from their teachers.

While most of the variables measuring resources availability appeared to be insignificant, a child’s ownership of a library card was associated with higher ratings on the self-control measure and fewer externalizing problem behaviors. Home Internet access was associated with fewer internalizing problem behaviors. Surprisingly, availability of home computer for child use was correlated with more internalizing problem behaviors. While the underlying cause of this observed relationship is unclear, one possible explanation could be that children with a computer at home tend to go out and play with other children less often as they use the computer for leisure activities. This could make them seem more shy or withdrawn, and thus receiving a higher teacher rating of internalizing problem behaviors.

For home environment, parental report that their child appeared to like them was associated with higher ratings of interpersonal skills and fewer externalizing problem behaviors. In addition, parent-child interaction was positively associated with approaches to learning and self-control.

With respect to parenting and disciplinary practices, more frequent use of spanking was associated with lower ratings of approaches to learning, self-control, and interpersonal skills, as well as fewer externalizing problem behaviors. Children who are subject to more family rules on television watching tended to receive lower ratings of approaches to learning, self-control, and interpersonal skills. The use of more disciplinary methods was associated with lower ratings of self-control and interpersonal skills. These findings may suggest that children with lower levels of nonacademic skills are more likely to be exposed to parental disciplinary actions.

Finally, a number of variables measuring parental involvement in school and home learning activities were found to be significantly associated with teacher ratings of the nonacademic outcomes. Specifically, more parental involvement in school events was associated with higher ratings of approaches to learning, self-control, and interpersonal skills, as well as fewer internalizing problem behaviors.
behaviors. Less frequent help with both reading and math homework was associated with better approaches to learning, and less frequent help with math homework alone was associated with fewer internalizing problem behaviors. Children whose parents played sports or exercised with them more often tended to demonstrate fewer internalizing behaviors. However, parents’ frequent talk about nature or working on science project with their child was associated lower levels of approaches to learning and interpersonal skills as well as more internalizing problem behaviors. Children who were involved in household chores more often tended to demonstrate lower levels of interpersonal skills and more externalizing problem behaviors.

A comparison between the baseline and family process models reveals that family process variables explained approximately 4.5 percent of the within-school variation in approaches to learning, 1.8 percent in self-control, 2.1 percent in interpersonal skills, 1.2 percent in externalizing problem behaviors, and 2.9 percent in internalizing problem behaviors. In comparison with baseline models, differences in the five nonacademic outcomes by SES and family structure were less pronounced once family process variables were introduced into the model. Specifically, the magnitude of the SES coefficients reduced by about one third after controlling for family process factors, and the decrease in the magnitude of single-parent household coefficients ranged from 4 percent for internalizing problem behaviors to 18 percent for approaches to learning. This reduction in coefficient magnitude suggests that while family status factors are important, better family process explains a good portion of the differences in outcomes by SES and family structure. However, most of the SES and family structure coefficients remained statistically significant after controlling for family process factors, and there was not much difference in the effects of race on nonacademic outcomes between the baseline and family process models.

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47 Following the methods by Singer (1998), percentages of the within-school variation explained by family process variables were obtained by examining the reduction in the residual term with and without the inclusion of family process skills in the models (also see Le et al., 2006).
Table 2.16. Tobit Results of Baseline and Family Process Models

<table>
<thead>
<tr>
<th>Variable</th>
<th>Approaches To Learning</th>
<th>Self-Control</th>
<th>Interpersonal Skills</th>
<th>Externalizing Problem Behaviors</th>
<th>Internalizing Problem Behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRS Scales at Kindergarten</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approaches to learning</td>
<td>0.447**†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-control</td>
<td>0.420**†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interpersonal skills</td>
<td>0.396**†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Externalizing problem behaviors</td>
<td></td>
<td></td>
<td></td>
<td>0.604**† 0.590†</td>
<td></td>
</tr>
<tr>
<td>Internalizing problem behaviors</td>
<td></td>
<td></td>
<td></td>
<td>0.330**† 0.308**†</td>
<td></td>
</tr>
<tr>
<td>Parental Expectations and Beliefs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree expected</td>
<td>0.152**†</td>
<td>0.087**†</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belief in reading performance</td>
<td>0.146**†</td>
<td>Insig</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belief in math performance</td>
<td>0.208**†</td>
<td>0.169**†</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning Structure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doing homework more than 2 times a week</td>
<td>Insig</td>
<td>Insig</td>
<td></td>
<td>Insig</td>
<td>Insig</td>
</tr>
<tr>
<td>Place set aside for homework</td>
<td>Insig</td>
<td>Insig</td>
<td></td>
<td>Insig</td>
<td>Insig</td>
</tr>
<tr>
<td>Time for homework per day</td>
<td>Insig</td>
<td>Insig</td>
<td></td>
<td>Insig</td>
<td>Insig</td>
</tr>
<tr>
<td>Frequency of reading books – Infrequent</td>
<td>-0.126**†</td>
<td>Insig</td>
<td>-0.065*</td>
<td>0.083**†</td>
<td>0.109**†</td>
</tr>
<tr>
<td>Frequency of reading books – Every day</td>
<td>0.068**†</td>
<td>Insig</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home computer use 3 times a week or more</td>
<td>Insig</td>
<td>Insig</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resource Availability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home computer for child use</td>
<td>Insig</td>
<td>Insig</td>
<td></td>
<td>Insig</td>
<td>0.141**†</td>
</tr>
<tr>
<td>Home Internet access</td>
<td>Insig</td>
<td>Insig</td>
<td></td>
<td>Insig</td>
<td>-0.099*</td>
</tr>
<tr>
<td>Number of books child has at home</td>
<td>Insig</td>
<td>Insig</td>
<td></td>
<td>Insig</td>
<td>Insig</td>
</tr>
<tr>
<td>Family resources</td>
<td>Insig</td>
<td>Insig</td>
<td></td>
<td>Insig</td>
<td>Insig</td>
</tr>
<tr>
<td>Community library card for child</td>
<td>Insig</td>
<td></td>
<td>0.072**†</td>
<td>Insig</td>
<td>-0.061*</td>
</tr>
<tr>
<td>Home Affective Environment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Having warm, close times with child</td>
<td>Insig</td>
<td>Insig</td>
<td></td>
<td>Insig</td>
<td>Insig</td>
</tr>
<tr>
<td>Child likes parents</td>
<td>Insig</td>
<td>Insig</td>
<td></td>
<td></td>
<td>-0.077*</td>
</tr>
<tr>
<td>Sacrifice to meet child’s needs</td>
<td>Insig</td>
<td>Insig</td>
<td></td>
<td>Insig</td>
<td>Insig</td>
</tr>
<tr>
<td></td>
<td>Parents feeling child harder to care</td>
<td>Parent-child interactions</td>
<td>Talk with child about school every day</td>
<td>Parenting and Disciplinary Practices</td>
<td>Parental Involvement</td>
</tr>
<tr>
<td>--------------------------------------</td>
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<tr>
<td></td>
<td>Insig</td>
<td>0.037*</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.044*</td>
<td></td>
<td></td>
<td>Insig</td>
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<td></td>
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<td>Insig</td>
<td></td>
<td>Insig</td>
</tr>
<tr>
<td>Disciplinary methods</td>
<td>Insig</td>
<td>-0.022**†</td>
<td>-0.019*</td>
<td>Insig</td>
<td>Insig</td>
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<tr>
<td>Frequency of spanking in a week</td>
<td>-0.047**†</td>
<td>-0.056**†</td>
<td>-0.071**†</td>
<td>0.057**†</td>
<td>Insig</td>
</tr>
<tr>
<td>Number of family rules on TV viewing</td>
<td>-0.039***</td>
<td>-0.037*</td>
<td>-0.034*</td>
<td>Insig</td>
<td>Insig</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekday</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
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<tr>
<td>Hours of TV viewing on a weekend</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
</tr>
<tr>
<td>Parental involvement in school events</td>
<td>0.028**†</td>
<td>0.023*</td>
<td>0.029**†</td>
<td>Insig</td>
<td>-0.033**†</td>
</tr>
<tr>
<td>Contact with parents of child’s peers</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
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<tr>
<td>Frequency of help with reading homework</td>
<td>-0.077**†</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
</tr>
<tr>
<td>Frequency of help with math homework</td>
<td>-0.091**†</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
</tr>
<tr>
<td>Frequency of talking about nature/science</td>
<td>-0.079**†</td>
<td>Insig</td>
<td>-0.059*</td>
<td>Insig</td>
<td>0.074**†</td>
</tr>
<tr>
<td>Frequency of playing games/puzzles</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
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<tr>
<td>Frequency of playing sports or exercising</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
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<tr>
<td>Frequency of involving child in chores</td>
<td>Insig</td>
<td>Insig</td>
<td>-0.075*</td>
<td>0.072*</td>
<td>Insig</td>
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<tr>
<td>Involvement in artistic/cultural activities</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
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<tr>
<td>Library visit with child in last month</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
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<tr>
<td>Black</td>
<td></td>
<td>0.261**†</td>
<td>0.285**†</td>
<td>0.169**†</td>
<td>Insig</td>
</tr>
<tr>
<td>Hispanic</td>
<td></td>
<td>0.266**†</td>
<td>0.284**†</td>
<td>0.169**†</td>
<td>Insig</td>
</tr>
<tr>
<td>Asian</td>
<td></td>
<td>0.266**†</td>
<td>0.285**†</td>
<td>0.169**†</td>
<td>Insig</td>
</tr>
<tr>
<td>Other race</td>
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<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
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<tr>
<td>SES</td>
<td></td>
<td>0.182**†</td>
<td>0.123**†</td>
<td>0.145**†</td>
<td>Insig</td>
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<tr>
<td>Single-parent household</td>
<td></td>
<td>-0.093**†</td>
<td>-0.091**†</td>
<td>-0.083***</td>
<td>0.090**†</td>
</tr>
<tr>
<td>Other type of household</td>
<td></td>
<td>-0.253**†</td>
<td>-0.186*</td>
<td>Insig</td>
<td>-0.254**†</td>
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<tr>
<td>Family Status Factors</td>
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<tr>
<td>Black</td>
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<tr>
<td>Hispanic</td>
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</tr>
<tr>
<td>Asian</td>
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<tr>
<td>Other race</td>
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<tr>
<td>SES</td>
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<tr>
<td>Single-parent household</td>
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<tr>
<td>Other type of household</td>
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<td>Child Characteristics</td>
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<td>Female</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Age at assessment</td>
<td></td>
<td></td>
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<tr>
<td>School Factors</td>
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<td>------</td>
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<tr>
<td>Age at assessment squared</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
</tr>
<tr>
<td>Speak non-English at home</td>
<td>0.124**†</td>
<td>0.122***†</td>
<td>Insig</td>
<td>Insig</td>
<td>0.093*</td>
</tr>
<tr>
<td>Transferred school</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>-0.081†</td>
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<tr>
<td>Disability</td>
<td>-0.404**†</td>
<td>-0.296**†</td>
<td>-0.318**†</td>
<td>-0.261***†</td>
<td>-0.317***†</td>
</tr>
<tr>
<td>Number of siblings</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
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<tr>
<td>50 percent or more being minority</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
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<tr>
<td>10 percent or more with reduced-price lunch</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
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<tr>
<td>Percent students eligible for free lunch</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
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<tr>
<td>Central city</td>
<td>Insig</td>
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<td>Insig</td>
<td>Insig</td>
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<tr>
<td>Rural and small town</td>
<td>Insig</td>
<td>Insig</td>
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<tr>
<td>Class size</td>
<td>Insig</td>
<td>Insig</td>
<td>0.010***†</td>
<td>0.008*</td>
<td>Insig</td>
</tr>
<tr>
<td>Teacher experience (in years)</td>
<td>Insig</td>
<td>Insig</td>
<td>0.003**†</td>
<td>0.003*</td>
<td>Insig</td>
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<td>Intercept</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
<td>Insig</td>
</tr>
</tbody>
</table>

NOTE: Effect sizes. * indicates significance at .05 level, ** indicates significance at .01 level. † indicates significance at .05 false discovery rate. Insig stands for insignificant coefficients. BL stands for baseline models, and FP stands for family process models.
Interaction Models: Black Vs. Non-Black and SES

Table 2.17 presents results of the interaction models that included interaction terms between a dummy for black versus non-black and family process variables that had statistically significant coefficients in the family process models. The table also provides results of the interaction models that included interaction terms between SES and family process variables. Only family process variables and interaction terms are shown in the table. Moreover, only variables that are statistically significant are presented with actual values for effect sizes (see Appendix 2.H for the complete results including all coefficients, effect sizes, and standard errors).

For the models including interaction terms between a dummy for black versus non-black and family process factors, only a few family process variables appeared to be statistically significant for both main effects terms and interaction terms, indicating that black children had different returns to these family process inputs as compared to their non-black peers. For both approaches to learning and self-control, blacks appeared to have a significantly lower return to parental expectations of child’s educational attainment. In terms of interpersonal skills, blacks had a significantly higher return to the exposure of more disciplinary methods. While most of these interaction terms showed small effect sizes, one variable had an average effect size. Specifically, the effect size for the interaction term between the dummy of black versus non-black and parental expectations of child’s educational attainment was -0.27 in the model using self-control as the outcome, indicating that black children had a return to parental expectations 0.27 SD lower than their non-black peers for self-control.

For the SES interaction models, only one family process variable appeared to be statistically significant for both main effects terms and interaction terms. Specifically, the coefficient of the interaction term for child’s ownership of a community library card was significantly negative in the model using self-control as the outcome, indicating that with respect to self-control, children with low SES tended to have a significantly higher return to child’s ownership of a community library card. However, effect size for the variable was small.
Table 2.17. Tobit Results of Interaction Models (Black Vs. Non-Black/SES)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Approaches to Learning</th>
<th>Self-Control</th>
<th>Interpersonal Skills</th>
<th>Externalizing Problem Behaviors</th>
<th>Internalizing Problem Behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRS Scales at Kindergarten</td>
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<td>0.083* 0.075*</td>
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NOTE: Effect sizes. * indicates significance at .05 level, ** indicates significance at .01 level. † indicates significance at .05 false discovery rate. Insig stands for insignificant coefficients.
Discussion

Results of this chapter indicate that family process factors are important predictors of nonacademic outcomes. Several family process variables were found to be significantly associated with multiple dimensions of nonacademic outcomes even after controlling for demographics and school inputs. Higher parental expectations was associated with all five nonacademic outcomes including higher ratings in approaches to learning, self-control, and interpersonal skills, and fewer internalizing and externalizing problem behaviors. Greater parental involvement in school activities was correlated with higher ratings in approaches to learning, self-control, and interpersonal skills, and fewer internalizing problem behaviors. Moreover, less frequent use of spanking was correlated with higher ratings in approaches to learning, self-control, and interpersonal skills, and fewer externalizing problem behaviors. However, many family process variables were statistically insignificant, and most of the statistically significant variables showed small effect sizes.

Consistent with previous research, nonacademic outcomes were found to vary by race, SES, and family structure (Brooks-Gunn and Markman-Pithers, 2005; Cannon and Karoly, 2007; Carneiro and Heckman, 2003; Carneiro, Cunha, and Heckman, 2003; Cunha et al., 2006; Heckman, Stixrud, and Urzua, 2006; Magnuson and Waldfogel, 2005; Rimm-Kaufman, Pianta, and Cox, 2000). In general, children who were black, low SES, and from single-parent households demonstrated lower levels of nonacademic skills and higher levels of problem behaviors. Controlling for family process factors reduced the magnitude of the effects of SES and family structure, but most coefficients for SES and family structure were still statistically significant in the family process models. This reduction in coefficient magnitude suggests that while family status factors are important, better family process explains a good portion of the differences in outcomes by SES and family structure. Interaction models indicate that most of the interaction terms were statistically insignificant, and only one variable showed significant and meaningful result. Specifically, in terms of self-control, children with low SES were shown to have a significantly higher return to child’s ownership of a community library card, but the effect size was small.

Development of nonacademic skills among young children is not just an end to itself, as research evidence has pointed out its potential effects on longer-term outcomes including achievement (Agostin and Bain, 1997; Cunha et al., 2006; Heckman, Stixrud, and Urzua, 2006; Ladd, Birch, and Buhs, 1999; Le et al., 2006; McClelland, Morrison, and Holmes, 2000). Investing in family process factors
may bring about not only better nonacademic outcomes, but eventually higher student achievement as well.
CHAPTER 3. FAMILY FACTORS AND STUDENT ACHIEVEMENT: AN INTERNATIONAL COMPARISON

Policymakers and educators have long been concerned about the poor performance of U.S. students in international assessments relative to their peers in other countries. International comparisons of student achievement indicate that U.S. students do not fare well, especially compared to students in other developed countries. By the end of middle school, U.S. students lag behind in reading, mathematics, and science in comparison with their peers in other Organization for Economic Cooperation and Development (OECD) countries (Baldi et al., 2007; Juvonen et al., 2004; Lemke et al., 2004; Miller et al., 2009). The performance of U.S. students in international assessments is even worse at the secondary level, with high school students scoring significantly below the international average in both mathematics and science (Juvonen et al., 2004; Mullis et al., 1998). As pointed out by Hanushek (1998), while the U.S. was able to produce a competitively skilled labor force with more years of schooling in the past, many countries have dramatically increased the years of schooling for their youth in recent years. As the “advantage in quantity of schooling” is quickly disappearing, the U.S. is facing the urgent need to improve educational outcomes. This serious challenge calls for a better understanding of factors influencing student achievement in an international setting.

To understand the sources of achievement differences across countries, a great deal of international comparative research has focused on assessing the determinants of student achievement. The stimuli for much of this research came from two influential reports—the Coleman Report (Coleman et al., 1966) in the U.S. and the Plowden Report in Great Britain (Peaker, 1971), which generally concluded that student achievement was determined more by family factors than school characteristics (Buchmann, 2002). These studies set off a heated debate regarding the relative roles of family and schools on student achievement.

Earlier studies, typically utilizing a production function approach and regression analysis, generally found large family effects on student achievement in developed countries, and significant school effects and weak family effects in developing countries (Buchmann, 2002; Fuller, 1987; Fuller and Clarke, 1994; Heyneman, 1976; Heyneman and Loxley, 1983). However, these studies have been widely criticized for methodological weaknesses including inadequacy of the measurement of family background, reliance on single-level model of OLS regression analysis, and the use of the R-square measure to determine the impact
of family and school effects on student achievement (Bidwell and Kasarda, 1980; Buchmann, 2002; Fuller and Clarke, 1994; Riddell, 1989). As a result, many have questioned the validity of claims regarding cross-national variations in the patterns of family and school effects.

Recent studies have utilized multilevel modeling techniques to assess family and school effects on student achievement (Buchmann, 2002; Raudenbush and Bryk, 1986). While only a few studies have applied multilevel models in international comparative research, they found greater effects of family factors than school characteristics on student achievement (Buchmann, 2002; Lockheed and Longford, 1991; Riddell, 1989; Woesmann, 2004). For example, in his analysis of family impact on mathematics and science achievement in the U.S. and 16 European countries, Woesmann (2004) found that both the size of the family effects and the explained proportion of the test-score variation “dwarf the effects that have been found for school inputs such as class sizes, teacher characteristics, resource endowments, and institutional features” (p. 18). Lockheed and Longford (1991) reported that family and individual factors contributed 68 percent of the explained variance in mathematics achievement, whereas school characteristics accounted for 32 percent of the explained variance in Thailand.

Although the family is identified as one of the most important determinants of student achievement, many studies that have investigated the family impact on achievement are mostly based on data within a country. Cross-country studies are scarce because of the limited availability of internationally comparable data. Results of a few studies that examined family influence over student achievement across counties indicated that performance on international assessments was related to a variety of family background measures including family income, family structure (whether a single-parent or two-parent household), parental education, parental occupation, and number of books available at home (Hampden-Thompson and Johnston, 2006; Lee and Barro, 2001; Woesmann, 2004). However, these studies only included one or two family variables in their analysis, and typically focused on harder-to-change family status factors such as SES, family income, family structure, parental education, and parental occupation.

This chapter examines the extent to which student achievement is related to family factors across different countries using the Program for International Student Assessment (PISA), a cross-country, cross-sectional dataset that measures capabilities of 15-year-old students in reading, mathematics, and science literacy in 2000, 2003 and 2006. Prior research based on PISA datasets
generally suggested that U.S. students fared worse vis-à-vis their counterparts in OECD countries, especially in mathematics and science. In 2003 and 2006, U.S. students continued to perform below the OECD average on both mathematics and science (Baldi et al., 2007; Lemke et al., 2004; Miller et al., 2009; Provasnik, Gonzales, and Miller, 2009). They were placed in the bottom quarter of participating OECD countries for mathematics and bottom third for science in 2006 (Baldi et al., 2007; Provasnik, Gonzales, and Miller, 2009). In 2003, U.S. students’ average reading score was not measurably different from the OECD average, and the U.S. ranked in the middle third of participating OECD countries (Miller et al., 2009; Provasnik, Gonzales, and Miller, 2009). In addition, statistics from PISA 2006 indicated that the highest average scores were from Korea for reading, from Chinese Taipei, Finland, Hong Kong, and Korea for mathematics, and from Finland for science (Baldi et al., 2007; Provasnik, Gonzales, and Miller, 2009).

While the above findings revealed the U.S. standing in international comparisons of student achievement based on descriptive statistics, other studies used PISA datasets to analyze possible relationships between student achievement and educational inputs including student, family, and school factors. Using PISA 2000 dataset, Fuchs and Woessmann (2007) estimated international education production functions to look for factors that account for international differences in student achievement. They found that student characteristics, family backgrounds, home inputs, resources, and teachers and institutions were all significantly contributed to the differences in reading, mathematics and science achievement across countries. Their models accounted for “more than 85 percent of the between-country performance variation, with roughly 25 percent accruing to institutional variation” (p. 433).

Hampden-Thompson and Johnston (2006) compared the U.S. with 19 countries at similar level of economic development in terms of the differences in nonschool factors and their relationships with student achievement using PISA 2003 dataset. They reported that U.S. did not differ from the other 19 countries in terms of SES, parental education, number of books at home, immigrant status, and language spoken at home. However, the U.S. had “a higher percentage of 15-year-olds with parents of high occupational status and a higher percentage of 15-year-olds residing in non-two-parent households compared to the 20-country average” (p. 15). While having parents of high occupational status was associated with better student performance in mathematics literacy in all 20 countries, the achievement gap between students with parents of high occupational status and students with parents of middle and low occupational status in the U.S. did not differ.
significantly from the international average of the achievement gap by parent occupational status. In terms of the achievement gaps by family structure, the U.S. had a larger achievement gap between students from two-parent households and their peers from non-two-parent households than 17 other countries, and the achievement gap by family structure in the U.S. was significantly different from the international average. Moreover, within-country analyses based on OLS regressions indicated that in nearly all of the 20 countries, students with certain family characteristics (including speaking the language of test at home, being born in the country of test, and residing in two-parent households) outperformed other students.

This chapter extends previous literature by distinguishing *unchangeable* family status factors (such as SES) from *alterable* family process factors (such as learning structure, resource availability, and parental involvement), and examining how these two groups of factors are related to student achievement among 15 year olds in 21 jurisdictions. Specifically, this chapter addresses the following research questions:

1. How do U.S. middle school students compare with their peers in other jurisdictions in terms of academic achievement and family factors?
2. What is the relationship between family process factors and academic achievement, after controlling for student, school, and country-level characteristics? What are the differences in achievement across jurisdictions after controlling for student, family, and school factors?
3. How does U.S. compare to other jurisdictions in terms of the academic effects of family factors, after controlling for student, school, and country-level characteristics?

This chapter is organized as follows: It begins with a detailed description of the data including sampling procedure, weights, and measures of academic achievement, family factors, and school characteristics used in the analysis. It then presents the analytical methodology including imputation procedure, analysis with plausible values, and regression models. It concludes with findings and policy implications.

**Data**

This chapter uses the Program for International Student Assessment (PISA), a cross-country, cross-sectional dataset that assesses the student achievement of 15-year-old students in reading, mathematics, and science literacy every three years. The program is carried out by OECD, an intergovernmental organization
of 30 developed countries. It collects a range of family, school, and student information using student, school, and parent surveys as well as a cognitive test. Unlike other international assessments, the cognitive test in PISA is designed to measure the ability to apply broad knowledge and skills in reading, mathematics, and science to problems within real-life contexts, as opposed to more specific curriculum-based outcomes. The framework for each subject area is based on concepts or knowledge domains, processes, competencies, and situations or contexts (Baldi et al., 2007; Fuchs and Woessmann, 2007; Lemke, Calsyn, et al., 2001; Lemke, Sen, et al., 2004; OECD, 2007; Provasnik, Gonzales, and Miller, 2009).

PISA was first implemented in 2000, and so far data are available for three waves: 2000, 2003, and 2006. Each wave assesses one of the three subject areas in depth, even though all three subjects are assessed in each wave to provide an ongoing source of achievement data in every subject. In 2000, reading literacy was the subject area assessed in depth. In 2003, it was mathematics literacy. And in 2006, it was science literacy (Baldi et al., 2007; Hampden-Thompson and Johnston, 2006; Miller et al., 2009; OECD, 2009a). Since PISA is an age-based survey, it collects information from different cohorts of students in each wave. Moreover, contents of the cognitive tests have gone through changes over years. Therefore, this analysis uses the most recent wave of data—PISA 2006, which encompasses 57 participating jurisdictions. This section describes the sample size, weights, and measures used in the analysis.

**Sample and Weights**

PISA 2006 surveyed students in 57 countries including 30 OECD member countries and 27 non-OECD economies. This analysis is based on students in 21 countries and economies: 16 Western countries including the U.S. and 5 East Asian economies. The 15 Western countries are selected because they have a similar level of social and economic development to the U.S. In contrast, the group of East Asian economies differs from the U.S. with respect to cultural, familial, and social attitudes toward education. For example, parenting style of Asians such as the Chinese is often described as authoritarian (directive and controlling) while parents in the Western countries including the U.S. tend to use authoritative (responsive and supportive) parenting practices (Steinberg, Dornbusch, and Brown, 1992; Chen, Dong, and Zhou, 1997; Wu et al., 2002; Chao, 1994). Different parenting styles are associated with children’s socio-emotional adjustment, which in turn may affect their academic achievement (Huntsinger, Jose, and Larson, 1998; Chen, Dong, and Zhou, 1997). The resulting sample
consists of 160,624 students from 21 jurisdictions. Appendix 3.A presents the sample size for each jurisdiction included in the analysis.

As described above, PISA’s target population in each country consisted of 15-year-old students who were attending a school or other educational institution located within the country, in grades 7 and higher. More specifically, the target population was defined as all students aged from 15 years and 3 months to 16 years and 2 months at the beginning of the assessment period, with a permitted variation of up to one month in this age definition. The target age of 15 was intended to allow comparisons of academic outcomes as students are near the end of compulsory schooling (Baldi et al., 2007; Fuchs and Woessmann, 2007; OECD, 2009a). However, this age-based sampling design creates a sample of students that come from several grade levels. Moreover, the modal grade for the 15-year-old students can differ across countries as a result of differences in the starting age of education. The sample of this chapter consists of students with grade levels ranging from grade 7 to grade 13. Grade 10 is the modal grade in 12 out of the 21 jurisdictions included in the analysis, while grade 9 is the modal grade in seven jurisdictions and grade 11 is the modal grade in the remaining 2 jurisdictions.48

In most participating jurisdictions, PISA employed a two-stage probability sample design to ensure that a representative sample of the target population was selected in each country.49 The first stage drew a stratified random sample of schools where 15-year-old students were enrolled, producing a minimum sample of 150 schools per country. The second stage randomly sampled 35 students in each of the participating schools, with each student in a school having an equal probability of being selected (Fuchs and Woessmann, 2007; OECD, 2009a, 2009b).50

48 The seven countries where grade 9 is the modal grade for the 15 year olds are Denmark, Finland, Germany, Ireland, Luxembourg, Sweden and Switzerland. The 12 jurisdictions where grade 10 is the modal grade for the 15 year olds are Australia, Belgium, Canada, Chinese Taipei, Hong Kong, Italy, Japan, Korea, Netherland, Norway, United Kingdom, and U.S. And the two jurisdictions where grade 11 is the modal grade for the 15-year-old students are Macao and New Zealand.

49 One country employed a three-stage design while all other participating jurisdictions used a two-stage stratified sample design (OECD, 2009a).

50 For schools with fewer than 35 15-year-old students, all eligible students were selected. Some participating jurisdictions used values other than 35 as the number of the students to be sampled within a school (OECD, 2009a).
Throughout the analysis, weights are used to account for stratification, over-sampling of certain populations, and non-response adjustments.\textsuperscript{51} Weights are normalized so that the sum of the weights was equal to the number of students in the data and each country contributed equally to the analysis (OECD, 2009b).

\textit{Measures}
This chapter is based on the same conceptual model shown in Chapter 1, which depicts the relationship between three types of factors (i.e., family process factors, family status factors, and school factors) and two types of student outcomes (i.e., academic outcomes, and nonacademic outcomes). As this chapter focuses on student achievement as the outcome, this analysis includes the following measures: student achievement, family process variables, family status variables, child characteristics, and school factors.

Student achievement is measured by test scores from cognitive assessments in mathematics and science calculated using Item Response Theory (IRT) procedures.\textsuperscript{52} IRT identifies patterns of correct, incorrect, and omitted responses and uses statistical models to predict the probabilities of a student giving correct answers as a function of the student’s proficiency in answering other questions (OECD, 2009a, 2009b). Test scores are estimated as plausible values since each student completed only a subset of items. Plausible values, defined as random values from the posterior distribution of estimated student achievement, represent the distribution of potential scores for all students in the population with similar characteristics and identical patterns of item response (Baldi et al., 2007; OECD, 2009a, 2009b). Five plausible values were estimated for each student for each subject.

Family process factors are measured by variables collected from student and parent surveys, which contain information on three types of family process factors, i.e., learning structure, resource availability, and parental involvement. Appendix 3.B provides a detailed description of variables used to measure family process factors.

\textsuperscript{51} This study uses the W\_FSTUWT weight for interested readers familiar with the PISA data. Replicate weights generated using the Fay method (i.e., W\_FSTR1-W\_FSTR80) are also used to estimate standard errors.

\textsuperscript{52} PISA 2006 reading results are not reported for the U.S. due to an error in printing the test booklets (see Baldi et al., 2007 for details). As a result, this chapter excludes reading achievement from analysis.
PISA 2006 contains several family status variables including parental education, parental occupation, and SES. SES is a composite measure, created using three variables: parental education (measured as the higher education level of mother or father), parental occupation (measured as the higher occupation status of mother or father), and home possessions encompassing 21 items measuring family wealth. Since parental education and parental occupation were used to derive SES, they are not included in the analysis.

Child characteristics include gender, grade level at assessment, language spoken at home (i.e., whether or not the child speaks the language of test or other national language at home), and immigration status. School-level covariates consist of school sector (i.e., whether the school is public or private), quality of educational resources at school, class size, and dummies measuring the number of hours spent on attending regular lessons at school.

PISA’s complicated survey procedure was designed to ensure the comparability of measures across countries. Countries are required to meet the established target rates for participation and non-responses and to comply with standardized procedures for the preparation, administration, and scoring of assessments in order for the country’s results to be included in the international reports and datasets. However, potential biases may arise from possible differences in ways that countries implemented the survey procedure. For example, student responses to certain open-ended items were manually coded by

53 The rationale for using the three components for deriving SES is that SES is usually based on education, occupational status, and income. Since no direct income measure is available from the PISA data, possession of household items is used as a proxy for family wealth. Moreover, in international studies of education, household assets are believed to capture family wealth better than income because they reflect a more stable source of wealth (OECD, 2009b).

54 The quality of educational resources at school is a composite index computed using seven items measuring the school principal’s perceptions of potential factors hindering instruction at school. These seven items are shortage or inadequacy of science laboratory equipment, shortage or inadequacy of instructional materials (e.g., textbooks), shortage or inadequacy of computers for instruction, lack or inadequacy of Internet connectivity, shortage or inadequacy of computer software for instruction, shortage or inadequacy of library materials, and shortage or inadequacy of audio-visual resources. All seven items were measured using Likert-scale (not at all/very little/to some extent/a lot). They were then calibrated and transformed to indicate the value relative to the OECD average (for example, a score of 2 represents 2 standard deviations below the OECD average). All items were inverted for scaling, and thus higher values on the index indicate higher levels of educational resources at school (OECD, 2009a, 2009b).

55 There are two dummies for each of the three subjects, with one dummy equal to 1 for less than two hours per week and the other dummy equal to 1 for four or more hours per week. The reference category is two up to four hours per week.
coders trained at the national level. Since coders in one country may interpret and apply the coding instructions more or less leniently than coders in another country, it could lead to national-level bias in the resulting test scores. As one of the quality control procedures, PISA conducted an international coding review to investigate the possibility of systematic differences among countries in the coding of these items (OECD, 2009a; Provasnik, Gonzales, and Miller, 2009).

**Analytic Methods**

*Imputation*
Approximately 10 percent of the sample has missing values in one or more of the variables included in the analysis. While it is possible to exclude cases that have a missing value for any variables required for the analysis, such an approach may produce biased estimates if individuals with complete data differ systematically from the target population. This approach would also fail to take full advantage of the partially complete cases, thus leading to inefficient use of the collected information (Carlin et al., 2003; Le et al., 2006; Schafer, 1999). In contrast, the multiple imputation method provides multiple predictions for each of the missing values, thus making it possible to obtain practically unbiased estimates of all parameters and standard errors (Carlin et al., 2003; Le et al., 2006; Royston, 2005; Schafer, 1999; Zhang, Liao, and Zhu, 2008). However, multiple imputation procedure typically only works well with small to medium-sized datasets. When dealing with large datasets with large numbers of variables and/or observations, multiple imputation procedure can be very slow or even incapable of imputing the data at all (Zhang, Liao, and Zhu, 2008).

An alternative to case-wise deletion and multiple imputation is single imputation, which substitutes a missing value with a definite value calculated by following an established statistical procedure. Although single imputation, unlike multiple imputation, is unable to reflect the uncertainty of the predictions about the unknown missing values, it is still widely used due to its simplicity and efficiency. In some cases, results from single imputation are not substantially different from those from multiple imputation (Zhang, Liao, and Zhu, 2008).

Because of the relatively large sample of 160,624 students, this chapter uses a single imputation procedure to address the missing data problem. Following the methods by Zhang, Liao, and Zhu (2008), a complete dataset is generated with missing values replaced by the sum of sample mean and the standard deviation times a random number drawn from a normal distribution with zero mean and
standard deviation of one.\textsuperscript{56} Categorical and dichotomous variables are treated as continuous during the imputation process, and then rounded back to discrete numbers for analysis.\textsuperscript{57}

\textit{Effect Size Calculation}

Because of the large sample size, variables can achieve statistical significance even when they are of little substantive significance. To understand the practical importance of the variables, results are also shown in terms of effect sizes, which can be interpreted as the change in standard deviations (SDs) of the dependent variable associated with one-unit change in an independent variable. Following the methods by Von Secker and Lissitz (1999), effect sizes are calculated by dividing each coefficient by the pooled within-school standard deviations from the unconditional models.\textsuperscript{58}

For context, the observed effect sizes are compared to the typical effect size of past educational interventions as reported by Hill et al. (2008). Hill et al. (2007) synthesized 76 meta-analyses of past studies of educational intervention programs in kindergarten through grade 12, and found that the mean effect sizes ranged from 0.20 to 0.30 across different interventions, achievement outcomes, and grade levels. Specifically, the mean effect size for the elementary grades was 0.23, the mean effect size for the middle grades was 0.27, and the mean effect size for the grades of high school was 0.24. Using these effect sizes as benchmarks, effect sizes less than or equal to 0.20 SD (in absolute value) are interpreted as “small,” effect sizes between 0.20 and 0.30 SD as “average,” and effect sizes of 0.30 SD or more as “above average.”

\textit{Analysis of Data with Plausible Values}

As described earlier, student test scores are estimated as plausible values with each student having five plausible values for each subject. Analysis with plausible values is conducted with the following steps (OECD, 2009b). First, each of the five plausible values are used separately to obtain the statistics of

\textsuperscript{56} The detailed procedure of single imputation is as follows. First, generate a random number that follows a normal distribution with zero mean and standard deviation of one, i.e., \( R \sim \text{N}(0,1) \). Then estimate the sample mean (\( \hat{\mu} \)) and standard deviation (\( \hat{\sigma} \)) of the variable being imputed. Finally, the missing value is replaced by the imputed value (\( \hat{X} \)) using the following formula: \( \hat{X} = \hat{\mu} + \hat{\sigma} \times R \). See Zhang, Liao, and Zhu (2008) for more discussions.

\textsuperscript{57} The break point for rounding is 0.5, with values of 0.5 and more being rounded up and values less than 0.5 being rounded down.

\textsuperscript{58} Unconditional models partition the variance in achievement into between- and within-school components. Results of the unconditional models are shown in Appendix 3.D.
interest ($\hat{\beta}_i$, $i = 1, 2, 3, 4, 5$; e.g., mean of test scores, or regression coefficients) and variances ($\sigma_i^2$, $i = 1, 2, 3, 4, 5$). The resulting statistics ($\hat{\beta}_i$) are combined to obtain the final statistic ($\hat{\beta}$) using the simple average method. Similarly, the estimated sampling variances ($\sigma^2_{\hat{\beta},i}$) are averaged to obtain the final sampling variance ($\sigma^2_{\hat{\beta}}$). A separate imputation variance ($\sigma^2_{\text{impute}}$) is computed as the sum of the squared differences between the final statistic ($\hat{\beta}$) and each of the five statistics associated with each of the plausible values ($\hat{\beta}_i$) divided by 4. The final variance ($\sigma^2$) is then calculated as the sum of final sampling ($\sigma^2_{\hat{\beta}}$) variance and the imputation variance ($\sigma^2_{\text{impute}}$) times 1.2, and the final standard error ($\sigma$) is the square root of the final variance ($\sigma^2$). SAS macros that reflect the above procedures are used to carry out the analyses with plausible values (OECD, 2009b).

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Throughout all analyses, a final weight (W_FSTUWT) and 80 replicate weights (W_FSTR1-W_FSTR80) are used to obtain the statistic of interest and its standard error. As a result, a total of 405 estimates are obtained for analyses involving plausible values (see OECD, 2009b for details on analysis of data with plausible values and weights).

Each sampling variance ($\sigma^2_{\hat{\beta},i}$) is estimated using the 80 replicate weights (W_FSTR1-W_FSTR80). More specifically, the statistic of interest ($\hat{\beta}_i$) is estimated using the final weight (W_FSTUWT), and 80 replicate statistics of interest ($\hat{\beta}_{i,j}$, $j = 1, 2, 3...80$) are estimated using the 80 replicate weights (W_FSTR1-W_FSTR80). The sampling variance ($\sigma^2_{\hat{\beta},i}$) is then calculated as the sum of the squared differences between the statistic of interest ($\hat{\beta}_i$) and 80 replicate statistics of interest ($\hat{\beta}_{i,j}$) divided by 20. The general formula for computing the sampling variance is as follows: $\sigma^2_{\hat{\beta},i} = \frac{1}{G(1-k)^2} \sum_{j=1}^{G} (\hat{\beta}_{i,j} - \hat{\beta}_i)^2$, where $G$ is the number of replicates and $k$ is the Fay coefficient. Since PISA 2006 includes 80 replicates and the Fay coefficient is set to 0.5, the divisor equals 20 (see OECD, 2009b for details on computation of variances and standard errors.)

The formula for computing the imputation variance ($\sigma^2_{\text{impute}}$) is as follows: $\sigma^2_{\text{impute}} = \frac{1}{M-1} \sum_{j=1}^{5} (\hat{\beta}_i - \hat{\beta})^2$, where $M$ is the number of plausible values. Since PISA 2006 computes five sets of plausible values for each of the student achievement variable, the divisor equals 4 (OECD, 2009b).

The formula for computing the final variance is as follows: $\sigma^2 = \sigma^2_{\hat{\beta}} + \left(1 + \frac{1}{M}\right)\sigma^2_{\text{impute}}$. With five sets of plausible values, the multiplier in front of the final imputation variance equals 1.2 (OECD, 2009b).
International Comparison and Regression Models

Descriptive statistics by countries are used to analyze whether U.S. students differ with their counterparts in other countries in terms of student achievement and family process factors. Specifically, U.S. students are compared with two groups of countries, i.e., Western countries and East Asian economies. Comparison of country effects on student achievement after controlling for student, family, and school factors is based on regression analyses discussed below.

To estimate the relationship between student achievement and family factors, two-level hierarchical models are used:

\[ Y_{ij} = \gamma_j + \theta_j FP_{ij} + \delta_j FS_{ij} + \beta_j C_{ij} + \epsilon_{ij} \] \hspace{2cm} (3.1)

\[ \gamma_j = \pi S_j + \mu_c + \nu_j \] \hspace{2cm} (3.2)

where \( i \) and \( j \) index individual students and schools respectively. \( Y_{ij} \) is student achievement measured with test scores in mathematics and science, \( FP_{ij} \) is a vector of variables measuring family process factors, \( FS_{ij} \) is a vector of variables measuring family status factors, \( C_{ij} \) is a vector of student-level covariates, \( S_j \) is a vector of school factors, and \( \mu_c \) is a vector of dummy variables for countries.

As shown in equation 3.1, the Level-1 model estimates the relationship between achievement and student-specific variables including family process factors, family status factors, and other student-level covariates. The coefficients of the student-specific variables \( \theta, \delta, \beta \) are assumed to be fixed across all schools, but the intercept \( \gamma_j \) is allowed to vary across schools and modeled with a random component \( \nu_j \) in equation 3.2. The error term \( \epsilon_{ij} \) in equation 3.1 is assumed to be normally distributed with zero mean and standard deviation \( \sigma_e \). Equation 3.2 models \( \gamma_j \) as a function of school-level variables. The coefficients \( \pi \) estimate effects of school-level factors on the outcome variable \( Y_{ij} \), and \( \nu_j \) is the random effect term for each school, with an assumed normal distribution of zero mean and standard deviation \( \sigma_v \). The vector of dummy variables for countries \( \mu_c \) is the fixed effects term, which accounts for all country-specific factors (including unobservables) that might cause endogeneity problems by influencing both the dependent variable (i.e., student achievement) and the independent variable of interest (i.e., family factors). Since U.S. is used as the reference category for country fixed effects in models estimating mathematics and science achievement, the coefficients of the country fixed effects terms also indicate whether the particular country fares better or worse vis-à-vis the U.S. after controlling for student, family, and school factors. Error terms \( \epsilon_{ij} \) and \( \nu_j \) are assumed to be independent from each other.
Two separate models are estimated to address the second research question. The model presented above (hereinafter, referred to as the family process model) estimates the relationship between family factors and student achievement. Baseline models that regress achievement as a function of family status variables, student-specific covariates, and school factors are also estimated. A comparison of results from the family process models with the baseline models reveals whether and how family status variables (i.e., SES) change once family process variables are added into the estimation.

For the third research question, interaction terms between family process variables and two country group dummies are added to the family process model to understand how the U.S. compares with other countries in terms of the academic effects of family factors. Specifically, the two country dummies are 15 Western countries excluding the U.S. (with a sample size of 125,665) and 5 East Asian economies (with a sample size of 29,348), using the U.S. (with a sample size of 5,611) as the reference group.

**Multiple Testing Issues**

The regression models, especially the interaction models, include quite many independent variables and statistical tests are performed to test the null hypothesis of whether each of the coefficients is equal to zero. Given the number of tests performed, one concern is the increase in the rate of false positives (also known as type I error). In other words, the issue is that, through multiple testing, the study would reject the null hypothesis of zero coefficients too often and falsely infer that there are more statistically significant effects than there actually are. To guard against this issue of multiple inferences, this study adopts Benjamini and Hochberg’s (1995) approach to control for the false discovery rate, i.e., the expected proportion of falsely rejected hypotheses.63 In doing so, families of tests are defined by the different regression model discussed previously. For example, the baseline model using mathematics achievement as the dependent variable is considered one family of test while the baseline model with science achievement as the outcome variable is another family of test. The false discovery rate is set at 0.05 level.64 In general, results in this chapter that are statistically significant at the 0.01 level based on single inference remain

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63 Benjamini and Hochberg (1995) showed that controlling for the false discovery rate is a more powerful test than the more conservative Bonferonni approach of controlling for the family-wise error rate. See Newson et al. (2003) and Karoly et al. (2008) for more discussion on application of multiple-test procedures.

64 Multiple-test procedures are not conducted for random effects parameters.
significant according to the Benjamini and Hochberg multiple-test procedure. In most cases, coefficients that are statistically significant at the 0.05 level also remain significant after accounting for multiple testing. Results shown in the next section indicate significance based on the multiple-test procedure.

Results

*Descriptive Statistics*
Table 3.1 presents the means and standard deviations of the mathematics and science test scores. Mathematics test scores range from 0.62 to 945.23, with a mean of 498.44. Science test scores range from 21.39 to 923.28, with a mean of 506.50.

<table>
<thead>
<tr>
<th>Test Scores</th>
<th>Mean</th>
<th>S.E.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>498.44</td>
<td>1.66</td>
<td>0.62</td>
<td>945.23</td>
</tr>
<tr>
<td>Science</td>
<td>506.50</td>
<td>1.74</td>
<td>21.39</td>
<td>923.28</td>
</tr>
</tbody>
</table>

NOTE: Includes imputed values.

Table 3.2 shows descriptive statistics of family process variables. On average, approximately 88 percent of students had a quiet place to study at home. The percentage of students who reported spending no time on homework or self-study was approximately 14 percent for mathematics and 23 percent for science. The proportion of students who reported spending four or more hours per week on homework and self-study was around 12 percent for mathematics and 7 percent for science. In terms of available resources, more than 88 percent of students had the ownership of a home computer to use for school work and nearly 86 percent of students had Internet access at home. Around 27 percent of students owned no more than 25 books, and 43 percent owned more than 100 books at home. With respect to parental involvement, the majority of students reported spending no time on out-of-school lessons, with 51 percent for mathematics and 64 percent for science. A small percentage of students reported spending four hours or more per week on out-of-school lessons, ranging from 2 percent for science to 6 percent for mathematics.\(^{65}\)

\(^{65}\) The variables "time spent on out-of-school lessons" were constructed based on a question from the student survey. The question asks about the amount of time students spent attending out-of-school lessons which can take place at school, at home or somewhere else (OECD, 2009b). However, the question does not specify funding sources (i.e., whether funded by the school, parents, or others), lesson providers (i.e., whether taught by teachers, parents, or other qualified service providers), or other participants (i.e., whether attended by teachers, parents, or other
Table 3.2. Descriptive Statistics: Family Process Variables

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Learning Structure</strong></td>
<td></td>
</tr>
<tr>
<td>A quiet place to study</td>
<td>88.12</td>
</tr>
<tr>
<td>Time on math homework/studying</td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>14.46</td>
</tr>
<tr>
<td>Frequent: 4 or more hours per week</td>
<td>12.04</td>
</tr>
<tr>
<td>Time on science homework/studying</td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>22.88</td>
</tr>
<tr>
<td>Frequent: 4 or more hours per week</td>
<td>6.66</td>
</tr>
<tr>
<td><strong>Resource Availability</strong></td>
<td></td>
</tr>
<tr>
<td>Home computer to use for school work</td>
<td>88.40</td>
</tr>
<tr>
<td>Home Internet access</td>
<td>85.90</td>
</tr>
<tr>
<td>Number of books at home</td>
<td></td>
</tr>
<tr>
<td>A few: 0 to 25 books</td>
<td>27.00</td>
</tr>
<tr>
<td>Many: 101 or more books</td>
<td>42.51</td>
</tr>
<tr>
<td><strong>Parental Involvement</strong></td>
<td></td>
</tr>
<tr>
<td>Time on out-of-school math lessons</td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>50.88</td>
</tr>
<tr>
<td>Frequent: 4 or more hours per week</td>
<td>5.58</td>
</tr>
<tr>
<td>Time on out-of-school science lessons</td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>63.94</td>
</tr>
<tr>
<td>Frequent: 4 or more hours per week</td>
<td>2.27</td>
</tr>
</tbody>
</table>

NOTE: Includes imputed values.

Table 3.3 presents the means and standard deviations of continuous variables measuring family and school characteristics. The average SES was 0.11.66 The schools had an average class size of approximately 28 students. The average scale score for quality of educational resources at school was 0.24, indicating that accompanying adults. Out-of-school lessons are included under the parental involvement category because parents are typically involved in out-of-school lessons in some way through initiation, funding, or parental consent of participation.

66 SES is a composite measure, created using three variables: parental education (measured as the higher education level of mother or father), parental occupation (measured as the higher occupation status of mother or father), and home possessions encompassing 21 items measuring family wealth. The SES values were generated as component scores for the first principal component with zero being the SES value of an average OECD student and one the standard deviation across equally weighted OECD countries. For non-OECD countries, SES values were computed using the following formula: $SES = \frac{\beta_1 PE' + \beta_2 PO' + \beta_3 HP'}{\epsilon_f}$, where $\beta_1$, $\beta_2$, and $\beta_3$ are the OECD factor loadings, PE', PO' and HP' are the “OECD-standardized” variables measuring parental education, parental occupation, and home possessions respectively, and $\epsilon_f$ is the eigenvalue of the first principal component (see OECD, 2009b for details).
on average, few principals in the 21 countries perceived inadequacy of educational resources as hindering their schools’ capacity to provide instruction.67

### Table 3.3. Descriptive Statistics: Family and School Characteristics – Continuous

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mean</th>
<th>S.E.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Family Status Factors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>0.110</td>
<td>0.016</td>
<td>-5.67</td>
<td>3.49</td>
</tr>
<tr>
<td><strong>School Factors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class size</td>
<td>27.63</td>
<td>0.20</td>
<td>13</td>
<td>53</td>
</tr>
<tr>
<td>Quality of educational resources at school</td>
<td>0.24</td>
<td>0.04</td>
<td>-3.43</td>
<td>2.14</td>
</tr>
</tbody>
</table>

NOTE: Includes imputed values.

Table 3.4 provides descriptive statistics of the dichotomous variables on student and school factors, which are reported as the percentages of students with selected characteristics. About half of the students were female. While the data surveyed 15-year-old students, close to 3 percent were enrolled in grades 7 and 8 at the time of survey, around 18 percent in grade 9, over 63 percent in grade 10, more than 15 percent in grade 11, and less than 0.2 percent in grade 12 and above. Approximately 7 percent of students spoke a language other than the national language at home, and 11 percent were immigrants. In terms of school characteristics, around 84 percent of students were enrolled in public schools. With respect to the amount of time that students spent attending regular lessons at school per week, the proportion of students who reported less than 2 hours per week was 17 percent for mathematics and 29 percent for science. The percentage of students who reported spending four or more hours per week on regular school lessons was 53 for mathematics, and 38 for science.

### Table 3.4. Descriptive Statistics: Student and School Characteristics – Dichotomous

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Child Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>49.43</td>
</tr>
<tr>
<td>Grade</td>
<td></td>
</tr>
<tr>
<td>Grade 7</td>
<td>0.52</td>
</tr>
<tr>
<td>Grade 8</td>
<td>2.43</td>
</tr>
<tr>
<td>Grade 9</td>
<td>18.03</td>
</tr>
<tr>
<td>Grade 10</td>
<td>63.47</td>
</tr>
<tr>
<td>Grade 11</td>
<td>15.42</td>
</tr>
<tr>
<td>Grade 12</td>
<td>0.13</td>
</tr>
<tr>
<td>Grade 13</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

| Language at home                         |         |

National language 93.40
Other language 6.60
Immigration status
Non-immigrant 89.08
Immigrant 10.92

School Factors
Public 83.51
Time on regular math lessons at school
Infrequent: less than 2 hours per week 17.40
Very frequent: 4 or more hours per week 52.56
Time on regular science lessons at school
Infrequent: less than 2 hours per week 29.14
Very frequent: 4 or more hours per week 37.99

NOTE: Includes imputed values.

Differences in Achievement and Family Factors Across Countries
Figure 3.1 shows the ranking of the U.S. 15-year-olds relative to their peers in other countries in mathematics and science achievement. In the figure, U.S. is denoted by a triangle, and other countries are represented by circles. The figure shows that U.S. students scored significantly below the international average in both mathematics and science. U.S. students ranked above only one country (Italy) in mathematics and three other countries (Italy, Luxembourg, and Norway) in science. Appendix 3.C presents mean test scores by country.

Figure 3.1. Mathematics and Science Test Scores by Country

SOURCE: Adapted from Juvonen et al. (2004).
NOTE: Full scale is from 0 to 1000. Triangles represent the U.S.; circles denote other countries.

Tables 3.5-3.7 present differences in family factors by country. As shown in Table 3.5, the proportion of students who reported having a quiet place to study at home ranged from about 77 percent in Macao (China) to over 96 percent in Austria. In comparison with East Asian economies, Western countries had relatively higher percentages of students with a quiet place to study at home, ranging from 86 percent in the United Kingdom to 96 percent in Austria. Almost 88 percent of the U.S. students had a quiet place to study at home.

With respect to the amount of time spent on homework and self-study, Western countries had a lower percentage of students who reported spending no time on homework or self-study in both subject areas as compared to East Asia economies. Western countries also had a relatively higher percentage of students who reported spending four or more hours per week on homework or self-study. The U.S. was close to the average of Western countries in terms of the percentages of students who spent no time on homework or self-study for both subjects and the percentage of students who spent four or more hours per week on science homework or self-study.

### Table 3.5. Family Factors by Country – Learning Structure

<table>
<thead>
<tr>
<th>Country</th>
<th>A Quiet Place to Study (Percent)</th>
<th>Time on Mathematics Homework/Study (Percent)</th>
<th>Time on Science Homework/Study (Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Never</td>
<td>Frequent</td>
<td>Never</td>
</tr>
<tr>
<td><strong>Western countries</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>96.13</td>
<td>9.77</td>
<td>13.53</td>
</tr>
<tr>
<td>Belgium</td>
<td>93.98</td>
<td>13.91</td>
<td>8.39</td>
</tr>
<tr>
<td>Canada</td>
<td>91.09</td>
<td>16.04</td>
<td>12.84</td>
</tr>
<tr>
<td>Denmark</td>
<td>91.30</td>
<td>9.90</td>
<td>6.11</td>
</tr>
<tr>
<td>Finland</td>
<td>95.03</td>
<td>15.48</td>
<td>1.91</td>
</tr>
<tr>
<td>Germany</td>
<td>95.59</td>
<td>7.07</td>
<td>13.96</td>
</tr>
<tr>
<td>Ireland</td>
<td>88.29</td>
<td>13.96</td>
<td>8.66</td>
</tr>
<tr>
<td>Italy</td>
<td>92.04</td>
<td>7.59</td>
<td>19.03</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>94.69</td>
<td>12.81</td>
<td>7.79</td>
</tr>
<tr>
<td>Netherlands</td>
<td>95.63</td>
<td>16.59</td>
<td>4.78</td>
</tr>
<tr>
<td>New Zealand</td>
<td>90.18</td>
<td>15.82</td>
<td>6.83</td>
</tr>
<tr>
<td>Norway</td>
<td>91.61</td>
<td>19.93</td>
<td>5.06</td>
</tr>
<tr>
<td>Sweden</td>
<td>88.89</td>
<td>20.14</td>
<td>3.39</td>
</tr>
<tr>
<td>Switzerland</td>
<td>95.83</td>
<td>8.55</td>
<td>5.83</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>85.87</td>
<td>10.72</td>
<td>4.18</td>
</tr>
<tr>
<td>United States</td>
<td>87.97</td>
<td>13.78</td>
<td>13.83</td>
</tr>
<tr>
<td><strong>Western Average</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| East Asia     |                                  |                                              |                                         |
|---------------|----------------------------------|---------------------------------------------|                                         |
|               | Never                            | Frequent                                    | Never                                    | Frequent                                  |
|               |                                  |                                              |                                         |
In terms of available resources, Table 3.6 shows that the proportions of students who reported having home computers and Internet access were quite high across all countries. Almost 89 percent of the U.S. students had home computers and approximately 85 percent had Internet access. Percentage of students with home computers in the U.S. (89 percent) is statistically significantly lower than the average of the Western countries (92 percent), but higher than the average of the East Asian economies (77 percent). With regard to the number of books available at home, around 32 percent of the U.S. students reported to have no more than 25 books at home, significantly higher than the average of the East Asian economies (23 percent) but not statistically different from the Western average (28 percent) and. In addition, 40 percent of the U.S. students reported to have more than 100 books at home, significantly lower than the average of the East Asian economies (44 percent) but not statistically different from the Western average (42 percent). Of the 21 jurisdictions, Korea, Norway and Sweden had the highest percentage of students owning more than 100 books and the lowest percentage of students owning fewer than 25 books at home.

### Table 3.6. Family Factors by Country – Resource Availability

<table>
<thead>
<tr>
<th>Country</th>
<th>Home Computer (Percent)</th>
<th>Home Internet Access (Percent)</th>
<th>Number of Books at Home</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>A Few: 0-25 books</td>
</tr>
<tr>
<td><strong>Western countries</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>95.64</td>
<td>80.16</td>
<td>25.79</td>
</tr>
<tr>
<td>Belgium</td>
<td>93.45</td>
<td>89.06</td>
<td>30.31</td>
</tr>
<tr>
<td>Canada</td>
<td>96.29</td>
<td>93.80</td>
<td>20.66</td>
</tr>
<tr>
<td>Denmark</td>
<td>98.30</td>
<td>95.63</td>
<td>25.10</td>
</tr>
<tr>
<td>Finland</td>
<td>95.34</td>
<td>92.62</td>
<td>16.08</td>
</tr>
<tr>
<td>Germany</td>
<td>95.41</td>
<td>87.56</td>
<td>22.69</td>
</tr>
<tr>
<td>Ireland</td>
<td>88.04</td>
<td>80.74</td>
<td>25.98</td>
</tr>
<tr>
<td>Italy</td>
<td>89.43</td>
<td>72.37</td>
<td>26.41</td>
</tr>
<tr>
<td><strong>East Asian Average</strong></td>
<td>77.01</td>
<td>14.73</td>
<td>30.65</td>
</tr>
<tr>
<td><strong>East Asian Average</strong></td>
<td>82.15</td>
<td>21.50</td>
<td>38.90</td>
</tr>
</tbody>
</table>

*NOTE: Includes imputed values. * indicates significance at .05 level, ** indicates significance at .01 level.*
Luxembourg 93.22  86.71  22.08  51.14
Netherlands  97.33  96.47  30.29  42.10
New Zealand  93.26  89.36  18.85  50.56
Norway  96.80  95.21  14.49  58.40
Sweden  97.76  96.63  15.09  56.68
Switzerland  95.98  93.31  26.76  42.88
United Kingdom  95.10  90.35  27.53  42.52
United States  88.78  85.24  31.82  39.58
Western Average  91.63  86.41  28.20  42.13

East Asia
Chinese Taipei  89.26  91.81  34.26  33.07
Hong Kong – China  97.02  96.87  47.16  19.17
Japan  62.69  74.87  22.54  44.11
Korea  97.21  96.48  14.37  52.15
Macao – China  94.72  89.36  55.46  15.68
East Asian Average  77.45  84.16  22.92  43.79

T-test
U.S. vs. West  t= -1.98*  t= -0.76  t= 1.68  t= -1.31
U.S. vs. East Asia  t= 7.74**  t= 0.68  t= 4.12**  t= -2.14*
West vs. East Asia  t= 39.25**  t= 5.41**  t= 13.57**  t= -3.99**

NOTE: Includes imputed values. * indicates significance at .05 level, ** indicates significance at .01 level.

With respect to parental involvement, Austria, Finland and Japan had the highest percentages of students who reported spending no time on out-of-school lessons in both subjects (see Table 3.7). Finland also had the lowest percentage of students who reported spending four or more hours per week on out-of-school lessons (less than 1 percent for both subjects). In contrast, Denmark, Korea, and Norway had the lowest percentage of students spending no time on out-of-school lessons in both subjects. Korea had the highest percentage of students spending four or more hours per week on out-of-school lessons in mathematics (20 percent), and Macao (China) had the highest percentage for science (6 percent). In comparison, the U.S. had 45 percent of students spending no time on out-of-school lessons in mathematics, and 56 percent for science, which are significantly lower than the Western as well as East Asian averages for both subjects. Moreover, the U.S. had approximately 6 percent of students spending four or more hours per week on out-of-school lessons in mathematics and 3 percent for science, which are significantly higher than the Western averages. In terms of SES, Western countries had an average of 0.17, significantly higher than the East Asian average (-0.08). Of all 21 jurisdictions, Macao (China) had the lowest SES of -0.91, and Norway had the highest SES of 0.41. SES for the U.S. was 0.14, significantly lower than the Western average but higher than the East Asian average.
Table 3.7. Family Factors by Country – Parental Involvement (Time on Out-of-School Lessons) and Family Status (SES)

<table>
<thead>
<tr>
<th>Country</th>
<th>Mathematics Lessons (Percent)</th>
<th>Time on Out-of-School Science Lessons (Percent)</th>
<th>SES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Never</td>
<td>Frequent</td>
<td>Never</td>
</tr>
<tr>
<td><strong>Western countries</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>72.46</td>
<td>2.57</td>
<td>86.89</td>
</tr>
<tr>
<td>Belgium</td>
<td>68.21</td>
<td>2.29</td>
<td>79.07</td>
</tr>
<tr>
<td>Canada</td>
<td>52.22</td>
<td>4.57</td>
<td>65.67</td>
</tr>
<tr>
<td>Denmark</td>
<td>30.80</td>
<td>4.91</td>
<td>47.02</td>
</tr>
<tr>
<td>Finland</td>
<td>74.41</td>
<td>0.93</td>
<td>76.65</td>
</tr>
<tr>
<td>Germany</td>
<td>57.98</td>
<td>3.92</td>
<td>69.27</td>
</tr>
<tr>
<td>Ireland</td>
<td>60.12</td>
<td>2.85</td>
<td>78.19</td>
</tr>
<tr>
<td>Italy</td>
<td>57.31</td>
<td>4.46</td>
<td>69.60</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>55.92</td>
<td>3.70</td>
<td>69.94</td>
</tr>
<tr>
<td>Netherlands</td>
<td>56.56</td>
<td>1.92</td>
<td>62.27</td>
</tr>
<tr>
<td>New Zealand</td>
<td>61.73</td>
<td>3.03</td>
<td>74.15</td>
</tr>
<tr>
<td>Norway</td>
<td>37.15</td>
<td>2.83</td>
<td>40.19</td>
</tr>
<tr>
<td>Sweden</td>
<td>59.57</td>
<td>1.65</td>
<td>64.01</td>
</tr>
<tr>
<td>Switzerland</td>
<td>58.94</td>
<td>2.58</td>
<td>75.45</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>59.93</td>
<td>1.83</td>
<td>67.10</td>
</tr>
<tr>
<td>United States</td>
<td>45.09</td>
<td>6.15</td>
<td>56.14</td>
</tr>
<tr>
<td><strong>Western Average</strong></td>
<td>51.41</td>
<td>4.71</td>
<td>62.20</td>
</tr>
<tr>
<td><strong>East Asia</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chinese Taipei</td>
<td>44.32</td>
<td>8.65</td>
<td>64.67</td>
</tr>
<tr>
<td>Hong Kong – China</td>
<td>38.04</td>
<td>8.62</td>
<td>61.03</td>
</tr>
<tr>
<td>Japan</td>
<td>62.24</td>
<td>2.75</td>
<td>82.24</td>
</tr>
<tr>
<td>Korea</td>
<td>27.59</td>
<td>19.65</td>
<td>49.91</td>
</tr>
<tr>
<td>Macao – China</td>
<td>47.86</td>
<td>8.89</td>
<td>52.82</td>
</tr>
<tr>
<td><strong>East Asian Average</strong></td>
<td>49.10</td>
<td>8.54</td>
<td>69.86</td>
</tr>
</tbody>
</table>

**T-test**

- U.S. vs. West: t = -4.17**, t = 3.08**, t = -5.67**, t = 2.18*, t = -58.99**
- U.S. vs. East Asia: t = -2.53*, t = -4.83**, t = -12.34**, t = 3.64**, t = 409.22**
- West vs. East Asia: t = 4.43**, t = -21.28**, t = -22.02**, t = 6.67**, t = 2941.31**

**NOTE:** Includes imputed values. * indicates significance at .05 level, ** indicates significance at .01 level.

**Baseline and Family Process Models**

Tables 3.8 and 3.9 present results of the baseline and family process models for mathematics and science achievement respectively. The baseline models indicated significant associations between student achievement and SES. Specifically, SES was positively associated with achievement in both
mathematics and science. For every 1 SD increase in SES, average achievement was expected to increase by over 0.3 SD for mathematics and 0.29 SD for science.

Based on the results of the family process models for mathematics and science achievement in Tables 3.8 and 3.9, a number of family process variables appeared to be significantly associated with achievement in both subjects. In terms of learning structure, students who reported spending no time on mathematics homework or self-study tended to score 0.31 SD lower in mathematics and 0.26 SD lower in science than those who reported spending more than zero and less than four hours per week. For resource availability, achievement in both mathematics and science was positively associated with all three variables including ownership of home computers, home Internet access, and number of books at home. Effect sizes for the variables of home computer ownership and home Internet access were small, but effect sizes for number of books owned at home ranged from 0.23 to 0.27 (in absolute value). With respect to parental involvement, achievement in both subjects was negatively correlated with the amount of time spent on out-of-school lessons, suggesting the possibility that parents were more likely to resort to outside help when students had academic difficulties. Effect sizes for time spent on out-of-school lessons ranged from 0.16 to 0.26 (in absolute value).

| Table 3.8. Coefficients of Baseline and Family Process Models for Mathematics Achievement |
|---------------------------------|-----------------|----------------------|------------------|-----------------|-----------------|------------------|
| Variable                        | Baseline        | Family Process       |
|                                 | Estimate        | S.E. | Effect Size | Estimate        | S.E. | Effect Size |
| Learning Structure              |                 |      |             |                 |      |             |
| A quiet place to study          | 1.283           | 1.687 | 0.014       |                 |      |             |
| Time on math homework/studying  |                 |      |             | -27.720**†      | 1.912 | -0.307       |
| Never                           |                 |      |             | -1.271          | 2.127 | -0.014       |
| Frequent: 4 or more hours per week |                 |      |             |                 |      |             |
| Resource Availability           |                 |      |             | 6.580**†        | 2.128 | 0.073        |
| Home computer for school work   |                 |      |             | 7.139**†        | 1.963 | 0.079        |
| Home Internet access            |                 |      |             |                 |      |             |
| Number of books at home         |                 |      |             | -20.899**†      | 1.049 | -0.232       |
| A few: 0-25 books               |                 |      |             | 21.540**†       | 1.181 | 0.239        |
| Many: 101 or more books         |                 |      |             |                 |      |             |
| Parental Involvement            |                 |      |             | 23.609**†       | 1.255 | 0.262        |
| Time on out-of-school math lessons |                 |      |             | -13.988**†      | 2.552 | -0.155       |
| Never                           |                 |      |             |                 |      |             |
| Frequent: 4 or more hours per week |                 |      |             |                 |      |             |
| Family Status Factors           |                 |      |             | 27.242**†       | 1.159 | 0.302        |
| SES                             |                 |      |             | 16.758**†       | 0.972 | 0.186        |
| Child Characteristics           |                 |      |             |                 |      |             |
The country fixed effects terms indicated that U.S. students scored significantly lower on average than 17 jurisdictions in mathematics and 16 jurisdictions in science even after controlling for student, family, and school factors. The most pronounced difference existed with the fixed effects term for Finland, with students in Finland scored 103 points (equivalent to and effect size of 1.1) higher

68 U.S. is the reference category for the country fixed effects.
than U.S. students in mathematics, and 104 points (equivalent to an effect size of 1.1) higher in science. U.S. students scored 0.28 SD higher in mathematics and 0.27 SD higher in science than their counterparts in United Kingdom. U.S. students also scored higher in mathematics than students in Italy, but the effects size was small (i.e., smaller than 0.2 SD in absolute value).

A comparison between the baseline and family process models reveals that family process variables explained approximately 8 percent of the within-school variation in mathematics, 7 percent in science. In comparison with the baseline models, coefficients of SES in the family process models were much smaller in magnitude in the family process models. Specifically, the effect size of SES was reduced by about one third (i.e., from 0.30 SD to 0.19 SD for mathematics and from 0.29 SD to 0.17 SD for science), after controlling for family process variables. This large reduction in the effects of SES suggests that family process factors are important predictors of achievement collectively, and that while more family resources are important, better family process explains a good portion of the SES advantage in outcomes. However, SES remained statistically significant in the family process models.

Table 3.9. Coefficients of Baseline and Family Process Models for Science Achievement

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline Effect Size</th>
<th>Family Process Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>S.E.</td>
</tr>
<tr>
<td>Learning Structure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A quiet place to study</td>
<td>1.667</td>
<td>2.148</td>
</tr>
<tr>
<td>Time on science homework/studying</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>-25.248**†</td>
<td>1.600</td>
</tr>
<tr>
<td>Frequent: 4 or more hours per week</td>
<td>-0.099</td>
<td>2.127</td>
</tr>
<tr>
<td>Resource Availability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home computer for school work</td>
<td>9.688**+</td>
<td>2.382</td>
</tr>
<tr>
<td>Home Internet access</td>
<td>3.677</td>
<td>2.105</td>
</tr>
<tr>
<td>Number of books at home</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A few: 0-25 books</td>
<td>-26.075**†</td>
<td>1.532</td>
</tr>
<tr>
<td>Many: 101 or more books</td>
<td>23.091**+</td>
<td>1.341</td>
</tr>
<tr>
<td>Parental Involvement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time on out-of-school science lessons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>21.584**†</td>
<td>1.419</td>
</tr>
<tr>
<td>Frequent: 4 or more hours per week</td>
<td>-25.279**†</td>
<td>5.472</td>
</tr>
<tr>
<td>Family Status Factors</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Following the methods by Singer (1998), percentages of the within-school variation explained by family process variables were obtained by examining the reduction in the residual term with and without the inclusion of family process skills in the models (also see Le et al., 2006).
School Random Intercept Table 3.10

Interaction Models
Table 3.10 shows results of the interaction models for both mathematics and science achievement. Two country dummies were used to distinguish the three

---

70 U.S. is the reference category for the country fixed effects.
country groups: U.S., Western countries, and East Asian economies. Interaction terms between the two country dummies and family process variables were included in the estimation. Only family process variables and interaction terms are shown in the table (see Appendix 3.E for the complete results including family status variables, child characteristics, school factors, country group fixed effects, and random effect terms).

Several family process variables appeared to be statistically significant for both main effects terms and interaction terms with the country dummy for East Asian economies, indicating differential academic effects between the U.S. and East Asian economies. In comparison with the U.S., the East Asian economies showed stronger academic effects of spending no time on homework or self-study, with an effect size of -0.25 for mathematics achievement and an effect size of -0.09 for science achievement.

With respect to number of books owned at home, the U.S. appeared to have a stronger effect of owning more than 100 books at home on mathematics achievement than East Asian economies, but a less pronounced effect of owning no more than 25 books at home than Western countries. The U.S., compared to East Asian economies, also showed stronger effects of number of books owned at home on science achievement. But the effect sizes for all these interaction terms were small.

In terms of time spent on out-of-school lessons, the U.S. showed a significantly negative relationship with student achievement in mathematics while East Asians had a positive association. Effect sizes for the interaction terms were average to above average. For science achievement, Western countries showed a stronger effect on spending no time on out-of-school lessons than the U.S. with a small effect size, and East Asians had a less pronounced effect on spending four hours or more per week on out-of-school lessons than the U.S with an effect size of 0.33.

Table 3.10. Coefficients of Interaction Models

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mathematics Effect</th>
<th>Science Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>S.E.</td>
</tr>
<tr>
<td>Learning Structure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A quiet place to study</td>
<td>-1.990</td>
<td>3.769</td>
</tr>
<tr>
<td>Time on math homework/studying</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>-16.753**†</td>
<td>3.628</td>
</tr>
<tr>
<td>Frequent: 4 or more hours per week</td>
<td>-3.535</td>
<td>4.417</td>
</tr>
<tr>
<td>Time on science homework/studying</td>
<td>Never</td>
<td>Frequent: 4 or more hours per week</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td><strong>Never</strong></td>
<td>-19.607**†</td>
<td>3.583  -0.201</td>
</tr>
<tr>
<td><strong>Frequent</strong></td>
<td>5.110</td>
<td>3.895  -0.052</td>
</tr>
</tbody>
</table>

**Resource Availability**

| Home computer for school work   | 8.434  | 5.183  0.093 | 15.387**† | 6.252  0.158 |
| Home Internet access           | 4.254  | 4.632  0.047 | -2.108    | 5.611  -0.022 |
| Number of books at home        |
| A few: 0-25 books              | -19.851***† | 2.497  -0.220 | -28.741***† | 3.426  -0.295 |
| Many: 101 or more books        | 23.034***† | 2.622  0.255 | 28.335***† | 2.971  0.291 |

**Parental Involvement**

<table>
<thead>
<tr>
<th>Time on out-of-school math lessons</th>
<th>Never</th>
<th>Frequent: 4 or more hours per week</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Never</strong></td>
<td>26.908**†</td>
<td>2.629  0.298</td>
</tr>
<tr>
<td><strong>Frequent</strong></td>
<td>-25.805***†</td>
<td>5.361  -0.286</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time on out-of-school science lessons</th>
<th>Never</th>
<th>Frequent: 4 or more hours per week</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Never</strong></td>
<td>18.543**†</td>
<td>2.829  0.190</td>
</tr>
<tr>
<td><strong>Frequent</strong></td>
<td>-34.486***†</td>
<td>9.209  -0.353</td>
</tr>
</tbody>
</table>

**Interaction Terms**

| Western*A quiet place to study      | 17.342**† | 4.311  0.192 | 14.828**† | 4.983  0.152 |
| Western*Time on math homework/studying | -5.092  3.794  -0.056 | -7.119  4.367  -0.079 |
| Western*Time on science homework/studying | Never | Frequent: 4 or more hours per week |
| **Never**                           | -5.529  3.705  -0.057 | -13.439***† | 4.369  -0.138 |
| **Frequent**                        | -7.119  4.367  -0.079 |
| Western*Home computer for school work | 6.769  5.564  0.075 | -1.194    | 6.711  -0.012 |
| Western*Home Internet access        | 11.894† | 4.821  0.132 | 12.027*    | 5.871  0.123 |
| Western*Number of books at home     |
| A few: 0-25 books                   | -5.668* | 2.826  -0.063 | 0.058      | 3.545  0.001 |
| Many: 101 or more books             | -0.073  2.644  0.001 | -4.270    | 3.019  -0.044 |
| Western*Time on out-of-school math lessons | 4.686  2.755  0.052 | 2.319  6.123  0.026 |
| Western*Time on out-of-school science lessons | Never | Frequent: 4 or more hours per week |
| **Never**                           | 11.075**† | 3.007  0.114 | 8.461     | 9.894  0.087 |
| **Frequent**                        | 2.319  6.123  0.026 |
| East Asian*A quiet place to study   | -1.816  4.318  -0.020 | 0.441     | 4.874  0.005 |
| East Asian*Time on math homework/studying | Never | Frequent: 4 or more hours per week |
| **Never**                           | -22.788***† | 4.608  -0.252 | 8.461     | 9.894  0.087 |
| **Frequent**                        | 28.939**† | 5.417  0.321 |
| East Asian*Time on science homework/studying | Never | Frequent: 4 or more hours per week |
| **Never**                           | -8.523* | 4.289  -0.087 | 11.468    | 6.715  0.118 |
| **Frequent**                        | 11.468  6.715  0.118 |
| East Asian*Home computer for school work | 2.132  5.866  0.024 | -13.401   | 7.134  -0.137 |
| East Asian*Home Internet access     | 9.135  5.483  0.101 | 12.024    | 6.777  0.123 |
| East Asian*Number of books at home  |
| A few: 0-25 books                   | 4.361  3.531  0.048 | 10.826†   | 4.215  0.111 |
| Many: 101 or more books             | -8.719***† | 3.374  -0.097 | -15.864***† | 3.683  -0.163 |
East Asian*Time on out-of-school math lessons

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Frequent: 4 or more hours per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Asian*Time on out-of-school science lessons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>2.069</td>
<td>3.287</td>
</tr>
<tr>
<td>Frequent: 4 or more hours per week</td>
<td>31.847**†</td>
<td>9.554</td>
</tr>
</tbody>
</table>

NOTE: * indicates significance at .05 level, ** indicates significance at .01 level. † indicates significance at .05 false discovery rate.

Discussion

Results of this chapter indicate that, consistent with findings based on U.S. data in Chapter 1, family process factors are important predictors of student achievement in a cross-country setting. Several family process variables appeared to be significantly associated with achievement even after controlling for demographics, school inputs, and country fixed effects. Better performance in mathematics and science was associated with ownership of home computers, home Internet access, and number of books at home. Students who reported spending no time on homework or self-study tended to score lower in both subjects than those who reported spending more than zero and less than four hours per week. Performance and time spent on attending out-of-school lessons were inversely related, suggesting the possibility that less able students required more outside help. While most of these statistically significant family process variables had small to average effect sizes (i.e., less than 0.3 in absolute value), the effects of SES on achievement reduced by one third once family process variables were introduced into the models, suggesting the importance of family process factors in explaining achievement collectively. However, SES remained statistically significant even after controlling for family process factors.

The international comparison of student achievement indicates that U.S. students scored significantly below the international average in both mathematics and science. U.S. students ranked above only one country in mathematics and three other countries in science. After controlling for student, family, and school factors, U.S. students still showed significantly lower average scores than 17 jurisdictions in mathematics and 16 jurisdictions in science. These findings are consistent with existing literature (Baldi et al., 2007; Juvonen et al., 2004; Lemke et al., 2004; Miller et al., 2009; Provasnik, Gonzales, and Miller, 2009). While there were concerns that U.S. students were compared with selective groups of students in some countries in early years of testing, they have been lessened in recent years and the finding of relatively low standing of U.S. students in
international assessments has gained continued attention among researchers, policymakers, and the public in recent years (Hanushek, 1998).

Several family process variables showed differential effects on student achievement between the U.S. and the other two country groups (Western countries and East Asian economies), with most of these differential effects existing between the U.S. and East Asian economies. Interestingly, the U.S. showed stronger effects of the number of books owned at home on both mathematics and science achievement than East Asian economies. Yet, in comparison with the East Asian average, the U.S. had a higher percentage of students owning no more than 25 books at home and a lower percentage of students owning more than 100 books at home. A possible explanation for the observed relationships could be that U.S. students are more likely to take advantage of and benefit from the books owned at home than their counterparts in the East Asian economies. Thus, U.S. had a stronger effects of books owned at home on student achievement despite the fact that U.S. students on average owned fewer books than their East Asian counterparts.

This chapter has several limitations partly due to the nature of the data. First, only a limited number of family process variables are collected in the data, and thus are included in the analysis. In some cases, included variables are not the perfect measures for the intended constructs. For example, parental involvement includes time spent on out-of-school lessons as main measures. However, the variable is not a direct measure of the extent to which parents are involved in their children’s educational activities. Instead, it is used as a proxy for parental involvement as parents are typically involved in out-of-school lessons in some way through initiation, funding, or consent of participation. Moreover, regression analyses based on the cross-sectional data may be subject to the endogeneity problem. Finally, measures may not be really comparable across countries despite the considerable data collection effort. For instance, SES is a composite measure created using three variables (i.e., parental education, parental occupation, and home possessions) that are “OECD-standardized” (OECD, 2009b). However, countries vary in terms of the quantity and quality of publicly provided services, which may affect the real level of social and economic well-being of families in different countries. Since this factor is not captured in creation of the variable, the measure of SES may not be completely comparable across countries. Despite these limitations, findings from this chapter suggest the importance of family process variables, especially when considered collectively, in predicting student achievement in the international context. Future research may explore the potential causal relationships between
the international achievement gaps and differences in individual family process factors across countries.
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### APPENDIX 1.A. VARIABLES MEASURING FAMILY PROCESS FACTORS IN ECLS-K

<table>
<thead>
<tr>
<th>Family Process Factors</th>
<th>Variable</th>
<th>Variable Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parental Expectations and Beliefs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental expectations of child’s educational attainment</td>
<td>What degree expected of child</td>
<td>A dummy with 1 for expecting child to have a bachelor’s degree or higher and 0 otherwise</td>
</tr>
<tr>
<td>Parental beliefs regarding child’s academic performance</td>
<td>Belief about child’s reading performance</td>
<td>A dummy with 1 for believing child’s performance as good as or better than the peers and 0 otherwise</td>
</tr>
<tr>
<td></td>
<td>Belief about child’s math performance</td>
<td>A dummy with 1 for believing child’s performance as good as or better than the peers and 0 otherwise</td>
</tr>
<tr>
<td><strong>Learning Structure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homework routines</td>
<td>Frequency of doing homework</td>
<td>A dummy with 1 for doing homework more than 2 times a week and 0 otherwise</td>
</tr>
<tr>
<td></td>
<td>Place set aside for homework</td>
<td>A dummy with 1 for having a place at home set aside for homework and 0 for otherwise</td>
</tr>
<tr>
<td></td>
<td>Time set aside for homework</td>
<td>Number of minutes set aside for homework per day (value range: 0-240)</td>
</tr>
<tr>
<td>Other learning routines</td>
<td>Frequency of child reading books outside of school</td>
<td>Two dummy variables measuring number of times reading books in a week: - Infrequent: 1 for 1 to 2 times a week or less - Very frequent: 1 for every day - Reference category: 3 to 6 times a week</td>
</tr>
<tr>
<td></td>
<td>Frequency of using home computer</td>
<td>A dummy with 1 for using home computer 3 times a week or more and 0 otherwise</td>
</tr>
<tr>
<td><strong>Resource Availability</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home resources</td>
<td>Home computer for child use</td>
<td>A dummy with 1 for having a home computer available for child use and 0 otherwise</td>
</tr>
<tr>
<td></td>
<td>Home Internet access</td>
<td>A dummy with 1 for having home Internet and 0 otherwise</td>
</tr>
<tr>
<td></td>
<td>Number of books child has at home</td>
<td>Number of books available for child use at home (value range: 0-5000)(^7)</td>
</tr>
<tr>
<td></td>
<td>Family resources</td>
<td>A 4-item scale indicating whether family has one or more of the following four resources: - Regularly receives newspaper - Regularly receives magazines - Has dictionary or encyclopedia</td>
</tr>
</tbody>
</table>

---

\(^7\) The number of books child has at home is capped at 200 for the wave of kindergarten fall, and at 5,000 for the three waves at spring of 1st grade, 3rd grade, and 5th grade. Excluding the imputed values, 1,161 children had 200 books at kindergarten fall, 1 child reported to have 5,000 books at spring of 1st grade and 3rd grade, and 2 children reported 5,000 books at spring of 5th grade, out of the total 8,370 children that are included in the final sample for analysis.
<table>
<thead>
<tr>
<th>Community resources</th>
<th>Community library card for child</th>
<th>A dummy with 1 for child having his/her own library card and 0 otherwise</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Home Affective Environment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indicators of affection</td>
<td>Warm and close times together</td>
<td>A dummy with 1 for parent indicating true for the statement and 0 for false: parent and child often have warm, close times together</td>
</tr>
<tr>
<td></td>
<td>Child likes parents</td>
<td>A dummy with 1 for parent indicating true for the statement and 0 for false: most of the time parent feels that child likes him/her and wants to be near him/her</td>
</tr>
<tr>
<td>Indicators of disaffection or negative sentiments</td>
<td>Sacrifice to meet child’s needs</td>
<td>A dummy with 1 for parent indicating true for the statement and 0 for false: parent finds himself/herself giving up more of his/her life to meet child’s needs than s/he ever expected</td>
</tr>
<tr>
<td>Parent feeling child hard to care</td>
<td>A dummy with 1 for parent indicating true for the statement and 0 for false: parent feels that child seems harder to care for than most</td>
<td></td>
</tr>
<tr>
<td>Parent-child interactions</td>
<td>Parent-child interactions</td>
<td>A 4-item scale indicating whether one or more of the following statement are true: - Parent makes time to listen to child even busy - Parent encourages child to talk about troubles - Parent encourages child to talk about friends and activities - Parent encourages child to express opinions</td>
</tr>
<tr>
<td>Parenting and Disciplinary Practices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental discipline</td>
<td>Number of constructive disciplinary methods if child got angry and hit parents</td>
<td>A 6-item scale indicating whether one or more constructive disciplinary methods are used when child got angry and hit the parent: - Have child take a time out - Discuss what child did wrong - Make child do some chores - Make child apologize - Take away a privilege - Give child a warning</td>
</tr>
<tr>
<td></td>
<td>Frequency of spanking</td>
<td>Number of times parent spanked child last week (value rage: 0-20)</td>
</tr>
<tr>
<td><strong>TV viewing</strong></td>
<td>Family rules on TV viewing</td>
<td>A 3-item scale assessing the number of rules family has on TV viewing: - What programs child can watch - How early or late child may watch TV - How many hours child may watch TV on weekdays</td>
</tr>
<tr>
<td>Frequency of TV viewing on a weekday</td>
<td>Number of hours for which child watches TV on a typical weekday (value range: 0-15)</td>
<td></td>
</tr>
<tr>
<td>Frequency of TV viewing on a weekend</td>
<td>Number of hours for which child watches TV on a typical weekend (value range: 0-30)</td>
<td></td>
</tr>
</tbody>
</table>

**Parental Involvement**

| Parental involvement in school-related activities | Parental involvement in school events | A 6-item scale indicating since the beginning of the school year whether parents have attended one or more of the school events:  
- Open house or back-to-school night  
- PTA or Parent-Teacher Organization meeting  
- Regularly scheduled Parent-teacher conference  
- School or class event such as a play, sports event, or science fair  
- Volunteering at the school or serving on a committee  
- Fundraising for child’s school |
| Contact with parents of child’s peers | Number of parents of children in child’s class with whom the parent talks regularly (value range: 0-40) |

**Parental involvement in home-based activities**

| Frequency of family members helping child with reading homework | A dummy with 1 for 3 to 4 times a week or more and 0 otherwise |
| Frequency of family members helping child with math homework | A dummy with 1 for 3 to 4 times a week or more and 0 otherwise |
| Frequency of family members talking about nature or doing science projects with child | A dummy with 1 for more than 2 times a week and 0 otherwise |
| Frequency of family members playing games or doing puzzles with child | A dummy with 1 for more than 2 times a week and 0 otherwise |
| Frequency of family members playing a sport with child or exercising together | A dummy with 1 for more than 2 times a week and 0 otherwise |
| Frequency of family members involving child in household chores | A dummy with 1 for more than 2 times a week and 0 otherwise |
| Parental involvement in learning activities outside of school or home | Parental involvement in artistic or cultural activities | A 5-item scale indicating the number of below activities that the child participated in:
- Dance lessons
- Music lessons
- Art classes or lessons
- Organized clubs or recreational programs like scouts
- Organized performing arts programs such as choirs, dance programs, or theater performances |
| Library visit library with child | A dummy with 1 for family members having visited library with child in last month or 0 otherwise |
APPENDIX 1.B. SCALE ITEMS AND RELIABILITY COEFFICIENTS

Family Resources
In your home, does your family have...
- A newspaper received on a regular basis
- A magazine received on a regular basis
- A dictionary or an encyclopedia
- A pocket calculator
Reliability coefficient: 0.39

Parent-Child Interactions
Is each of the following statements true for you?
- Even if I am really busy, I make time to listen to my child.
- I encourage my child to talk about his/her troubles.
- I encourage my child to tell me about his/her friends and activities.
- I encourage my child to express his/her opinions.
Reliability coefficient: 0.56

Disciplinary Methods
If your child got so angry that he/she hit you, would you...
- Have him/her take a time out
- Talk to him/her about what he/she did wrong
- Make him/her do some chores
- Make him/her apologize
- Take away a privilege
- Give a warning
Reliability coefficient: 0.57

Number of Family Rules on Television Viewing
Are there family rules for your child about any of the following television-related activities?
- What program your child can watch
- How early or late your child may watch television
- How many hours child may watch television on weekdays
Reliability coefficients for waves 1-5: 0.56, 0.56, 0.57, 0.51, 0.50

Parental Involvement in School Events
Since the beginning of this school year, have you or the other adults in your household...
- Attended an open house or back-to-school night
- Attended a meeting of a PTA, PTO, or Parent-Teacher Organization?
- Gone to a regularly-scheduled parent-teacher conference with your child’s teacher or meeting with your child’s teacher?
- Attended a school or class event, such as a play, sports event, or science fair
- Volunteered at the school or served on a committee
- Participated in fundraising for your child’s school
Reliability coefficients for waves 1-5: 0.57, 0.57, 0.58, 0.57, 0.57

Involvement in Artistic or Cultural Activities
Outside of school hours, has your child ever participated in…

- Dance lessons
- Music lessons, for example, piano, instrumental music or singing lessons
- Art classes or lessons, for example, painting, drawing, sculpturing
- Organized clubs or recreational programs, like scouts
- Organized performing arts programs, such as children’s choirs, dance programs, or theater performances

Reliability coefficients for waves 1-5: 0.50, 0.50, 0.51, 0.46, 0.45
**APPENDIX 1.C. DESCRIPTIVE STATISTICS: WAVES 2-5**

**Table 1.C.1.**
Descriptive Statistics at Spring Kindergarten (Wave 2)

<table>
<thead>
<tr>
<th>Variable</th>
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<th>S.D.</th>
<th>Min.</th>
<th>Max.</th>
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</tr>
<tr>
<td>Expecting a bachelor’s degree or higher</td>
<td>0.7455</td>
<td>0.4356</td>
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<tr>
<td><strong>Learning Structure</strong></td>
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<tr>
<td>Child reading books outside school</td>
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<tr>
<td>Infrequent: one to two times a week or less</td>
<td>0.3114</td>
<td>0.4631</td>
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<td>Very frequent: every day</td>
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<td>0.4866</td>
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</tr>
<tr>
<td>Home computer use three times a week or more</td>
<td>0.2768</td>
<td>0.4474</td>
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</tr>
<tr>
<td><strong>Resource Availability</strong></td>
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<td>Home computer for child use</td>
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<td>Number of books child has at home</td>
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<td><strong>Parenting and Disciplinary Practices</strong></td>
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<td>0.93</td>
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<td>5.00</td>
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<tr>
<td>Library visit with child in last month</td>
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<td>50 percent or more being minority</td>
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**NOTE:** Includes imputed values.
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<th>Max.</th>
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<td>50 percent or more being minority</td>
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<td>10 percent or more with reduced-price lunch</td>
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<td>Percent students eligible for free lunch</td>
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<td>Urban fringe and large town</td>
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<td>0.4796</td>
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NOTE: Includes imputed values.
Table 1.C.3.
Descriptive Statistics at Spring Third Grade (Wave 4)

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<tr>
<td>Child reading books outside school</td>
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<td><strong>Parenting and Disciplinary Practices</strong></td>
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<td>Number of family rules on TV viewing</td>
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<td>Hours of TV viewing on a weekend</td>
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<td><strong>Parental Involvement</strong></td>
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<td>Parental involvement in school events</td>
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<td>Involvement in artistic or cultural activities</td>
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<td>50 percent or more being minority</td>
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<td>10 percent or more with reduced-price lunch</td>
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<td>Percent students eligible for free lunch</td>
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<td>Urban fringe and large town</td>
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NOTE: Includes imputed values.
Table 1.C.4.
Descriptive Statistics at Spring Fifth Grade (Wave 5)

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<td>Child reading books outside school</td>
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<td>Infrequent: one to two times a week or less</td>
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<td>Very frequent: every day</td>
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<td>Home computer for child use</td>
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<td>Number of books child has at home</td>
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<td>Number of family rules on TV viewing</td>
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<td>Involvement in artistic or cultural activities</td>
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<td>Two-parent household</td>
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<td>Single-parent household</td>
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<td>Other type of household</td>
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<td>Age at assessment (in months)</td>
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<td>Number of siblings</td>
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<td><strong>School Factors</strong></td>
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<td>Public</td>
<td>0.8968</td>
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<td>50 percent or more being minority</td>
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<td>10 percent or more with reduced-price lunch</td>
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<td>Percent students eligible for free lunch</td>
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<td>Urban fringe and large town</td>
<td>0.4625</td>
<td>0.4986</td>
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<td>Central city</td>
<td>0.3288</td>
<td>0.4698</td>
<td>0.00</td>
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<td>Rural and small town</td>
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<td>Class size for reading</td>
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<td>Class size for mathematics</td>
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<td>40</td>
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<td>Reading teacher experience (in years)</td>
<td>13.80</td>
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<td>Mathematics teacher experience (in years)</td>
<td>13.88</td>
<td>9.37</td>
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</table>

NOTE: Includes imputed values.

Table 1.D.1.
Family Process Factors by Race/Ethnicity at Spring Kindergarten (Wave 2)

<table>
<thead>
<tr>
<th>Family Process Variables</th>
<th>White</th>
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<th>Hispanic</th>
<th>Asian</th>
<th>Other</th>
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<td>Expecting a bachelor’s degree or higher</td>
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<td>0.7045</td>
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<tr>
<td>Child reading books outside school</td>
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<td>0.2343</td>
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<td>0.3711</td>
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<td>0.3460</td>
<td>0.4743</td>
<td>0.3889</td>
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<tr>
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<td>0.1615</td>
<td>0.2890</td>
<td>0.2831</td>
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<td>Home computer for child use</td>
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<td>Number of family rules on TV viewing</td>
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<td>3.18</td>
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<td>2.07</td>
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<tr>
<td>Involvement in artistic or cultural activities</td>
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<td>0.59</td>
<td>0.33</td>
<td>0.63</td>
<td>0.64</td>
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<tr>
<td>Child reading books outside school</td>
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<tr>
<td>Infrequent: one to two times a week or less</td>
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<td>Home computer for child use</td>
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<td>0.7464</td>
<td>0.5743</td>
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<td>57.02</td>
<td>70.42</td>
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<tr>
<td>Number of family rules on TV viewing</td>
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<td>3.86</td>
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<td>2.30</td>
<td>2.05</td>
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<td>Involvement in artistic or cultural activities</td>
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<td>0.99</td>
<td>0.95</td>
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Table 1.D.3.
Family Process Factors by Race/Ethnicity at Spring Third Grade (Wave 4)

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<tr>
<td>Child reading books outside school</td>
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</tr>
<tr>
<td>Infrequent: one to two times a week or less</td>
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<td>Home computer use three times a week or more</td>
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<td>Home computer for child use</td>
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<td>Number of books child has at home</td>
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<td>Number of family rules on TV viewing</td>
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<td>2.51</td>
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<td>Hours of TV viewing on a weekday</td>
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<tr>
<td>Hours of TV viewing on a weekend</td>
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<tr>
<td>Parental involvement in school events</td>
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<td>3.74</td>
<td>3.81</td>
<td>4.02</td>
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<td>Contact with parents of child’s peers</td>
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<td>1.62</td>
<td>2.15</td>
<td>2.68</td>
<td>2.72</td>
</tr>
<tr>
<td>Involvement in artistic or cultural activities</td>
<td>1.05</td>
<td>0.92</td>
<td>0.73</td>
<td>1.33</td>
<td>0.91</td>
</tr>
<tr>
<td>Library visit with child in last month</td>
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<td>0.5422</td>
<td>0.7229</td>
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Table 1.D.4.
Family Process Factors by Race/Ethnicity at Spring Fifth Grade (Wave 5)

<table>
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<th>Family Process Variables</th>
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<th>Hispanic</th>
<th>Asian</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expecting a bachelor’s degree or higher</strong></td>
<td>0.7163</td>
<td>0.6956</td>
<td>0.7678</td>
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<td>0.6965</td>
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<td><strong>Learning Structure</strong></td>
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<td></td>
</tr>
<tr>
<td>Child reading books outside school</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrequent: one to two times a week or less</td>
<td>0.2258</td>
<td>0.2394</td>
<td>0.2187</td>
<td>0.1019</td>
<td>0.3279</td>
</tr>
<tr>
<td>Very frequent: every day</td>
<td>0.4339</td>
<td>0.4913</td>
<td>0.4718</td>
<td>0.5987</td>
<td>0.4093</td>
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<td>Home computer use three times a week or more</td>
<td>0.5857</td>
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<td>Home computer for child use</td>
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<td>0.6780</td>
<td>0.9338</td>
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<td>Number of books child has at home</td>
<td>125.26</td>
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<td>63.47</td>
<td>90.31</td>
<td>97.10</td>
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## Appendix 1.E. Correlations Between SES and Reading/Mathematics Test Scores

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### APPENDIX 1.F. CORRELATIONS BETWEEN SES AND FAMILY PROCESS FACTORS: WAVES 2-5

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## APPENDIX 1.G. SES BY FAMILY PROCESS FACTORS: WAVES 2-5

Table 1.G.1.
SES by Family Process Factors at Spring Kindergarten (Wave 2)

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<th>SES</th>
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<tr>
<td><strong>Learning Structure</strong></td>
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</tr>
<tr>
<td>Child reading books outside school</td>
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<tr>
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Table 1.G.3.  
SES by Family Process Factors at Spring Third Grade (Wave 4)

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<td>Maximum</td>
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<tr>
<td>Child reading books outside school</td>
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### APPENDIX 1.H. COEFFICIENTS OF UNCONDITIONAL MODELS

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<td>Estimate</td>
<td>S.E.</td>
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NOTE: * indicates significance at .05 level, ** indicates significance at .01 level.
## APPENDIX 1.I. COEFFICIENTS OF INTERACTION MODELS

### Table 1.I.1.
**Coefficients of Interaction Models: Black Vs. Non-Black**

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<td>Teacher experience (in years)</td>
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<td>Black*Reading books – Every day</td>
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<td>Black*Sacrifice to meet child’s needs</td>
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<td>Black*Parents feeling child harder to care</td>
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<td>Black*Parent-child interactions</td>
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<td>Black*Talk with child about school every day</td>
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<td>Black*Frequency of spanking in a week</td>
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<td>Black*Hours of TV viewing on a weekend</td>
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<td>Black*Contact with parents of child’s peers</td>
<td>-0.143</td>
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<td>Black*Frequent help with reading homework</td>
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<td>Black*Frequent help with math homework</td>
<td>0.318</td>
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<td>Black*Frequency of talking about nature/science</td>
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<td>Black*Frequency of playing games/puzzles</td>
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<td>Black*Frequency of playing sports or exercising</td>
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<td>Black*Frequency of involving child in chores</td>
<td>-1.056</td>
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<td>Black*Involvement in artistic/cultural activities</td>
<td>-1.588**†</td>
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</tbody>
</table>

**Intercept**

| -238.872**† | 2.147 | --- | -181.104**† | 1.793 | --- |

**Random-Effects Parameters**

| School-level random effects – sigma | 4.035** | 0.204 | --- | 3.306** | 0.178 | --- |
| Child-level random effects – sigma | 12.484** | 0.121 | --- | 11.574** | 0.099 | --- |
| Within-child variability – sigma | 12.096** | 0.058 | --- | 9.098** | 0.045 | --- |

**NOTE:** * indicates significance at .05 level, ** indicates significance at .01 level. † indicates significance at .05 false discovery rate.
Table 1.I.2.

Coefficients of Interaction Models: SES

<table>
<thead>
<tr>
<th>Variable</th>
<th>Reading Estimate</th>
<th>Reading S.E.</th>
<th>Reading Effect Size</th>
<th>Mathematics Estimate</th>
<th>Mathematics S.E.</th>
<th>Mathematics Effect Size</th>
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<td>Parental Expectations and Beliefs</td>
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<td>Degree expected</td>
<td>3.822**† 0.250</td>
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<td>2.949**† 0.194</td>
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<td>Belief in math performance</td>
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<td>Learning Structure</td>
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<td>Doing homework more than 2 times a week</td>
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<td>1.107**† 0.361</td>
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<td>Place set aside for homework</td>
<td>-1.307 0.722</td>
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<td>-1.238* 0.630</td>
<td>-0.009† 0.004</td>
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<td>Time for homework per day</td>
<td>-0.008* 0.004</td>
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<td>-1.545**† 0.153</td>
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<td>-0.209</td>
<td>-2.581**† 0.199</td>
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<tr>
<td>Frequency of reading books – Every day</td>
<td>2.211**† 0.178</td>
<td>0.179</td>
<td>0.915**† 0.138</td>
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<td>Home computer use 3 times a week or more</td>
<td>1.082**† 0.204</td>
<td>0.087</td>
<td>0.543**† 0.162</td>
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<td>Resource Availability</td>
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<td>Home computer for child use</td>
<td>1.321**† 0.263</td>
<td>0.107</td>
<td>0.747**† 0.204</td>
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<td>2.278**† 0.364</td>
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<td>0.003**† 0.001</td>
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<td>0.952**† 0.150</td>
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<td>1.110**† 0.255</td>
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<td>Home Affective Environment</td>
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<td>Having warm, close times with child</td>
<td>-0.562 0.344</td>
<td>-0.045</td>
<td>-0.383 0.304</td>
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<td>Child likes parents</td>
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<td>0.055 0.339</td>
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<td>Sacrifice to meet child’s needs</td>
<td>-1.226**† 0.438</td>
<td>-0.099</td>
<td>-1.513**† 0.377</td>
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<td>Parents feeling child harder to care</td>
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<td>-0.412</td>
<td>-4.116**† 1.332</td>
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<td>0.124 0.170</td>
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<td>Talk with child about school every day</td>
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<td>-0.062</td>
<td>-1.732**† 0.295</td>
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<td>Disciplinary methods</td>
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<td>0.120 0.075</td>
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<td>Frequency of spanking in a week</td>
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<td>-0.581**† 0.195</td>
<td>-0.062</td>
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<td>Number of family rules on TV viewing</td>
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<td>0.013</td>
<td>0.008 0.085</td>
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<td>Hours of TV viewing on a weekday</td>
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<td>-0.006</td>
<td>-0.132* 0.062</td>
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<td>Hours of TV viewing on a weekend</td>
<td>0.070* 0.033</td>
<td>0.006</td>
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<td>0.017</td>
<td>0.219**† 0.058</td>
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<td>Frequency of playing games/puzzles</td>
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<td>0.854**† 0.232</td>
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<td>Frequency of playing sports or exercising</td>
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<td>-0.180</td>
<td>-1.538**† 0.227</td>
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<td>Frequency of involving child in chores</td>
<td>-1.505**† 0.377</td>
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<td>-0.429 0.331</td>
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<td>Involvement in artistic/cultural activities</td>
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<td>0.521**† 0.075</td>
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<td>Library visit with child in last month</td>
<td>0.203 0.177</td>
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<td>-0.141 0.141</td>
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<td>-6.301**+ 0.418 -0.671</td>
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<td>SES</td>
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<td>-0.188 0.231 -0.020</td>
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<td>Single-parent household</td>
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<td>-1.427* 0.681 -0.152</td>
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<td>Other type of household</td>
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<th>Child Characteristics</th>
<th>Female</th>
<th>1.695**+ 0.247 0.137</th>
<th>-2.831**+ 0.216 -0.301</th>
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<td>3.465**+ 0.026 0.369</td>
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<td>Age at assessment squared</td>
<td>-0.014**+ 0.0002 -0.001</td>
<td>-0.010**+ 0.0001 -0.001</td>
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<td>Speak non-English at home</td>
<td>-2.573**+ 0.448 -0.208</td>
<td>-0.952*+ 0.389 -0.101</td>
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<td>Transferred school</td>
<td>0.507 0.313 0.041</td>
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<td>Disability</td>
<td>-2.980**+ 0.230 -0.241</td>
<td>-2.828**+ 0.181 -0.301</td>
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<td>Number of siblings</td>
<td>-1.465**+ 0.106 -0.118</td>
<td>-0.725**+ 0.088 -0.077</td>
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<th>0.282 0.343 0.030</th>
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<td>50 percent or more being minority</td>
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<td>-0.394 0.296 -0.042</td>
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<tr>
<td>10 percent or more with reduced-price lunch</td>
<td>-0.993**+ 0.315 -0.080</td>
<td>0.017 0.201 0.002</td>
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<tr>
<td>Percent students eligible for free lunch</td>
<td>-0.046**+ 0.007 -0.004</td>
<td>-0.032**+ 0.005 -0.003</td>
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</tr>
<tr>
<td>Central city</td>
<td>0.159 0.335 0.013</td>
<td>0.197 0.291 0.021</td>
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<tr>
<td>Rural and small town</td>
<td>-1.630**+ 0.402 -0.132</td>
<td>-2.104**+ 0.349 -0.224</td>
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<td>Class size</td>
<td>0.085**+ 0.025 0.007</td>
<td>0.090**+ 0.019 0.010</td>
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<tr>
<td>Teacher experience (in years)</td>
<td>0.027**+ 0.010 0.002</td>
<td>-0.014 0.007 -0.002</td>
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<table>
<thead>
<tr>
<th>Interaction Terms</th>
<th>SES*Degree expected</th>
<th>0.196 0.342 0.016</th>
<th>-0.037 0.270 -0.004</th>
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<tbody>
<tr>
<td>SES*Belief in math performance</td>
<td>0.411 0.521 0.033</td>
<td>1.459**+ 0.485 0.155</td>
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<tr>
<td>SES*Doing homework &gt; 2 times a week</td>
<td>-1.827**+ 0.475 -0.148</td>
<td>-1.357**+ 0.399 -0.144</td>
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<tr>
<td>SES*Time for homework per day</td>
<td>-0.099* 0.005 -0.001</td>
<td>-0.015**+ 0.004 -0.002</td>
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<tr>
<td>SES*Reading books – Infrequent</td>
<td>-0.518* 0.251 -0.042</td>
<td>-0.448*+ 0.194 -0.048</td>
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<tr>
<td>SES*Reading books – Every day</td>
<td>1.484**+ 0.218 0.120</td>
<td>0.524**+ 0.169 0.056</td>
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<tr>
<td>SES*Home computer use ≥ 3 times a week</td>
<td>0.044 0.254 0.004</td>
<td>0.050 0.201 0.005</td>
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<tr>
<td>SES*Home computer for child use</td>
<td>2.070**+ 0.354 0.167</td>
<td>1.744**+ 0.279 0.186</td>
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<td>SES*Home Internet access</td>
<td>-2.489**+ 0.491 -0.201</td>
<td>-1.457**+ 0.405 -0.155</td>
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<td>SES*Number of books child has at home</td>
<td>0.0003 0.001 0.00002</td>
<td>0.0002 0.001 0.00002</td>
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<td>SES*Family resources</td>
<td>-0.667**+ 0.197 -0.054</td>
<td>-0.212 0.166 -0.023</td>
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<tr>
<td>SES*Community library card for child</td>
<td>-1.382**+ 0.331 -0.112</td>
<td>-1.207**+ 0.279 -0.128</td>
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<tr>
<td>SES*Sacrifice to meet child’s needs</td>
<td>0.382 0.474 0.031</td>
<td>0.279 0.409 0.030</td>
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<tr>
<td>SES*Parents feeling child harder to care</td>
<td>-0.524 1.608 -0.042</td>
<td>-2.310 1.422 -0.246</td>
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<td>SES*Parent-child interactions</td>
<td>-0.636**+ 0.209 -0.051</td>
<td>-0.349* 0.177 -0.037</td>
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<tr>
<td>SES*Talk with child about school every day</td>
<td>-1.065**+ 0.399 -0.086</td>
<td>-0.839**+ 0.334 -0.089</td>
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<td>SES*Disciplinary methods</td>
<td>-0.104 0.099 -0.008</td>
<td>0.058 0.084 0.006</td>
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<tr>
<td>SES*Frequency of spanking in a week</td>
<td>1.069**+ 0.241 0.086</td>
<td>0.946**+ 0.204 0.101</td>
<td></td>
</tr>
<tr>
<td>SES*Hours of TV viewing on a weekday</td>
<td>-0.014 0.101 -0.001</td>
<td>0.147 0.078 0.016</td>
<td></td>
</tr>
<tr>
<td>SES*Hours of TV viewing on a weekend</td>
<td>-0.047 0.042 -0.004</td>
<td>-0.064* 0.033 -0.007</td>
<td></td>
</tr>
<tr>
<td>SES*Parental involvement in school events</td>
<td>0.362**+ 0.087 0.029</td>
<td>0.332**+ 0.069 0.035</td>
<td></td>
</tr>
<tr>
<td>SES*Contact with parents of child’s peers</td>
<td>-0.009 0.030 -0.001</td>
<td>-0.041 0.024 -0.004</td>
<td></td>
</tr>
<tr>
<td>SES*Frequent help with reading homework</td>
<td>-0.711**+ 0.302 -0.057</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES*Frequent help with math homework</td>
<td>-0.021</td>
<td>0.254</td>
<td>-0.002</td>
</tr>
<tr>
<td>SES*Frequency of talking about nature/science</td>
<td>-0.010</td>
<td>0.320</td>
<td>-0.001</td>
</tr>
<tr>
<td>SES*Frequency of playing games/puzzles</td>
<td>0.707*†</td>
<td>0.303</td>
<td>0.057</td>
</tr>
<tr>
<td>SES*Frequency of playing sports or exercising</td>
<td>-0.309</td>
<td>0.304</td>
<td>-0.025</td>
</tr>
<tr>
<td>SES*Frequency of involving child in chores</td>
<td>-1.170**†</td>
<td>0.416</td>
<td>-0.095</td>
</tr>
<tr>
<td>SES*Involvement in artistic/cultural activities</td>
<td>0.769**†</td>
<td>0.106</td>
<td>0.062</td>
</tr>
</tbody>
</table>

**Intercept**
-235.581**† 2.127  --- -178.560**† 1.789  ---

**Random-Effects Parameters**

**School-level random effects – sigma**
3.977** 0.203  --- 3.302** 0.178  ---

**Child-level random effects – sigma**
12.475** 0.122  --- 11.555** 0.100  ---

**Within-child variability – sigma**
12.063** 0.058  --- 9.095** 0.045  ---

**NOTE:** * indicates significance at .05 level, ** indicates significance at .01 level. † indicates significance at .05 false discovery rate.
APPENDIX 2.A. SCALE ITEMS AND RELIABILITY COEFFICIENTS

Family Resources
In your home, does your family have...
- A newspaper received on a regular basis
- A magazine received on a regular basis
- A dictionary or an encyclopedia
- A pocket calculator
Reliability coefficient: 0.39

Parent-Child Interactions
Is each of the following statements true for you?
- Even if I am really busy, I make time to listen to my child.
- I encourage my child to talk about his/her troubles.
- I encourage my child to tell me about his/her friends and activities.
- I encourage my child to express his/her opinions.
Reliability coefficient: 0.56

Number of Disciplinary Methods
If your child got so angry that he/she hit you, would you...
- Have him/her take a time out
- Talk to him/her about what he/she did wrong
- Make him/her apologize
- Take away a privilege
- Give a warning
- Hit him/her back
- Yell at him/her or threaten him/her
Reliability coefficient: 0.57

Number of Family Rules on Television Viewing
Are there family rules for your child about any of the following television-related activities?
- What program your child can watch
- How early or late your child may watch television
- How many hours child may watch television on weekdays
Reliability coefficient: 0.50

Parental Involvement in School Events
Since the beginning of this school year, have you or the other adults in your household...
- Attended an open house or back-to-school night
- Attended a meeting of a PTA, PTO, or Parent-Teacher Organization?
- Gone to a regularly-scheduled parent-teacher conference with your child’s teacher or meeting with your child’s teacher?
- Attended a school or class event, such as a play, sports event, or science fair
- Volunteered at the school or served on a committee
- Participated in fundraising for your child’s school
Reliability coefficient: 0.57
Involvement in Artistic or Cultural Activities

Outside of school hours, has your child ever participated in...

- Dance lessons
- Music lessons, for example, piano, instrumental music or singing lessons
- Art classes or lessons, for example, painting, drawing, sculpturing
- Organized clubs or recreational programs, like scouts
- Organized performing arts programs, such as children’s choirs, dance programs, or theater performances

Reliability coefficient: 0.45
### APPENDIX 2.B. CORRELATIONS BETWEEN SES AND TEACHER SRS SCALE SCORES

<table>
<thead>
<tr>
<th>SRS Scale Scores</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approaches to Learning</td>
<td></td>
</tr>
<tr>
<td>Fall kindergarten</td>
<td>0.1837</td>
</tr>
<tr>
<td>Spring 5th grade</td>
<td>0.2424</td>
</tr>
<tr>
<td>Self-Control</td>
<td></td>
</tr>
<tr>
<td>Fall kindergarten</td>
<td>0.1054</td>
</tr>
<tr>
<td>Spring 5th grade</td>
<td>0.1799</td>
</tr>
<tr>
<td>Interpersonal Skills</td>
<td></td>
</tr>
<tr>
<td>Fall kindergarten</td>
<td>0.1454</td>
</tr>
<tr>
<td>Spring 5th grade</td>
<td>0.1902</td>
</tr>
<tr>
<td>Externalizing Problem Behaviors</td>
<td></td>
</tr>
<tr>
<td>Fall kindergarten</td>
<td>-0.0764</td>
</tr>
<tr>
<td>Spring 5th grade</td>
<td>-0.1476</td>
</tr>
<tr>
<td>Internalizing Problem Behaviors</td>
<td></td>
</tr>
<tr>
<td>Fall kindergarten</td>
<td>-0.0908</td>
</tr>
<tr>
<td>Spring 5th grade</td>
<td>-0.1105</td>
</tr>
</tbody>
</table>
## APPENDIX 2.C. COEFFICIENTS OF UNCONDITIONAL MODELS

### Table 2.C.1.
Coefficients of Unconditional Model for Approaches to Learning

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>3.147**</td>
<td>0.011</td>
</tr>
<tr>
<td>Random-Effects Parameters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School-level random effects – sigma</td>
<td>0.232**</td>
<td>0.012</td>
</tr>
<tr>
<td>Within-school variability – sigma</td>
<td>0.702**</td>
<td>0.007</td>
</tr>
</tbody>
</table>

NOTE: * indicates significance at .05 level, ** indicates significance at .01 level.

### Table 2.C.2.
Coefficients of Unconditional Model for Self-Control

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>3.314**</td>
<td>0.011</td>
</tr>
<tr>
<td>Random-Effects Parameters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School-level random effects – sigma</td>
<td>0.257**</td>
<td>0.011</td>
</tr>
<tr>
<td>Within-school variability – sigma</td>
<td>0.626**</td>
<td>0.006</td>
</tr>
</tbody>
</table>

NOTE: * indicates significance at .05 level, ** indicates significance at .01 level.

### Table 2.C.3.
Coefficients of Unconditional Model for Interpersonal Skills

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>3.151**</td>
<td>0.011</td>
</tr>
<tr>
<td>Random-Effects Parameters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School-level random effects – sigma</td>
<td>0.253**</td>
<td>0.012</td>
</tr>
<tr>
<td>Within-school variability – sigma</td>
<td>0.656**</td>
<td>0.006</td>
</tr>
</tbody>
</table>

NOTE: * indicates significance at .05 level, ** indicates significance at .01 level.

### Table 2.C.4.
Coefficients of Unconditional Model for Externalizing Problem Behaviors

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.568**</td>
<td>0.010</td>
</tr>
<tr>
<td>Random-Effects Parameters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School-level random effects – sigma</td>
<td>0.217**</td>
<td>0.011</td>
</tr>
<tr>
<td>Within-school variability – sigma</td>
<td>0.612**</td>
<td>0.006</td>
</tr>
</tbody>
</table>

NOTE: * indicates significance at .05 level, ** indicates significance at .01 level.

### Table 2.C.5.
Coefficients of Unconditional Model for Internalizing Problem Behaviors

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.587**</td>
<td>0.009</td>
</tr>
<tr>
<td>Random-Effects Parameters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School-level random effects – sigma</td>
<td>0.186**</td>
<td>0.010</td>
</tr>
<tr>
<td>Within-school variability – sigma</td>
<td>0.575**</td>
<td>0.006</td>
</tr>
</tbody>
</table>

NOTE: * indicates significance at .05 level, ** indicates significance at .01 level.
Chapter 2 employs the lag model in the Level-1 equation of the two-level hierarchical models. This technical note explains the model specification, assumptions, advantages, and limitations of the lag model, in comparison with alternative estimation strategies. It starts with the conceptual framework of education production function, and then describes empirical models including levels model, lag model, gains model.

Education Production Function

Todd and Wolpin (2003) developed a conceptual model for estimating student cognitive achievement using an education production function framework. Their conceptual model assumes complete data, i.e., we know all historical inputs as well as the child’s endowed capability. The model is specified as follows:

\[ Y_{ija} = g[F_{ij}(a), S_{ij}(a), \mu, \epsilon_{ija}] \]  

where \( F_{ij}(a) = F_{ij0}, F_{ij1}, F_{ij2}, \ldots, F_{ija} \) and \( S_{ij}(a) = S_{ij0}, S_{ij1}, S_{ij2}, \ldots, S_{ija} \) for all \( k = 0, 1, 2, \ldots, a \).

In the above model, \( i, j, \) and \( a \) index individual students, families, and ages respectively. \( Y \) is the student cognitive achievement. \( \mu \) denotes the child’s endowed mental capacity of acquiring knowledge. \( F_{ija} \) is a vector of family-supplied inputs including family background when the child is at age \( a \), and \( F_{ij}(a) \) is a vector of all historical inputs that the family supplied up to age \( a \) including family background. Similarly, \( S_{ija} \) is a vector of school-supplied inputs when the child is at age \( a \), and \( S_{ij}(a) \) is a vector of all historical inputs that the school supplied up to age \( a \).\(^{72}\) \( \epsilon \) is a random error term. This conceptual model includes current-period school resources, current-period family inputs, historical school resources, historical family inputs, and genetic endowment of learning capacity.

---

\(^{72}\) Since most children usually start schools at age 6, the values for \( S_{ij0} - S_{ija} \) will equal zero for these children. However, more and more children are sent to day care centers or preschools prior to starting their formal schooling. Therefore, a more general form would include \( S_{ij0} - S_{ija} \) for preschool education.
We can easily apply this conceptual model to non-cognitive outcomes by specifying \( Y \) as the nonacademic outcomes and \( \mu \) as the child’s endowed capacity to develop nonacademic skills.

Two main issues arise in implementing this model empirically. First, data is usually incomplete: some inputs and/or some periods of historical inputs may be unavailable. Second, child’s endowment is unobservable. These two problems will result in omitted variable bias which a simple OLS (for continuous dependent variable) or a non-linear model (for ordinal dependent variable such as a scale) based on cross-sectional data is unable to solve.

In an attempt to address one or both of the problems, various econometric models have been used to analyze panel data such as lag model, gains model, and fixed effects model. Despite their different estimation strategies, all these empirical models assume a linear functional from. In the above Todd and Wolpin’s conceptual model, inputs (i.e., independent variables) can be related to the output (i.e., dependent variable) in any functional form, i.e., function \( g \) in the conceptual model can assume any mathematical form. If function \( g \) assumes a linear functional form, the conceptual model (i.e., equation 1) can be rewritten as follows:

\[
Y_{it} = \gamma_i^{T} + X_{it}^{\beta} + \sum_{k=0}^{t-1} (\gamma_k^{T} + X_{ik}^{\beta_k}) + \theta \mu_{i0} + \epsilon_{it}, \quad \text{.........................}(2)
\]

where \( i \) and \( t \) index individual students and time periods respectively.\(^73\) \( Y \) is the student outcome. \( \mu \) denotes the child’s endowed mental capacity of acquiring knowledge. \( T \) is the variable of interest. In this study, \( T \) corresponds to family process and status factors. \( X \) is a \( 1 \times K \) vector of \( K \) observable factors affecting \( Y \), including both observed school inputs as well as child characteristics. \( \epsilon \) is a random error term.

This linear conceptual model (i.e., equation 2) uses notations different from Todd and Wolpin’s model (i.e., equation 1). Specifically, \( T_i \) in equation 2 corresponds

\(^{73}\) As compared to the Todd and Wolpin’s conceptual model, equation 2 uses a different system to index time. While Todd and Wolpin’s model indexes time based on the child’s age \((a)\), equation 2 indexes time based on years \((t)\), an indexing method that are commonly used in many empirical models. Most studies examine a cohort of students who typically start school about the same age. In those cases, using years to index time will get the same result as using age to index time. However, there are cases where students are not of the same age and the implications of using which method to index time should be carefully examined. This study examines a cohort of students who are mostly of the same age at the entry of kindergarten. Therefore, for the remaining of the paper all discussions will use years to index time.
to the current family inputs $F_{ij}$ in equation 1. The school variables from the vector $X_{it}$ in equation 2 correspond to the current school inputs $S_{ijt}$ in equation 1. Similarly, $T_{ik}$ in equation 2 corresponds to the historical family inputs $F_{i0} \sim F_{ija-1}$ in equation 1, and the school variables from the vector $X_{ik}$ in equation 2 correspond to the historical school inputs $S_{j0} \sim S_{ija-1}$ in equation 1. For the ease of discussion, this linear conceptual model (i.e., equation 2) is used as a reference model in the following discussions on empirical models.

**Levels Model**

Implicitly assuming that exclusion of historical inputs and endowed learning capacity does not bias the estimates, levels model only includes current-period school inputs and family characteristics in the estimation. The model can be written as:

$$Y_{it} = \gamma_{it} + \beta_X T_{it} + \epsilon_{it}$$

where $i$ and $t$ index individual students and time periods respectively (Bifulco and Ladd, 2006; Todd and Wolpin, 2004). $Y$ is the student outcomes. $T$ is the variable of interest. $X$ is a $1 \times K$ vector of $K$ observable factors affecting $Y$, including both observed school inputs as well as child characteristics. $\epsilon$ is a random error term.

The advantages of this model include its simplicity and relatively less stringent data requirement. The model only requires data of the current period since it does not include any historical inputs in the equation. However, the validity of this model depends on three assumptions. First, historical inputs are either uncorrelated with the variable of interest ($T$) or have no effect on student outcome ($Y$). Second, student’s endowment of learning capacity is assumed to be uncorrelated with all the independent variables. Third, the model is assumed to have included all current-period inputs or any omitted current-period inputs are assumed to be uncorrelated with the variable of interest. Violation of any of the three assumptions will likely lead to a biased estimate for $\gamma$. In reality, the first two assumptions are not very likely to hold, thus leaving this model vulnerable to possible omitted variable bias.

**Lag Model**

Lag model differs from the levels model by adding a lagged (baseline) student outcome measure ($Y_{i,t-1}$) as a control variable:

$$Y_{it} = \gamma_{ita} + \beta_X T_{it} + \alpha Y_{i,t-1} + \epsilon_{it}$$
where \( i \) and \( t \) index individual students and time periods respectively (Allison, 1990; Betts, Zau, and King, 2005; Carbonaro, 2006; Chaplin and Puma, 2003; Sass, 2006; Todd and Wolpin, 2004).

The lag model imposes three assumptions in comparison with the linear conceptual model (equation 2). First, the lag model only includes inputs from the current period, i.e., \( T_{it} \) and \( X_{it} \). It does not include any historical inputs (\( T_{ik} \) and \( X_{ik} \)) or unobserved child endowment (\( \mu_{i0} \)) that are present in the linear conceptual model. Instead, the lag model uses a lagged student outcome term \( (Y_{i,t-1}) \) as a sufficient measure to control for unobserved historical inputs as well as the unobserved endowment of learning capacity.

Second, in the lag model the effect of all historical inputs (\( T_{ik} \) and \( X_{ik} \)) on the current-period student outcome (\( Y_{it} \)) is assumed to change by the same factor of \( \alpha \) as compared to the effect of these inputs on previous student achievement (\( Y_{i,t-1} \)). Specifically, below is the equation for previous student outcome based on the linear conceptual model:

\[
Y_{i,t-1} = \sum_{k=0}^{t-1} (\gamma_k' T_{ik} + X_{ik} \beta_k') + \theta' \mu_{i0} + \varepsilon_{i,t-1}, \ldots.
\]  

(5)

where \( \mu_{i0} \) is the unobserved endowment of learning capacity. Substituting equation 5 into equation 4, we would get:

\[
Y_{it} = \gamma_i' T_{it} + X_{it} \beta_i + \alpha \sum_{k=0}^{t-1} (\gamma_k' T_{ik} + X_{ik} \beta_k') + \alpha \theta' \mu_{i0} + \alpha \varepsilon_{i,t-1} + \varepsilon_i, \ldots.
\]

(6)

Now compare equation 6 with the linear conceptual model (equation 2). For the empirical model (equation 4) to consistently estimate the parameters in the linear conceptual model (equation 2), the following must be true: \( \alpha \gamma_k' = \gamma_k \) and \( \alpha \beta_k' = \beta_k \). In other words, the lag model implicitly assumes that the effect of all historical inputs on student achievement changes by the same factor of \( \alpha \) over time.

Similarly, the lag model also assumes that the effect of learning endowment (\( \mu_{i0} \)) on the current-period student achievement (\( Y_{it} \)) changes by the same factor of \( \alpha \) over time. This can be easily seen by comparing equation 6 with the linear conceptual model (equation 2), i.e., \( \alpha \theta' = \theta \).

The final assumption of the lag model imposes that either all current-period inputs are included in the model or any omitted current-period inputs are not correlated with the variable of interest.
One obvious advantage of the lag model is its control for historical inputs as well as unobserved endowment of learning capacity by adding a lagged student outcome term as covariates. As a result, this model is less likely to be subject to bias than the levels model.

A second advantage is that the model allows the coefficient of the lag term $\alpha$ to take on any estimated value, which helps address the issue of incomparable student outcomes across different time periods (Allison, 1990; Betts, Zau, and King, 2005; Carbonaro, 2006; Chaplin and Puma, 2003; Sass, 2006; Todd and Wolpin, 2004). To illustrate this point, suppose that if measures are comparable across years, we would have $Y_{it}$ as the current-period student outcome and $Y_{i,t-1}$ as the last-period student outcome. But the measure we are able to get for the last period is $Y'_{i,t-1}$, which follows $Y'_{i,t-1} = \eta Y_{i,t-1}$. In other words, $Y'_{i,t-1}$ and $Y_{it}$ are incomparable as one unit change in $Y_{it}$ are comparable to $\eta$ units change in $Y'_{i,t-1}$.

Using as the lag term, equation 4 becomes:

$$Y_{it} = \gamma_{i} T_{it} + X_{it} \beta_{i} + \alpha \eta Y'_{i,t-1} + \epsilon_{it} \tag{7}$$

A comparison of equation 7 with equation 4 reveals that a change from a lag term ($Y_{i,t-1}$ in equation 4) that is comparable to the dependent variable ($Y_{it}$) to an incomparable lag term ($Y'_{i,t-1}$ in equation 7) will only affect the coefficient of the lag term (i.e., change from $\alpha$ in equation 4 to $\alpha \eta$ in equation 7), but not the coefficients of the current-period inputs ($T_{it}$ and $X_{it}$). Chapter 2 uses the lag model mainly because of this flexibility in accommodating outcome variables that are incomparable across different time periods.

However, the lag model is subject to the three assumptions mentioned above. Moreover, the lag model has a serious problem: the lag term ($Y_{i,t-1}$) is likely to be correlated with the error term ($\epsilon_{it}$), thus biasing the estimators (Allison, 1990; Betts, Zau, and King, 2005; Carbonaro, 2006; Chaplin and Puma, 2003; Sass, 2006; Todd and Wolpin, 2004). Specifically, the lag term ($Y_{i,t-1}$) and the error term ($\epsilon_{it}$) will be correlated if either of the following two situations occur. First, unobservables are serially correlated, i.e., $\epsilon_{it}$ and $\epsilon_{it-1}$ are correlated. Second, the error term ($\epsilon_{it}$) contains inputs that have an effect on student outcomes ($Y$) and that are not included in the model. This is true even if error term ($\epsilon_{it}$) is orthogonal to the included inputs ($T$ and $X$).

---

74 This advantage can also be illustrated in comparison with the gains model which is discussed later: the lag model does not assume any value for $\alpha$ while gains model restricts $\alpha$ to 1. See the discussion on gains model for details.
Gains Model

Gains model regresses the changes in student test scores on current-period inputs:

\[ \Delta Y_{it} = \gamma_i T_{it} + X_i \beta_t + \varepsilon_{it} \] .................................(8)

where \( \Delta Y_{it} = Y_{it} - Y_{i,t-1} \) (Allison, 1990; Bifulco and Ladd, 2006; Todd and Wolpin, 2003).

Gains model imposes three assumptions in comparison with the linear conceptual model (equation 2). First, the gains model only includes inputs from the current period (\( T_{it} \) and \( X_{it} \)). It does not include any historical inputs (\( T_{ik} \) and \( X_{ik} \)) or unobserved child endowment (\( \mu_{ii} \)) that are present in the linear conceptual model. Instead, the gains model uses a differencing strategy as a sufficient measure to control for historical inputs as well as the unobserved endowment of learning capacity. Specifically, it uses the difference between the current-period student outcome (\( Y_t \)) and the lagged student outcome (\( Y_{i,t-1} \)) as the dependent variable. To illustrate this point, we rewrite the gains model as follows:

\[ \Delta Y_{it} = \gamma_i T_{it} + X_i \beta_t + \varepsilon_{it} \]
\[ \Rightarrow Y_{it} - Y_{i,t-1} = \gamma_i T_{it} + X_i \beta_t + \varepsilon_{it} \]
\[ \Rightarrow Y_{it} = \gamma_i T_{it} + X_i \beta_t + Y_{i,t-1} + \varepsilon_{it} \] .................................(9)

In comparison with the lag model, the gains model in equation 9 differs by a factor of \( \alpha \) (i.e., coefficient of the lagged student outcome in lag model). In other words, the coefficient \( \alpha \) in the lag model is set to 1 in the gains model. To further understand the gains model in relation to the linear conceptual model, we substitute equation 5 into equation 9 and get:

\[ Y_{it} = \gamma_i T_{it} + X_i \beta_t + \left[ \sum_{k=0}^{t-1} (\gamma_k T_{ik} + X_{ik} \beta_k) + \delta \mu_{i0} + \varepsilon_{i,t-1} \right] + \varepsilon_{it} \] .................................(10)

Comparing equation 10 with the linear conceptual model (equation 2), the gains model clearly imposes a second assumption—the effects of historical inputs and unobserved endowment on student learning capacity do not change in different time periods, i.e., \( \gamma_k = \gamma_k', \beta_k = \beta_k', \) and \( \delta = \delta'. \)

The third assumption is similar to that of the lag model—either all current-period inputs are included in the model or any omitted current-period inputs are uncorrelated with the variable of interest.
Clearly, one advantage of gains model is that it differences out the effects of all previous inputs as well as unobserved endowment of learning capacity. Moreover, it gets around the bias problem due to the correlation between the lag term \(Y_{it-1}\) and the error term \(\epsilon_{it}\) in the lag model. However, these advantages come with a price that gains model restricts the effects of previous inputs and endowment to be the same for student achievement in different time periods, i.e., the coefficient of the lag term \(Y_{it-1}\) is assumed to equal 1. If this assumption does not hold, i.e., \(\alpha\neq1\), then gains model will give biased estimates.

**Fixed Effects Model**

Fixed effects model uses multiple observations on student achievement and inputs from at least two time periods to difference out the student-specific time-invariant factors:

\[
Y_{it} = \gamma T_{it} + X_{it} \beta + \mu_i + \epsilon_{it}, \tag{11}
\]

or

\[
\Delta Y_{it} = \gamma \Delta T_{it} + \Delta X_{it} \beta + \delta_i, \tag{12}
\]

where \(\Delta Y_{it} = Y_{it} - Y_{i,t-1}\), \(\Delta T_{it} = T_{it} - T_{i,t-1}\) and \(\Delta X_{it} = X_{it} - X_{i,t-1}\) (Link and Mulligan, 1996; Todd and Wolpin, 2004; Zimmer and Buddin, 2006).

Equation 11 is a more general specification of fixed effects model, which can be used for panel data of at least two time periods. Equation 12 uses a differencing strategy and applies to data of two time periods. Data with more than two time periods can use a quasi-differencing method and variables can be calculated as

\[
\Delta Y_{ik} = Y_{ik} - \bar{Y}, \quad \Delta T_{ik} = T_{it} - \bar{T} \quad \text{and} \quad \Delta X_{ik} = X_{ik} - \bar{X}, \quad \text{in which} \quad \bar{Y} = \frac{1}{N} \sum_{t=N+1}^{1} Y_{it},
\]

\[
\bar{T} = \frac{1}{N} \sum_{t=N+1}^{1} T_{ik} \quad \text{and} \quad \bar{X} = \frac{1}{N} \sum_{t=N+1}^{1} X_{ik} \quad \text{for data of N time periods.}
\]

The following discussion focuses on the differencing formulation for data of two time periods specified in equation 12. This formulation looks most similar to the gains model, but it is different from the gains model which is discussed later. All the restrictions of the fixed effects model discussed below apply to all three formulations of the model, and the mathematical formulations shown below based on differencing method go through for the quasi-differencing method as well.

Unlike the lag model and gains model, fixed effects model makes use of panel data. In other words, fixed effects model includes current inputs \((T_{it} \text{ and } X_{it})\) as well as at least part of the historical inputs \((T_{ik} \text{ and } X_{ik})\). While it is plausible to collect a panel data that includes all periods of inputs, in most cases data only
contains part of the time periods. As a result, the fixed effects model imposes three assumptions.

First, the fixed effects model assumes that input effects remain constant over time. To illustrate this point, we rewrite the linear conceptual model (equation 2) for student \( i \) in period \( t \) as follows:

\[
Y_{it} = \sum_{k=0}^{t} (\gamma_k T_{ik} + X_{ik} \beta_k) + \theta \mu_{i0} + \varepsilon_{it} \quad \text{...............................................(13)}
\]

And similarly rewrite the linear conceptual model for student \( i \) in period \( t-1 \) (equation 5) as follows:

\[
Y_{i,t-1} = \sum_{k=0}^{t-1} (\gamma_k T_{ik} + X_{ik} \beta_k) + \theta' \mu_{i0} + \varepsilon_{i,t-1} \quad \text{...............................................(14)}
\]

This assumption essentially states that \( \gamma_k = \gamma_{k-1} \) and \( \beta_k = \beta_{k-1} \). In other words, the effect of current-period inputs on the current student outcomes is the same as the effect of the last-period inputs on the last-period student outcomes. So we difference the student outcomes of the two periods and get:

\[
\Delta Y_{it} = Y_{it} - Y_{i,t-1}
\]

\[
= (T_{it} - T_{i,t-1}) \gamma_i + (X_{it} - X_{i,t-1}) \beta_i + (T_{i,t-1} - T_{i,t-2}) \gamma_{i-1} + (X_{i,t-1} - X_{i,t-2}) \beta_{i-1}
\]

\[
+ \cdots + (T_{i1} - T_{i0}) \gamma_{i1} + (X_{i1} - X_{i0}) \beta_{i1} + T_{i0} \gamma_0 + X_{i0} \beta_0 + (\theta - \theta') \mu_{i0} + \varepsilon_{it} - \varepsilon_{i,t-1}
\]

\[
= (T_{it} - T_{i,t-1}) \gamma_i + (X_{it} - X_{i,t-1}) \beta_i + \sum_{k=1}^{t-1} [(T_{ik} - T_{i,k-1}) \gamma_k + (X_{ik} - X_{i,k-1}) \beta_k] + T_{i0} \gamma_0 + X_{i0} \beta + (\theta - \theta') \mu_{i0} + \varepsilon_{it} - \varepsilon_{i,t-1} \quad \text{...............................................(15)}
\]

The second assumption states that the effect of endowed learning capacity remains constant over time, i.e., \( \theta = \theta' \). Thus, the differencing strategy of the fixed effects model eliminates the unobserved endowment term. As a matter of fact, the fixed effects model differences out all observed and unobserved student-specific time-invariant factors including the unobserved endowment of learning capacity.

Third, differences in historical inputs are not correlated with differences in current-period inputs. In other words, excluding the terms \( (T_{ik} - T_{i,k-1}) \gamma_k + (X_{ik} - X_{i,k-1}) \beta_k \) for all \( k < t \) will not bias the estimate of \( \gamma_1 \) and \( \beta_1 \).

Combining assumptions 2 and 3, equation 15 is reduced to:

\[
\Delta Y_{it} = (T_{it} - T_{i,t-1}) \gamma_i + (X_{it} - X_{i,t-1}) \beta_i + \varepsilon_{it} - \varepsilon_{i,t-1} = \Delta T_{it} \gamma + \Delta X_{it} \beta + \Delta \varepsilon_{it},
\]

which is the specification for the fixed effects model written above (equation 12).
Obviously, an important advantage of fixed effects model is its ability to difference out all observed and unobserved student-specific time-invariant factors. The disadvantage of this model is the data requirement: it requires at least two time periods of data on outcome variable, variables of interest, and all student-specific time-varying factors that are correlated with the variable of interest. Moreover, fixed effects model can only measure the time-varying variables, but not time-invariant factors.

Two other models can be viewed as a modified version of fixed effects model: random growth model and random effects model. Random growth model allows the rate of growth in student outcomes to vary across students. Random effects model differs from fixed effects model by assuming that the individual-specific term is randomly distributed across cross-sectional units (Green, 2000; Zimmer and Buddin, 2006).

Fixed effects model may seem very similar to gains model since both use differencing strategy to address omitted bias problem. However, these two models are inherently different and warrant a detailed discussion.

First and most importantly, the two models impose different assumptions on the time-varying historical inputs. Gains model regresses the difference of student outcomes in two time periods on current inputs as shown in equation 8:

\[
\Delta Y_{it} = \gamma T_{it} + X_{it} \beta + \epsilon_{it} \text{..................................................(8)}
\]

According to the linear conceptual model, the difference of student outcomes in two periods is shown as follows:

\[
\Delta Y_{it} = Y_{it} - Y_{i,t-1}
\]

\[
= [\gamma T_{it} + X_{it} \beta + \sum_{k=0}^{t-1} (\gamma_k T_{ik} + X_{ik} \beta_k) + \theta \mu_{i0} + \epsilon_{it}]
\]

\[
- \sum_{k=0}^{t-1} (\gamma_k T_{ik} + X_{ik} \beta_k) + \theta \mu_{i0} + \epsilon_{i,t-1}
\]

Compared to the conceptual model, the gains model (equation 8) assumes that the historical inputs (T_{ik} and X_{ik}) have the same effects on student outcome of different time periods (Y_{it} and Y_{i,t-1}), i.e., \gamma_k = \gamma_k and \beta_k = \beta_k. As a result, gains model uses the lagged student outcome (Y_{i,t-1}) to difference out all the historical inputs (T_{ik} and X_{ik}) as well as the unobserved endowment of learning capacity (\mu_{i0}).

In contrast, the fixed effects model regresses the differences of student achievement in two time periods on differences of independent variables in two
time periods as show in equation 12. As discussed earlier, for the fixed effects model to consistently estimate the parameters in the linear conceptual model, the following assumption must hold: the effect of current-period inputs on the current student outcomes is the same as the effect of the last-period inputs on the last-period student outcomes, i.e., \( \gamma_k = \gamma_{k-1} \) and \( \beta_k = \beta_{k-1} \). So the fixed effects model differences out all student-specific time-invariant factors including the unobserved endowment of learning capacity (\( \mu_{i0} \)). This difference of assumption on the effects of time-varying historical inputs is a subtle yet important distinction between the two models.

In addition, gains model assumes that any excluded current inputs are not correlated with the variable of interest, while the fixed effects model assumes that any excluded difference terms (i.e., differences of historical inputs for all \( k < t \)) are not correlated with the difference terms of the current-period inputs (i.e., \( T_{it} - T_{i,t-1} \)). Moreover, gains model only requires one period of data on all independent variables and two periods of data on the outcome variable while the fixed effects model requires at least two periods of data on all variables.
## APPENDIX 2.E. SPECIFICATION TESTS

Table 2.E.1. Specification Test: Probit and Tobit Coefficients for Approaches to Learning, Self-Control, and Interpersonal Skills

<table>
<thead>
<tr>
<th>Variable</th>
<th>Approaches to Learning</th>
<th></th>
<th></th>
<th>Self-Control</th>
<th></th>
<th></th>
<th>Interpersonal Skills</th>
<th></th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Probit</td>
<td>Tobit</td>
<td>Probit</td>
<td>Tobit</td>
<td>Probit</td>
<td>Tobit</td>
<td>Probit</td>
<td>Tobit</td>
<td>Probit</td>
</tr>
<tr>
<td></td>
<td>Estimate</td>
<td>S.E.</td>
<td>Estimate</td>
<td>S.E.</td>
<td>Estimate</td>
<td>S.E.</td>
<td>Estimate</td>
<td>S.E.</td>
<td>Estimate</td>
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<tr>
<td>SRS Scales at Kindergarten</td>
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</tr>
<tr>
<td>Approaches to learning</td>
<td>0.462**</td>
<td>0.044</td>
<td>0.273**</td>
<td>0.012</td>
<td>0.403**</td>
<td>0.041</td>
<td>0.249**</td>
<td>0.013</td>
<td>0.376**</td>
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<tr>
<td>Self-control</td>
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<td>Interpersonal skills</td>
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<tr>
<td>Parental Expectations and Beliefs</td>
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</tr>
<tr>
<td>Degree expected</td>
<td>0.144*</td>
<td>0.068</td>
<td>0.107**</td>
<td>0.019</td>
<td>0.085</td>
<td>0.057</td>
<td>0.055**</td>
<td>0.019</td>
<td>0.120</td>
</tr>
<tr>
<td>Belief in reading performance</td>
<td>0.253*</td>
<td>0.110</td>
<td>0.099**</td>
<td>0.027</td>
<td>-0.038</td>
<td>0.081</td>
<td>-0.002</td>
<td>0.027</td>
<td>-0.002</td>
</tr>
<tr>
<td>Belief in math performance</td>
<td>0.227</td>
<td>0.122</td>
<td>0.145**</td>
<td>0.030</td>
<td>0.207*</td>
<td>0.095</td>
<td>0.106**</td>
<td>0.029</td>
<td>0.241*</td>
</tr>
<tr>
<td>Learning Structure</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Doing homework &gt; 2 times a week</td>
<td>-0.005</td>
<td>0.074</td>
<td>0.0002</td>
<td>0.023</td>
<td>0.043</td>
<td>0.070</td>
<td>0.016</td>
<td>0.024</td>
<td>0.086</td>
</tr>
<tr>
<td>Place set aside for homework</td>
<td>0.093</td>
<td>0.131</td>
<td>0.047</td>
<td>0.044</td>
<td>0.091</td>
<td>0.119</td>
<td>0.073</td>
<td>0.043</td>
<td>-0.046</td>
</tr>
<tr>
<td>Time for homework per day</td>
<td>-0.0003</td>
<td>0.001</td>
<td>-0.0004</td>
<td>0.0002</td>
<td>0.001</td>
<td>0.001</td>
<td>0.0001</td>
<td>0.0002</td>
<td>-0.0004</td>
</tr>
<tr>
<td>Frequency of reading books – Infrequent</td>
<td>-0.183*</td>
<td>0.073</td>
<td>-0.087**</td>
<td>0.021</td>
<td>-0.043</td>
<td>0.059</td>
<td>-0.030</td>
<td>0.020</td>
<td>-0.060</td>
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<tr>
<td>Frequency of reading books – Every day</td>
<td>0.115*</td>
<td>0.049</td>
<td>0.048**</td>
<td>0.016</td>
<td>-0.001</td>
<td>0.046</td>
<td>0.014</td>
<td>0.016</td>
<td>-0.014</td>
</tr>
<tr>
<td>Home computer use ≥ 3 times a week</td>
<td>0.092</td>
<td>0.051</td>
<td>-0.002</td>
<td>0.017</td>
<td>0.022</td>
<td>0.045</td>
<td>-0.003</td>
<td>0.016</td>
<td>-0.008</td>
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<tr>
<td>Resource Availability</td>
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<td></td>
</tr>
<tr>
<td>Home computer for child use</td>
<td>-0.137</td>
<td>0.107</td>
<td>0.028</td>
<td>0.030</td>
<td>0.025</td>
<td>0.091</td>
<td>0.053</td>
<td>0.029</td>
<td>0.0003</td>
</tr>
<tr>
<td>Home Internet access</td>
<td>0.085</td>
<td>0.090</td>
<td>0.003</td>
<td>0.027</td>
<td>-0.010</td>
<td>0.078</td>
<td>-0.011</td>
<td>0.025</td>
<td>0.035</td>
</tr>
<tr>
<td>Number of books child has at home</td>
<td>0.0001</td>
<td>0.0001</td>
<td>-0.00005</td>
<td>0.0004</td>
<td>-0.0001</td>
<td>0.0001</td>
<td>-0.0001</td>
<td>0.0004</td>
<td>-0.0001</td>
</tr>
<tr>
<td>Family resources</td>
<td>0.046</td>
<td>0.034</td>
<td>0.016</td>
<td>0.010</td>
<td>-0.032</td>
<td>0.030</td>
<td>-0.011</td>
<td>0.011</td>
<td>0.011</td>
</tr>
<tr>
<td>Community library card for child</td>
<td>-0.004</td>
<td>0.058</td>
<td>0.023</td>
<td>0.017</td>
<td>0.068</td>
<td>0.049</td>
<td>0.044**</td>
<td>0.017</td>
<td>0.033</td>
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<tr>
<td>Home Affective Environment</td>
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<td></td>
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</tr>
</tbody>
</table>

75 Sample excludes observations with the dependent variable equal to 1.
<table>
<thead>
<tr>
<th>Having warm, close times with child</th>
<th>-0.0005</th>
<th>0.066</th>
<th>-0.018</th>
<th>0.020</th>
<th>0.049</th>
<th>0.061</th>
<th>0.017</th>
<th>0.021</th>
<th>-0.019</th>
<th>0.067</th>
<th>0.004</th>
<th>0.021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child likes parents</td>
<td>-0.037</td>
<td>0.074</td>
<td>0.024</td>
<td>0.024</td>
<td>0.011</td>
<td>0.069</td>
<td>0.040</td>
<td>0.023</td>
<td>0.023</td>
<td>0.074</td>
<td>0.045</td>
<td>0.024</td>
</tr>
<tr>
<td>Sacrifice to meet child’s needs</td>
<td>0.042</td>
<td>0.081</td>
<td>-0.009</td>
<td>0.026</td>
<td>0.030</td>
<td>0.073</td>
<td>-0.012</td>
<td>0.025</td>
<td>0.029</td>
<td>0.080</td>
<td>-0.006</td>
<td>0.026</td>
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<tr>
<td>Parents feeling child harder to care</td>
<td>-0.362</td>
<td>0.447</td>
<td>-0.041</td>
<td>0.084</td>
<td>-0.434</td>
<td>0.327</td>
<td>-0.105</td>
<td>0.078</td>
<td>0.025</td>
<td>0.295</td>
<td>-0.059</td>
<td>0.085</td>
</tr>
<tr>
<td>Parent-child interactions</td>
<td>0.063</td>
<td>0.037</td>
<td>0.025*</td>
<td>0.011</td>
<td>0.055</td>
<td>0.034</td>
<td>0.028*</td>
<td>0.011</td>
<td>0.044</td>
<td>0.037</td>
<td>0.021</td>
<td>0.012</td>
</tr>
<tr>
<td>Talk with child about school every day</td>
<td>0.020</td>
<td>0.064</td>
<td>0.006</td>
<td>0.021</td>
<td>-0.061</td>
<td>0.059</td>
<td>-0.006</td>
<td>0.020</td>
<td>0.121</td>
<td>0.065</td>
<td>0.025</td>
<td>0.020</td>
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<tr>
<td>Parenting and Disciplinary Practices</td>
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</tr>
<tr>
<td>Disciplinary methods</td>
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<td>0.017</td>
<td>-0.009</td>
<td>0.005</td>
<td>-0.036*</td>
<td>0.016</td>
<td>-0.014**</td>
<td>0.005</td>
<td>-0.015</td>
<td>0.016</td>
<td>-0.012*</td>
<td>0.005</td>
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<tr>
<td>Frequency of spanking in a week</td>
<td>-0.030</td>
<td>0.049</td>
<td>-0.033*</td>
<td>0.013</td>
<td>-0.096*</td>
<td>0.045</td>
<td>-0.035**</td>
<td>0.013</td>
<td>-0.042</td>
<td>0.046</td>
<td>-0.047**</td>
<td>0.013</td>
</tr>
<tr>
<td>Number of family rules on TV viewing</td>
<td>-0.065*</td>
<td>0.029</td>
<td>-0.028**</td>
<td>0.009</td>
<td>-0.032</td>
<td>0.026</td>
<td>-0.023*</td>
<td>0.009</td>
<td>-0.044</td>
<td>0.028</td>
<td>-0.023*</td>
<td>0.010</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekday</td>
<td>0.027</td>
<td>0.021</td>
<td>0.005</td>
<td>0.007</td>
<td>0.006</td>
<td>0.019</td>
<td>-0.002</td>
<td>0.007</td>
<td>-0.005</td>
<td>0.021</td>
<td>-0.0002</td>
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<td>Hours of TV viewing on a weekend</td>
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<td>0.003</td>
<td>0.0002</td>
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<td>0.002</td>
<td>-0.004</td>
<td>0.008</td>
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<tr>
<td>Parental Involvement</td>
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</tr>
<tr>
<td>Parental involvement in school events</td>
<td>0.030</td>
<td>0.020</td>
<td>0.020**</td>
<td>0.006</td>
<td>0.029</td>
<td>0.017</td>
<td>0.015*</td>
<td>0.006</td>
<td>0.027</td>
<td>0.019</td>
<td>0.019**</td>
<td>0.006</td>
</tr>
<tr>
<td>Contact with parents of child’s peers</td>
<td>-0.001</td>
<td>0.006</td>
<td>0.003</td>
<td>0.002</td>
<td>-0.006</td>
<td>0.006</td>
<td>-0.001</td>
<td>0.002</td>
<td>0.003</td>
<td>0.006</td>
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<tr>
<td>Frequent help with reading homework</td>
<td>-0.154**</td>
<td>0.054</td>
<td>-0.054**</td>
<td>0.018</td>
<td>-0.041</td>
<td>0.050</td>
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<td>-0.093</td>
<td>0.056</td>
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<tr>
<td>Frequent help with math homework</td>
<td>-0.058</td>
<td>0.054</td>
<td>-0.063**</td>
<td>0.018</td>
<td>-0.053</td>
<td>0.049</td>
<td>-0.013</td>
<td>0.018</td>
<td>-0.013</td>
<td>0.055</td>
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<tr>
<td>Frequency of talking about nature/science</td>
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<td>0.052</td>
<td>-0.056**</td>
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<td>0.007</td>
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<td>-0.027</td>
<td>0.016</td>
<td>-0.011</td>
<td>0.051</td>
<td>-0.040*</td>
<td>0.017</td>
</tr>
<tr>
<td>Frequency of playing games/puzzles</td>
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<td>0.048</td>
<td>0.005</td>
<td>0.016</td>
<td>0.005</td>
<td>0.044</td>
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<td>0.016</td>
<td>-0.013</td>
<td>0.046</td>
<td>-0.005</td>
<td>0.016</td>
</tr>
<tr>
<td>Frequency of playing sports or exercising</td>
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<td>0.015</td>
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<td>Frequency of involving child in chores</td>
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<td>-0.036</td>
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<td>-0.043</td>
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<td>0.020</td>
<td>0.008</td>
<td>0.007</td>
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<td>0.019</td>
<td>0.002</td>
<td>0.007</td>
<td>0.042*</td>
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<td>Library visit with child in last month</td>
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<td>0.047</td>
<td>-0.019</td>
<td>0.015</td>
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<td>Asian</td>
<td>0.208</td>
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<td>0.186**</td>
<td>0.040</td>
<td>0.275**</td>
<td>0.100</td>
<td>0.178**</td>
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<td>0.184</td>
<td>0.110</td>
<td>0.119**</td>
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<td>Other race</td>
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<td>0.0002</td>
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<td>0.039</td>
<td>0.086**</td>
<td>0.014</td>
<td>0.148**</td>
<td>0.036</td>
<td>0.061**</td>
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<td>0.097*</td>
<td>0.039</td>
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<td>Single-parent household</td>
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<td>0.019</td>
<td>-0.026</td>
<td>0.063</td>
<td>-0.052**</td>
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<td>Other type of household</td>
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<td>0.205</td>
<td>-0.179**</td>
<td>0.054</td>
<td>-0.090</td>
<td>0.189</td>
<td>-0.096</td>
<td>0.052</td>
<td>-0.137</td>
<td>0.208</td>
<td>-0.145**</td>
<td>0.056</td>
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<td>Child Characteristics</td>
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<td>-------------------------------------------</td>
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<tr>
<td>Female</td>
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<td>0.049</td>
<td>0.282**</td>
<td>0.015</td>
<td>0.303**</td>
<td>0.044</td>
<td>0.195**</td>
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<td>0.458**</td>
<td>0.047</td>
<td>0.251**</td>
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<td>Age at assessment</td>
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<td>Age at assessment squared</td>
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<td>-0.0001</td>
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<td>-0.001</td>
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<tr>
<td>Speak non-English at home</td>
<td>0.195*</td>
<td>0.091</td>
<td>0.084**</td>
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<td>0.063</td>
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<td>0.043</td>
<td>0.030</td>
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<td>Transferred school</td>
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<td>0.021</td>
<td>-0.014</td>
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<td>0.007</td>
<td>0.022</td>
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<td>Disability</td>
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<td>-0.208**</td>
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<td>-0.335**</td>
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<td>-0.254**</td>
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<td>Number of siblings</td>
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<td>Public</td>
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<td>0.017</td>
<td>0.027</td>
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<td>0.080</td>
<td>-0.038</td>
<td>0.028</td>
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<td>50 percent or more being minority</td>
<td>-0.026</td>
<td>0.092</td>
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<td>0.028</td>
<td>-0.031</td>
<td>0.078</td>
<td>-0.020</td>
<td>0.028</td>
<td>-0.045</td>
<td>0.086</td>
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<td>10 percent or more reduced-price lunch</td>
<td>0.028</td>
<td>0.061</td>
<td>0.020</td>
<td>0.020</td>
<td>-0.030</td>
<td>0.066</td>
<td>0.001</td>
<td>0.021</td>
<td>0.037</td>
<td>0.073</td>
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<td>Percent students eligible for free lunch</td>
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<td>0.001</td>
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<td>Central city</td>
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<td>0.024</td>
<td>-0.078</td>
<td>0.070</td>
<td>-0.041</td>
<td>0.023</td>
<td>0.081</td>
<td>0.072</td>
<td>0.014</td>
<td>0.024</td>
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<tr>
<td>Rural and small town</td>
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<td>0.014</td>
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<td>0.033</td>
<td>0.080</td>
<td>0.030</td>
<td>0.028</td>
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<td>Class size</td>
<td>0.007</td>
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<td>0.002</td>
<td>0.002</td>
<td>0.013*</td>
<td>0.006</td>
<td>0.005*</td>
<td>0.002</td>
<td>-0.002</td>
<td>0.006</td>
<td>0.003</td>
<td>0.002</td>
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<tr>
<td>Teacher experience (in years)</td>
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<td>0.003</td>
<td>0.001</td>
<td>0.001</td>
<td>0.005</td>
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<td>School random effects – sigma</td>
<td>0.511**</td>
<td>0.038</td>
<td>0.218**</td>
<td>0.010</td>
<td>0.580**</td>
<td>0.035</td>
<td>0.231**</td>
<td>0.010</td>
<td>0.572**</td>
<td>0.038</td>
<td>0.232**</td>
<td>0.010</td>
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<td>Within-school variability – sigma</td>
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<td>0.587**</td>
<td>0.005</td>
<td>---</td>
<td>0.566**</td>
<td>0.006</td>
<td>---</td>
<td>0.586**</td>
<td>0.006</td>
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Number of Observations 8,356 8,356 8,368 8,368 8,360 8,360

NOTE: * indicates significance at .05 level, ** indicates significance at .01 level.
Table 2.E.2. Specification Test: Probit and Tobit Coefficients for Externalizing Problem Behavior, and Internalizing Problem Behaviors

<table>
<thead>
<tr>
<th>Variable</th>
<th>Externalizing Problem Behaviors</th>
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<th>Internalizing Problem Behaviors</th>
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<td>Probit Estimate</td>
<td>S.E.</td>
<td>Tobit Estimate</td>
<td>S.E.</td>
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<td>SRS Scales at Kindergarten</td>
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<td>Externalizing problem behaviors</td>
<td>0.789**</td>
<td>0.050</td>
<td>0.360**</td>
<td>0.012</td>
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<td>Internalizing problem behaviors</td>
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<tr>
<td>Parental Expectations and Beliefs</td>
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<td>Degree expected</td>
<td>-0.022</td>
<td>0.054</td>
<td>-0.063**</td>
<td>0.017</td>
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<tr>
<td>Belief in reading performance</td>
<td>0.025</td>
<td>0.075</td>
<td>-0.033</td>
<td>0.024</td>
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<tr>
<td>Belief in math performance</td>
<td>-0.025</td>
<td>0.088</td>
<td>-0.030</td>
<td>0.027</td>
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<td>Learning Structure</td>
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<td>Doing homework more than 2 times a week</td>
<td>-0.077</td>
<td>0.068</td>
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<tr>
<td>Place set aside for homework</td>
<td>-0.021</td>
<td>0.117</td>
<td>-0.039</td>
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<tr>
<td>Time for homework per day</td>
<td>-0.0005</td>
<td>0.001</td>
<td>-0.0001</td>
<td>0.0002</td>
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<tr>
<td>Frequency of reading books – Infrequent</td>
<td>0.056</td>
<td>0.059</td>
<td>0.049**</td>
<td>0.018</td>
</tr>
<tr>
<td>Frequency of reading books – Every day</td>
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<td>0.046</td>
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<td>Home computer use 3 times a week or more</td>
<td>0.016</td>
<td>0.044</td>
<td>0.007</td>
<td>0.014</td>
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<tr>
<td>Resource Availability</td>
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<td>Home computer for child use</td>
<td>-0.061</td>
<td>0.090</td>
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<tr>
<td>Home Internet access</td>
<td>0.052</td>
<td>0.078</td>
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<td>Number of books child has at home</td>
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<td>Family resources</td>
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<td>0.010</td>
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<td>Community library card for child</td>
<td>-0.101*</td>
<td>0.049</td>
<td>-0.038*</td>
<td>0.016</td>
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<td>Home Affective Environment</td>
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<tr>
<td>Having warm, close times with child</td>
<td>0.143*</td>
<td>0.057</td>
<td>0.006</td>
<td>0.019</td>
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<tr>
<td>Child likes parents</td>
<td>-0.164*</td>
<td>0.068</td>
<td>-0.043*</td>
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* Sample excludes observations with the dependent variable equal to 4.
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<th>Category</th>
<th>Values</th>
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<td>Sacrifice to meet child’s needs</td>
<td>0.030 0.073 0.017 0.024 0.039 0.076 -0.034 0.023</td>
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<tr>
<td>Parents feeling child harder to care</td>
<td>0.368 0.355 0.014 0.076 0.109 0.266 0.053 0.073</td>
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<tr>
<td>Parent-child interactions</td>
<td>-0.087** 0.033 -0.015 0.010 0.031 0.031 -0.003 0.010</td>
</tr>
<tr>
<td>Talk with child about school every day</td>
<td>0.046 0.056 0.025 0.018 0.066 0.058 -0.002 0.018</td>
</tr>
<tr>
<td>Parenting and Disciplinary Practices</td>
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<tr>
<td>Disciplinary methods</td>
<td>0.025 0.014 0.008 0.005 -0.018 0.015 -0.008 0.005</td>
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<td>Frequency of spanking in a week</td>
<td>0.109* 0.047 0.033** 0.012 -0.001 0.038 -0.0001 0.012</td>
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<tr>
<td>Number of family rules on TV viewing</td>
<td>0.021 0.026 0.010 0.008 0.006 0.027 0.012 0.008</td>
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<tr>
<td>Hours of TV viewing on a weekday</td>
<td>0.005 0.018 0.001 0.006 -0.003 0.019 -0.004 0.006</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekend</td>
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<td>Parental Involvement</td>
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<tr>
<td>Parental involvement in school events</td>
<td>-0.015 0.017 -0.005 0.006 -0.014 0.017 -0.017** 0.005</td>
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<tr>
<td>Contact with parents of child’s peers</td>
<td>0.006 0.006 -0.0002 0.002 0.005 0.006 -0.002 0.002</td>
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<td>Frequency of help with reading homework</td>
<td>0.001 0.052 -0.014 0.017 0.049 0.051 0.025 0.016</td>
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<tr>
<td>Frequency of help with math homework</td>
<td>0.074 0.050 0.016 0.017 0.038 0.050 0.042** 0.016</td>
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<tr>
<td>Frequency of talking about nature/science</td>
<td>0.004 0.045 0.016 0.015 0.035 0.049 0.036* 0.015</td>
</tr>
<tr>
<td>Frequency of playing games/puzzles</td>
<td>-0.047 0.043 0.002 0.014 -0.0001 0.044 0.011 0.014</td>
</tr>
<tr>
<td>Frequency of playing sports or exercising</td>
<td>0.032 0.043 0.006 0.014 -0.048 0.043 -0.036** 0.014</td>
</tr>
<tr>
<td>Frequency of involving child in chores</td>
<td>0.095 0.060 0.045* 0.020 -0.016 0.062 0.001 0.020</td>
</tr>
<tr>
<td>Involvement in artistic/cultural activities</td>
<td>0.032 0.019 0.007 0.006 0.013 0.019 0.008 0.006</td>
</tr>
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<td>Library visit with child in last month</td>
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<td>Single-parent household</td>
<td>0.092 0.056 0.051** 0.018 0.127* 0.060 0.088** 0.018</td>
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<td>Child Characteristics</td>
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<td>Female</td>
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<td>Variable</td>
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<td>Speak non-English at home</td>
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<td>Rural and small town</td>
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NOTE: * indicates significance at .05 level, ** indicates significance at .01 level.
### Table 2.6.3. Specification Test: Comparison of Probit and Tobit Coefficients

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<th>Variable</th>
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<td>Doing homework more than 2 times a week</td>
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<td>Place set aside for homework</td>
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<td>Time for homework per day</td>
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77 Probit coefficients (listed under the “Probit” columns) are compared with Tobit coefficients divided by the residual standard deviation (listed under the “Tobit” columns). Coefficients that are statistically insignificant in both Probit and Tobit estimations are indicated as “Insig.”
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<td>0.129*</td>
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*NOTE:* * indicates significance at .05 level, ** indicates significance at .01 level.
## Table 2.E.4. Specification Test: One-End Tobit Coefficients of Baseline Models

<table>
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<tr>
<th>Variable</th>
<th>Approaches To Learning</th>
<th>Self-Control</th>
<th>Interpersonal Skills</th>
<th>Externalizing Problem Behaviors</th>
<th>Internalizing Problem Behaviors</th>
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<td>-0.163**  0.032</td>
<td>-0.121**  0.032</td>
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<td>0.015  0.028</td>
<td>-0.024  0.024</td>
<td>-0.055*  0.024</td>
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<td>0.178**  0.038</td>
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<td>-0.011  0.037</td>
<td>-0.009  0.032</td>
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<td>0.096*  0.049</td>
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<td>-0.053*  0.022</td>
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<td>0.004  0.007</td>
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78 Estimates are based on tobit regressions that model the censoring at the higher boundary (i.e., value of 4) for approaches to learning, self-control and interpersonal skills, and at the lower boundary for externalizing and internalizing problem behaviors (i.e., value of 1).
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Random Effects Parameters

| School random effects – sigma                  | 0.218**  | 0.011    | 0.232**  | 0.010    | 0.233**  | 0.011    | 0.184**  | 0.010    | 0.169**  | 0.010    |
| Within-school variability – sigma              | 0.601**  | 0.006    | 0.571**  | 0.006    | 0.594**  | 0.006    | 0.535**  | 0.005    | 0.543**  | 0.005    |

Number of Observations 8,370

NOTE: * indicates significance at .05 level, ** indicates significance at .01 level.
Table 2.E.5.
Specification Test: One-End Tobit Coefficients of Family Process Models

<table>
<thead>
<tr>
<th>Variable</th>
<th>Approaches to Learning</th>
<th>Self-Control Skills</th>
<th>Interpersonal Skills</th>
<th>Externalizing Problem Behaviors</th>
<th>Internalizing Problem Behaviors</th>
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<tbody>
<tr>
<td>SRS Scales at Kindergarten</td>
<td></td>
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<td></td>
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<td>Approaches to learning</td>
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<td>Self-control</td>
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<td>0.250** 0.013</td>
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<td>0.177** 0.014</td>
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<td>0.107** 0.019</td>
<td>0.054** 0.019</td>
<td>0.055** 0.020</td>
<td>-0.061** 0.017</td>
<td>-0.079** 0.018</td>
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<tr>
<td>Belief in reading performance</td>
<td>0.102** 0.026</td>
<td>-0.003 0.027</td>
<td>0.014 0.027</td>
<td>-0.033 0.025</td>
<td>-0.061** 0.023</td>
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<tr>
<td>Belief in math performance</td>
<td>0.146** 0.030</td>
<td>0.106** 0.029</td>
<td>0.109** 0.031</td>
<td>-0.031 0.027</td>
<td>-0.094** 0.028</td>
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<td>Learning Structure</td>
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<tr>
<td>Doing homework more than 2 times a week</td>
<td>0.001 0.024</td>
<td>0.018 0.024</td>
<td>0.032 0.024</td>
<td>0.003 0.022</td>
<td>-0.001 0.023</td>
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<tr>
<td>Place set aside for homework</td>
<td>0.046 0.044</td>
<td>0.073 0.043</td>
<td>0.059 0.044</td>
<td>-0.038 0.039</td>
<td>0.032 0.039</td>
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<tr>
<td>Time for homework per day</td>
<td>-0.0004 0.0002</td>
<td>0.0001 0.0002</td>
<td>0.0002 0.0002</td>
<td>-0.0001 0.0002</td>
<td>0.001** 0.0002</td>
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<tr>
<td>Frequency of reading books – Infrequent</td>
<td>-0.088** 0.021</td>
<td>-0.030 0.020</td>
<td>-0.043* 0.020</td>
<td>0.050** 0.018</td>
<td>0.063** 0.020</td>
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<tr>
<td>Frequency of reading books – Every day</td>
<td>0.048** 0.016</td>
<td>0.013 0.016</td>
<td>-0.003 0.016</td>
<td>-0.016 0.015</td>
<td>0.061** 0.015</td>
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<td>Home computer use 3 times a week or more</td>
<td>-0.002 0.017</td>
<td>-0.003 0.016</td>
<td>-0.018 0.016</td>
<td>0.009 0.015</td>
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<td>Resource Availability</td>
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<td>Home computer for child use</td>
<td>0.026 0.030</td>
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<td>0.040 0.032</td>
<td>-0.021 0.028</td>
<td>0.081** 0.028</td>
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<td>Home Internet access</td>
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<td>0.009 0.026</td>
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<td>-0.057* 0.025</td>
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<td>Number of books child has at home</td>
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<td>-0.0001 0.00004</td>
<td>-0.0001 0.00004</td>
<td>0.00003 0.00004</td>
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<td>Family resources</td>
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<td>-0.011 0.011</td>
<td>-0.004 0.011</td>
<td>0.007 0.010</td>
<td>-0.009 0.009</td>
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</table>

79 Estimates are based on tobit regressions that model the censoring at the higher boundary (i.e., value of 4) for approaches to learning, self-control and interpersonal skills, and at the lower boundary for externalizing and internalizing problem behaviors (i.e., value of 1).
| Category                                               | Value  
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Community library card for child</td>
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<tr>
<td>Home Affective Environment</td>
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<tr>
<td>Having warm, close times with child</td>
<td>-0.017</td>
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<tr>
<td>Child likes parents</td>
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<tr>
<td>Sacrifice to meet child’s needs</td>
<td>-0.009</td>
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<tr>
<td>Parents feeling child harder to care</td>
<td>-0.040</td>
</tr>
<tr>
<td>Parent-child interactions</td>
<td>0.026</td>
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<tr>
<td>Talk with child about school every day</td>
<td>0.004</td>
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<tr>
<td>Parenting and Disciplinary Practices</td>
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</tr>
<tr>
<td>Disciplinary methods</td>
<td>-0.009</td>
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<tr>
<td>Frequency of spanking in a week</td>
<td>-0.033</td>
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<tr>
<td>Number of family rules on TV viewing</td>
<td>-0.028</td>
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<tr>
<td>Hours of TV viewing on a weekday</td>
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<tr>
<td>Hours of TV viewing on a weekend</td>
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<td>Parental Involvement</td>
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<td>Parental involvement in school events</td>
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<tr>
<td>Contact with parents of child’s peers</td>
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<tr>
<td>Frequency of help with reading homework</td>
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<tr>
<td>Frequency of help with math homework</td>
<td>-0.064</td>
</tr>
<tr>
<td>Frequency of talking about nature/science</td>
<td>-0.055</td>
</tr>
<tr>
<td>Frequency of playing games/puzzles</td>
<td>0.006</td>
</tr>
<tr>
<td>Frequency of playing sports or exercising</td>
<td>0.019</td>
</tr>
<tr>
<td>Frequency of involving child in chores</td>
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<tr>
<td>Involvement in artistic/cultural activities</td>
<td>0.008</td>
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<tr>
<td>Library visit with child in last month</td>
<td>-0.019</td>
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<tr>
<td>Family Status Factors</td>
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</tr>
<tr>
<td>Black</td>
<td>-0.148</td>
</tr>
<tr>
<td>Hispanic</td>
<td>-0.040</td>
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<tr>
<td>Asian</td>
<td>0.187</td>
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<tr>
<td>Other race</td>
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<tr>
<td>SES</td>
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<tr>
<td></td>
<td>Coefficient (SE)</td>
</tr>
<tr>
<td>------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Single-parent household</td>
<td>-0.054 (0.020)</td>
</tr>
<tr>
<td>Other type of household</td>
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</tr>
<tr>
<td>Child Characteristics</td>
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</tr>
<tr>
<td>Female</td>
<td>0.282 (0.015)</td>
</tr>
<tr>
<td>Age at assessment</td>
<td>0.102 (0.090)</td>
</tr>
<tr>
<td>Age at assessment squared</td>
<td>-0.0004 (0.0003)</td>
</tr>
<tr>
<td>Speak non-English at home</td>
<td>0.086 (0.030)</td>
</tr>
<tr>
<td>Transferred school</td>
<td>-0.024 (0.021)</td>
</tr>
<tr>
<td>Disability</td>
<td>-0.208 (0.021)</td>
</tr>
<tr>
<td>Number of siblings</td>
<td>0.0004 (0.007)</td>
</tr>
<tr>
<td>School Factors</td>
<td></td>
</tr>
<tr>
<td>Public</td>
<td>0.005 (0.028)</td>
</tr>
<tr>
<td>50 percent or more being minority</td>
<td>0.005 (0.028)</td>
</tr>
<tr>
<td>10 percent or more with reduced-price lunch</td>
<td>0.020 (0.020)</td>
</tr>
<tr>
<td>Percent students eligible for free lunch</td>
<td>0.001 (0.001)</td>
</tr>
<tr>
<td>Central city</td>
<td>-0.014 (0.024)</td>
</tr>
<tr>
<td>Rural and small town</td>
<td>0.039 (0.028)</td>
</tr>
<tr>
<td>Class size</td>
<td>0.002 (0.002)</td>
</tr>
<tr>
<td>Teacher experience (in years)</td>
<td>0.001 (0.001)</td>
</tr>
<tr>
<td>Intercept</td>
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<tr>
<td>Random Effects Parameters</td>
<td></td>
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<tr>
<td>School random effects – sigma</td>
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</tr>
<tr>
<td>Within-school variability – sigma</td>
<td>0.587 (0.005)</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>8,370</td>
</tr>
</tbody>
</table>

NOTE: * indicates significance at .05 level, ** indicates significance at .01 level.
### APPENDIX 2.F. OLS COEFFICIENTS OF BASELINE AND FAMILY PROCESS MODELS

#### Table 2.F.1.
OLS Coefficients of Baseline Models

<table>
<thead>
<tr>
<th>Variable</th>
<th>Approaches To Learning</th>
<th>Self-Control</th>
<th>Interpersonal Skills</th>
<th>Externalizing Problem Behaviors</th>
<th>Internalizing Problem Behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRS Scales at Kindergarten</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approaches to learning</td>
<td>0.283** 0.011</td>
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<tr>
<td>Self-control</td>
<td>0.232** 0.011</td>
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<td>0.234** 0.011</td>
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<tr>
<td>Interpersonal skills</td>
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</tr>
<tr>
<td>Externalizing problem behaviors</td>
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<td>0.326** 0.010</td>
<td>0.172** 0.012</td>
</tr>
<tr>
<td>Internalizing problem behaviors</td>
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<tr>
<td>Family Status Factors</td>
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</tr>
<tr>
<td>Black</td>
<td>-0.136** 0.029</td>
<td>-0.154** 0.028</td>
<td>-0.115** 0.029</td>
<td>0.140** 0.025</td>
<td>-0.084** 0.026</td>
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<tr>
<td>Hispanic</td>
<td>-0.033 0.024</td>
<td>-0.001 0.023</td>
<td>0.016 0.024</td>
<td>-0.020 0.020</td>
<td>-0.050* 0.021</td>
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<td>Asian</td>
<td>0.158** 0.035</td>
<td>0.146** 0.032</td>
<td>0.098** 0.034</td>
<td>-0.108** 0.030</td>
<td>-0.055 0.031</td>
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<tr>
<td>Other race</td>
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<td>-0.003 0.032</td>
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<td>-0.060** 0.017</td>
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<td>0.086** 0.016</td>
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<td>-0.160** 0.050</td>
<td>0.092* 0.043</td>
<td>0.143** 0.046</td>
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<tr>
<td>Child Characteristics</td>
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<tr>
<td>Female</td>
<td>0.262** 0.013</td>
<td>0.176** 0.012</td>
<td>0.235** 0.013</td>
<td>-0.170** 0.011</td>
<td>-0.044** 0.011</td>
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<td>0.145 0.075</td>
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<td>Age at assessment squared</td>
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<td>0.056* 0.027</td>
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<td>-0.051* 0.023</td>
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<td>-0.045* 0.020</td>
<td>0.020 0.016</td>
<td>0.043** 0.017</td>
</tr>
<tr>
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<td>-0.266** 0.018</td>
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<td>-0.194** 0.017</td>
<td>0.128** 0.015</td>
<td>0.270** 0.016</td>
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<td>0.006 0.005</td>
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<tr>
<td>Public</td>
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<td>0.004 0.022</td>
<td>-0.057* 0.024</td>
<td>0.015 0.020</td>
<td>0.038 0.020</td>
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<td>50 percent or more being minority</td>
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<td>-0.017</td>
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<td>0.017</td>
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<td>0.003</td>
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<tr>
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<td>0.0005</td>
<td>-0.0002</td>
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<td>-0.035</td>
<td>0.020</td>
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<td>0.015</td>
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<td>0.005**</td>
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Random Effects Parameters

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<td>0.191**</td>
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<td>0.499**</td>
<td>0.004</td>
<td>0.536**</td>
<td>0.005</td>
<td>0.465**</td>
<td>0.004</td>
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</table>

NOTE: * indicates significance at .05 level, ** indicates significance at .01 level.
### Table 2.F.2.
OLS Coefficients of Family Process Models

<table>
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<tr>
<th>Variable</th>
<th>Approaches to Learning</th>
<th>Self-Control</th>
<th>Interpersonal Skills</th>
<th>Externalizing Problem Behaviors</th>
<th>Internalizing Problem Behaviors</th>
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<td>Estimate</td>
<td>S.E.</td>
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<tr>
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<td>0.050**</td>
<td>0.017</td>
<td>-0.059**</td>
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<td>Belief in reading performance</td>
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<td>0.097**</td>
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<td>Learning Structure</td>
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<td>Doing homework more than 2 times a week</td>
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<td>Place set aside for homework</td>
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<td>Time for homework per day</td>
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189
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<th>Child likes parents</th>
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<th>0.039*</th>
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<td>0.020</td>
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<td>Parents feeling child harder to care</td>
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<td>Parent-child interactions</td>
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<td>0.010</td>
<td>0.024*</td>
<td>0.010</td>
<td>0.019</td>
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<td>-0.009</td>
<td>0.009</td>
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<td>Talk with child about school every day</td>
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<td>0.016</td>
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Parenting and Disciplinary Practices

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<th>0.005</th>
<th>-0.011*</th>
<th>0.005</th>
<th>0.006</th>
<th>0.004</th>
<th>-0.008</th>
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<td>0.012</td>
<td>-0.031**</td>
<td>0.011</td>
<td>-0.045**</td>
<td>0.012</td>
<td>0.030**</td>
<td>0.011</td>
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<td>Number of family rules on TV viewing</td>
<td>-0.023**</td>
<td>0.008</td>
<td>-0.020*</td>
<td>0.008</td>
<td>-0.020*</td>
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<td>0.008</td>
<td>0.007</td>
<td>0.013</td>
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<td>Hours of TV viewing on a weekday</td>
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<td>0.006</td>
<td>-0.002</td>
<td>0.006</td>
<td>0.001</td>
<td>0.006</td>
<td>-0.0002</td>
<td>0.005</td>
<td>-0.002</td>
<td>0.006</td>
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<td>Hours of TV viewing on a weekend</td>
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<td>0.002</td>
<td>0.003</td>
<td>0.002</td>
<td>0.003</td>
<td>0.002</td>
<td>-0.002</td>
<td>0.002</td>
<td>0.002</td>
<td>0.002</td>
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</table>

Parental Involvement

| Parental involvement in school events | 0.018** | 0.005 | 0.013* | 0.005 | 0.017** | 0.005 | -0.005 | 0.005 | -0.018** | 0.005 |
| Contact with parents of child’s peers | 0.003 | 0.002 | -0.001 | 0.002 | 0.003 | 0.002 | -0.0003 | 0.002 | -0.002 | 0.002 |
| Frequency of help with reading homework | -0.044** | 0.016 | 0.004 | 0.015 | -0.014 | 0.016 | -0.013 | 0.015 | 0.013 | 0.014 |
| Frequency of help with math homework | -0.058** | 0.016 | -0.010 | 0.015 | -0.016 | 0.015 | 0.011 | 0.014 | 0.038** | 0.014 |
| Frequency of talking about nature/science | -0.052** | 0.015 | -0.026 | 0.014 | -0.038* | 0.015 | 0.014 | 0.012 | 0.036** | 0.013 |
| Frequency of playing games/puzzles | 0.007 | 0.014 | -0.002 | 0.014 | -0.004 | 0.015 | 0.008 | 0.012 | 0.011 | 0.012 |
| Frequency of playing sports or exercising | 0.019 | 0.014 | 0.012 | 0.013 | 0.013 | 0.014 | 0.002 | 0.012 | -0.037** | 0.012 |
| Frequency of involving child in chores | -0.034 | 0.020 | -0.036 | 0.019 | -0.047* | 0.020 | 0.035* | 0.017 | -0.003 | 0.018 |
| Involvement in artistic/cultural activities | 0.007 | 0.006 | 0.002 | 0.006 | 0.008 | 0.007 | 0.005 | 0.006 | 0.006 | 0.006 |
| Library visit with child in last month | -0.018 | 0.013 | -0.019 | 0.013 | -0.020 | 0.014 | 0.009 | 0.012 | 0.024* | 0.012 |

Family Status Factors

| Black | -0.137** | 0.029 | -0.160** | 0.029 | -0.121** | 0.029 | 0.146** | 0.025 | -0.102** | 0.026 |
| Hispanic | -0.035 | 0.024 | -0.008 | 0.023 | 0.009 | 0.024 | -0.011 | 0.020 | -0.059** | 0.021 |
| Asian | 0.162** | 0.035 | 0.146** | 0.032 | 0.104** | 0.034 | -0.100** | 0.030 | -0.075* | 0.031 |
| Other race | -0.006 | 0.032 | -0.002 | 0.030 | 0.007 | 0.032 | -0.011 | 0.027 | -0.053 | 0.028 |
| SES | 0.076** | 0.012 | 0.048** | 0.011 | 0.063** | 0.013 | -0.032** | 0.010 | -0.043** | 0.010 |
| Single-parent household | -0.049** | 0.018 | -0.044** | 0.016 | -0.051** | 0.018 | 0.044** | 0.015 | 0.081** | 0.016 |
| Other type of household | -0.171** | 0.049 | -0.091** | 0.045 | -0.137** | 0.051 | 0.082 | 0.043 | 0.138** | 0.046 |

Child Characteristics
<table>
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<tr>
<th>Variable</th>
<th>Coefficient 1</th>
<th>Coefficient 2</th>
<th>Coefficient 3</th>
<th>Coefficient 4</th>
<th>Coefficient 5</th>
<th>Coefficient 6</th>
<th>Coefficient 7</th>
<th>Coefficient 8</th>
<th>Coefficient 9</th>
<th>Coefficient 10</th>
<th>Coefficient 11</th>
<th>Coefficient 12</th>
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<td>Female</td>
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<td>0.013</td>
<td>0.168**</td>
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<td>0.222**</td>
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<td>-0.048**</td>
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<td>0.075</td>
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<td>0.0003</td>
<td>-0.0001</td>
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<td>0.0002</td>
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<td>-0.0001</td>
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<td>Speak non-English at home</td>
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<td>-0.058*</td>
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<td>0.103**</td>
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<td>0.224**</td>
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<td>0.007</td>
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<td>0.020</td>
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<td>50 percent or more being minority</td>
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<td>0.036</td>
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<td>-0.007</td>
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<td>0.018</td>
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<td>0.017</td>
<td>0.004</td>
<td>0.019</td>
<td>-0.006</td>
<td>0.016</td>
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<td>0.017</td>
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<td>Percent students eligible for free lunch</td>
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<td>0.190**</td>
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<td>0.005</td>
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NOTE: * indicates significance at .05 level, ** indicates significance at .01 level.
### APPENDIX 2.G. TOBIT COEFFICIENTS OF BASELINE AND FAMILY PROCESS MODELS

**Table 2.G.1.**

Tobit Coefficients of Baseline Models for Approaches to Learning, Self-Control, and Interpersonal Skills

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<th>Interpersonal Skills</th>
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<td>S.E.</td>
<td>Effect Size</td>
<td>Estimate</td>
<td>S.E.</td>
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<td>SRS Scales at Kindergarten</td>
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<td>Approaches to learning</td>
<td>0.314**†</td>
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<td>Self-control</td>
<td>0.263**†</td>
<td>0.013</td>
<td>0.420</td>
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<td>Interpersonal skills</td>
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<td>0.259**†</td>
<td>0.013</td>
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<td>Family Status Factors</td>
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<tr>
<td>Black</td>
<td>-0.148**†</td>
<td>0.032</td>
<td>-0.211</td>
<td>-0.163**†</td>
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<td>Hispanic</td>
<td>-0.039</td>
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<td>-0.056</td>
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<td>Asian</td>
<td>0.183**†</td>
<td>0.041</td>
<td>0.261</td>
<td>0.178**†</td>
<td>0.038</td>
</tr>
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<td>Other race</td>
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<td>0.036</td>
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<td>0.035</td>
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<td>SES</td>
<td>0.127**†</td>
<td>0.013</td>
<td>0.182</td>
<td>0.081**†</td>
<td>0.012</td>
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<td>Single-parent household</td>
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<td>-0.057**†</td>
<td>0.019</td>
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<td>Female</td>
<td>0.300**†</td>
<td>0.015</td>
<td>0.427</td>
<td>0.205**†</td>
<td>0.014</td>
</tr>
<tr>
<td>Age at assessment</td>
<td>0.115</td>
<td>0.090</td>
<td>0.163</td>
<td>0.057</td>
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<td>-0.001</td>
<td>-0.0002</td>
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<tr>
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<td>0.030</td>
<td>0.124</td>
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<tr>
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<td>-0.052</td>
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<td>-1.487</td>
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Random Effects Parameters

| School random effects – sigma  | 0.218**  | 0.011    | ---      | 0.232**  | 0.010    | ---      | 0.233**  | 0.011    | ---      |
| Within-school variability – sigma | 0.601**  | 0.006    | ---      | 0.571**  | 0.006    | ---      | 0.594**  | 0.006    | ---      |

NOTE: * indicates significance at .05 level, ** indicates significance at .01 level. † indicates significance at .05 false discovery rate.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Externalizing Problem Behaviors</th>
<th>Internalizing Problem Behaviors</th>
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<td>Black</td>
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<td>0.029</td>
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<td>0.024</td>
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Random Effects Parameters

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<td>0.170**</td>
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<td>0.005</td>
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<td>0.545**</td>
<td>0.005</td>
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NOTE: * indicates significance at .05 level, ** indicates significance at .01 level. † indicates significance at .05 false discovery rate.
Table 2.G.3.
Tobit Coefficients of Family Process Models for Approaches to Learning, Self-Control, and Interpersonal Skills

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<thead>
<tr>
<th>Variable</th>
<th>Approaches to Learning</th>
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<th>Self-Control</th>
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<th>Interpersonal Skills</th>
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<td>Effect Size</td>
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<td>Estimate</td>
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<td>Frequency of reading books – Infrequent</td>
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<td>0.021</td>
<td>-0.126</td>
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<td>0.016</td>
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<td>Home computer for child use</td>
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<td>Community library card for child</td>
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<td>Home Affective Environment</td>
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<tr>
<td>Having warm, close times with child</td>
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<td>0.020</td>
<td>-0.023</td>
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<td>0.021</td>
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<tr>
<td>Child likes parents</td>
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<td>Sacrifice to meet child’s needs</td>
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<td>0.026</td>
<td>-0.014</td>
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<td>Parents feeling child harder to care</td>
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<td>-0.056</td>
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<td>-0.103</td>
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<th>Parent-child interactions</th>
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<th>0.011</th>
<th>0.037</th>
<th>0.028*</th>
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<th>0.012</th>
<th>0.032</th>
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<td>0.006</td>
<td>-0.006</td>
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<td>-0.010</td>
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<td>0.022</td>
<td>-0.012*</td>
<td>0.005</td>
<td>-0.019</td>
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<td>Frequency of spanking in a week</td>
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<td>0.013</td>
<td>-0.047</td>
<td>-0.035**†</td>
<td>0.013</td>
<td>-0.056</td>
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<td>Number of family rules on TV viewing</td>
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<td>-0.023*</td>
<td>0.009</td>
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<tr>
<td>Contact with parents of child’s peers</td>
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<td>0.017</td>
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<td>Frequency of talking about nature/science</td>
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<td>Frequency of playing games/puzzles</td>
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<td>0.008</td>
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<td>0.016</td>
<td>-0.001</td>
<td>-0.005</td>
<td>0.016</td>
<td>-0.007</td>
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<td>Frequency of playing sports or exercising</td>
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<td>0.011</td>
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<td>0.018</td>
<td>0.009</td>
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<td>0.014</td>
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<td>Frequency of involving child in chores</td>
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<td>Family Status Factors</td>
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<tr>
<td>Black</td>
<td>-0.148**†</td>
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<td>0.232**</td>
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<td>0.234**</td>
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<td>Within-school variability – sigma</td>
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<td>0.005</td>
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<td>0.566**</td>
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<td>0.588**</td>
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NOTE: * indicates significance at .05 level, ** indicates significance at .01 level. † indicates significance at .05 false discovery rate.
Table 2.G.4.  
Tobit Coefficients of Family Process Models for Externalizing Problem Behaviors and Internalizing Problem Behaviors

<table>
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<th>Variable</th>
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<td>-0.061**†</td>
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<td>Age at assessment squared</td>
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<td>Percent students eligible for free lunch</td>
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<td>-0.0001</td>
<td>-0.0002</td>
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<td>0.082</td>
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<td>Rural and small town</td>
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<td>-0.007</td>
<td>-0.004*</td>
<td>0.002</td>
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<td>Teacher experience (in years)</td>
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<td>-0.001</td>
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Random Effects Parameters

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<td>School random effects – sigma</td>
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<td>Within-school variability – sigma</td>
<td>0.532**</td>
<td>0.005</td>
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NOTE: * indicates significance at .05 level, ** indicates significance at .01 level. † indicates significance at .05 false discovery rate.
APPENDIX 2.H. TOBIT COEFFICIENTS OF INTERACTION MODELS

Table 2.H.1.
Tobit Coefficients of Interaction Models (Black Vs. Non-Black) for Approaches to Learning, Self-Control, and Interpersonal Skills

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<th>Variable</th>
<th>Approaches to Learning</th>
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<th>Interpersonal Skills</th>
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<td>Effect Size</td>
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<td>Interpersonal skills</td>
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<td>Degree expected</td>
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<td>0.174</td>
<td>0.074**†</td>
<td>0.020</td>
<td>0.119</td>
<td>0.068**†</td>
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<td>Belief in reading performance</td>
<td>0.108**†</td>
<td>0.027</td>
<td>0.154</td>
<td>0.003</td>
<td>0.028</td>
<td>0.006</td>
<td>0.015</td>
<td>0.028</td>
<td>0.023</td>
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<td>0.153**†</td>
<td>0.032</td>
<td>0.218</td>
<td>0.095**†</td>
<td>0.030</td>
<td>0.152</td>
<td>0.108**†</td>
<td>0.032</td>
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<td>Doing homework more than 2 times a week</td>
<td>-0.001</td>
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<td>Place set aside for homework</td>
<td>0.046</td>
<td>0.044</td>
<td>0.066</td>
<td>0.074</td>
<td>0.043</td>
<td>0.118</td>
<td>0.061</td>
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<td>Time for homework per day</td>
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<td>-0.001</td>
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<td>0.0003</td>
<td>-0.00003</td>
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<td>Frequency of reading books – Infrequent</td>
<td>-0.098**†</td>
<td>0.022</td>
<td>-0.140</td>
<td>-0.045*</td>
<td>0.020</td>
<td>-0.071</td>
<td>-0.054*</td>
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<td>Frequency of reading books – Every day</td>
<td>0.054**†</td>
<td>0.017</td>
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<td>0.017</td>
<td>0.018</td>
<td>-0.004</td>
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<td>Home computer use 3 times a week or more</td>
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<td>-0.001</td>
<td>-0.003</td>
<td>0.016</td>
<td>-0.004</td>
<td>-0.018</td>
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<td>Home computer for child use</td>
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<td>0.032</td>
<td>0.062</td>
<td>0.069*</td>
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<td>0.110</td>
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<td>Number of books child has at home</td>
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<td>0.00004</td>
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<td>Family resources</td>
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<td>Community library card for child</td>
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<td>0.018</td>
<td>0.026</td>
<td>0.046**</td>
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<td>0.073</td>
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<td>Home Affective Environment</td>
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<tr>
<td>Having warm, close times with child</td>
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<td>-0.024</td>
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<td>0.005</td>
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<td>Child likes parents</td>
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<td>0.029</td>
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<td>0.079</td>
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<td>Sacrifice to meet child’s needs</td>
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<td>0.026</td>
<td>-0.004</td>
<td>-0.005</td>
<td>0.025</td>
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<td>-0.004</td>
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<td>Parents feeling child harder to care</td>
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<td>0.085</td>
<td>-0.066</td>
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<td>-0.174</td>
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<td>Parent-child interactions</td>
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<td>0.034</td>
<td>0.014</td>
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<td>0.021</td>
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<td>Talk with child about school every day</td>
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<td>0.0002</td>
<td>-0.010</td>
<td>0.020</td>
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<td>Disciplinary methods</td>
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<td>-0.030</td>
<td>-0.018**†</td>
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<td>Frequency of spanking in a week</td>
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<td>-0.032*</td>
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<td>-0.052</td>
<td>-0.040**†</td>
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<td>Number of family rules on TV viewing</td>
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<td>0.010</td>
<td>-0.038</td>
<td>-0.022*</td>
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<td>-0.035</td>
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<tr>
<td>Parental involvement in school events</td>
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<td>0.023</td>
<td>0.013*</td>
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<td>0.021</td>
<td>0.018**†</td>
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<td>Contact with parents of child’s peers</td>
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<td>0.004</td>
<td>-0.001</td>
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<td>-0.002</td>
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<td>Frequency of help with reading homework</td>
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<td>0.011</td>
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<td>-0.013</td>
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<td>Frequency of talking about nature/science</td>
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<td>-0.051</td>
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<td>-0.0003</td>
<td>-0.004</td>
<td>0.016</td>
<td>-0.006</td>
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<tr>
<td>Frequency of playing sports or exercising</td>
<td>0.022</td>
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<td>0.031</td>
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<td>0.023</td>
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<td>0.007</td>
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<td>0.006</td>
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<td>Library visit with child in last month</td>
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<td>Black</td>
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<td>-0.075</td>
<td>0.200</td>
<td>-0.115</td>
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<td>0.128</td>
<td>0.064**†</td>
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<td>0.103</td>
<td>0.070**†</td>
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<td>-0.053**†</td>
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<td>Other type of household</td>
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<td>Female</td>
<td>0.282**†</td>
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<td>0.401</td>
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<td>0.251**†</td>
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<td>0.142</td>
<td>0.034</td>
<td>0.081</td>
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<td>0.131</td>
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<td>Age at assessment squared</td>
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<td>0.0003</td>
<td>-0.001</td>
<td>-0.0001</td>
<td>0.0003</td>
<td>-0.0002</td>
<td>-0.0005</td>
<td>0.0003</td>
<td>-0.001</td>
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<tr>
<td>Speak non-English at home</td>
<td>0.105**†</td>
<td>0.028</td>
<td>0.150</td>
<td>0.071*</td>
<td>0.028</td>
<td>0.114</td>
<td>0.083**†</td>
<td>0.028</td>
<td>0.126</td>
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Interaction Terms

- Black*Degree expected
- Black*Belief in reading performance
- Black*Belief in math performance
- Black*Time for homework per day
- Black*Frequency of reading books – Infrequent
- Black*Frequency of reading books – Every day
- Black*Home computer for child use
- Black*Home Internet access
- Black*Community library card for child
- Black*Child likes parents
- Black*Parent-child interactions
- Black*Disciplinary methods
- Black*Frequency of spanking in a week
- Black*Number of family rules on TV viewing
- Black*Parental involvement in school events
- Black*Frequent help with reading homework
- Black*Frequent help with math homework
- Black*Frequency of talking about nature/science
- Black*Frequency of playing sports/exercising

204
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NOTE: * indicates significance at .05 level, ** indicates significance at .01 level. † indicates significance at .05 false discovery rate.
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**Interaction Terms**

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Intercept  4.577  5.325   ---   -0.967  5.589   ---
Random Effects Parameters

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**NOTE:** * indicates significance at .05 level, ** indicates significance at .01 level. † indicates significance at .05 false discovery rate.
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<td>0.246**†</td>
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<td>Parental Expectations and Beliefs</td>
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<td>Degree expected</td>
<td>0.122**†</td>
<td>0.022</td>
<td>0.173</td>
<td>0.065**†</td>
<td>0.022</td>
<td>0.104</td>
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<td>Belief in reading performance</td>
<td>0.101**†</td>
<td>0.026</td>
<td>0.145</td>
<td>-0.002</td>
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<td>-0.003</td>
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<tr>
<td>Belief in math performance</td>
<td>0.145**†</td>
<td>0.031</td>
<td>0.206</td>
<td>0.103**†</td>
<td>0.029</td>
<td>0.165</td>
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<td>Learning Structure</td>
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<td>Doing homework more than 2 times a week</td>
<td>-0.002</td>
<td>0.024</td>
<td>-0.003</td>
<td>0.016</td>
<td>0.024</td>
<td>0.026</td>
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<td>Place set aside for homework</td>
<td>0.046</td>
<td>0.044</td>
<td>0.065</td>
<td>0.072</td>
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<td>Time for homework per day</td>
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<td>0.0002</td>
<td>-0.001</td>
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<tr>
<td>Frequency of reading books – Infrequent</td>
<td>-0.090**†</td>
<td>0.021</td>
<td>-0.129</td>
<td>-0.033</td>
<td>0.020</td>
<td>-0.052</td>
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<tr>
<td>Frequency of reading books – Every day</td>
<td>0.048**†</td>
<td>0.016</td>
<td>0.069</td>
<td>0.015</td>
<td>0.016</td>
<td>0.023</td>
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<td>Home computer use 3 times a week or more</td>
<td>0.001</td>
<td>0.017</td>
<td>0.001</td>
<td>-0.001</td>
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<td>Resource Availability</td>
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<tr>
<td>Home computer for child use</td>
<td>0.069</td>
<td>0.038</td>
<td>0.099</td>
<td>0.079*</td>
<td>0.038</td>
<td>0.127</td>
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<td>Home Internet access</td>
<td>-0.009</td>
<td>0.031</td>
<td>-0.013</td>
<td>-0.027</td>
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<td>Number of books child has at home</td>
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<tr>
<td>Community library card for child</td>
<td>0.022</td>
<td>0.017</td>
<td>0.032</td>
<td>0.043**</td>
<td>0.017</td>
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<td>Home Affective Environment</td>
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<td>Having warm, close times with child</td>
<td>-0.019</td>
<td>0.020</td>
<td>0.027</td>
<td>0.016</td>
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<td>Child likes parents</td>
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<td>0.041</td>
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<td>0.066</td>
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<td>Sacrifice to meet child’s needs</td>
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<td>0.026</td>
<td>-0.010</td>
<td>-0.010</td>
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<td>-0.017</td>
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<td>Parents feeling child harder to care</td>
<td>-0.044</td>
<td>0.085</td>
<td>-0.063</td>
<td>-0.106</td>
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<td>Parent-child interactions</td>
<td>0.026*</td>
<td>0.012</td>
<td>0.037</td>
<td>0.023</td>
<td>0.012</td>
<td>0.037</td>
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<td>Talk with child about school every day</td>
<td>-0.004</td>
<td>0.021</td>
<td>-0.005</td>
<td>-0.013</td>
<td>0.020</td>
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<td>-0.015</td>
<td>-0.015**†</td>
<td>0.005</td>
<td>-0.025</td>
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<td>Frequency of spanking in a week</td>
<td>-0.034**†</td>
<td>0.013</td>
<td>-0.048</td>
<td>-0.035**</td>
<td>0.013</td>
<td>-0.056</td>
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<tr>
<td>Number of family rules on TV viewing</td>
<td>-0.028**†</td>
<td>0.009</td>
<td>-0.039</td>
<td>-0.023*</td>
<td>0.009</td>
<td>-0.037</td>
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<td>Hours of TV viewing on a weekday</td>
<td>0.005</td>
<td>0.007</td>
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<td>-0.002</td>
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<td>Hours of TV viewing on a weekend</td>
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<td>Parental Involvement</td>
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<td>Parental involvement in school events</td>
<td>0.020**†</td>
<td>0.006</td>
<td>0.028</td>
<td>0.014*</td>
<td>0.006</td>
<td>0.022</td>
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<td>Contact with parents of child’s peers</td>
<td>0.002</td>
<td>0.002</td>
<td>0.004</td>
<td>-0.001</td>
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<tr>
<td>Frequency of help with reading homework</td>
<td>-0.051**†</td>
<td>0.019</td>
<td>-0.073</td>
<td>0.003</td>
<td>0.018</td>
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<td>Frequency of help with math homework</td>
<td>-0.065**†</td>
<td>0.018</td>
<td>-0.092</td>
<td>-0.013</td>
<td>0.018</td>
<td>-0.020</td>
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<tr>
<td>Frequency of talking about nature/science</td>
<td>-0.056**†</td>
<td>0.017</td>
<td>-0.080</td>
<td>-0.025</td>
<td>0.017</td>
<td>-0.040</td>
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<td>Frequency of playing games/puzzles</td>
<td>0.007</td>
<td>0.016</td>
<td>0.010</td>
<td>0.001</td>
<td>0.016</td>
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<tr>
<td>Frequency of playing sports or exercising</td>
<td>0.017</td>
<td>0.016</td>
<td>0.024</td>
<td>0.009</td>
<td>0.015</td>
<td>0.014</td>
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<tr>
<td>Frequency of involving child in chores</td>
<td>-0.038</td>
<td>0.022</td>
<td>-0.055</td>
<td>-0.041</td>
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<td>Involvement in artistic/cultural activities</td>
<td>0.009</td>
<td>0.007</td>
<td>0.012</td>
<td>0.003</td>
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<td>Library visit with child in last month</td>
<td>-0.016</td>
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<td>Family Status Factors</td>
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<td>Black</td>
<td>-0.141**†</td>
<td>0.030</td>
<td>-0.201</td>
<td>-0.171**†</td>
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<td>Single-parent household</td>
<td>-0.057**†</td>
<td>0.020</td>
<td>-0.081</td>
<td>-0.053**†</td>
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<td>-0.085</td>
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<td>Other type of household</td>
<td>-0.179**†</td>
<td>0.055</td>
<td>-0.255</td>
<td>-0.093</td>
<td>0.053</td>
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<td>Child Characteristics</td>
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<td>Female</td>
<td>0.282**†</td>
<td>0.015</td>
<td>0.402</td>
<td>0.194**†</td>
<td>0.015</td>
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<td>Age at assessment</td>
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<td>0.148</td>
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<td>0.081</td>
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<td>Age at assessment squared</td>
<td>-0.0004</td>
<td>0.0003</td>
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<td>-0.0002</td>
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<td>Speak non-English at home</td>
<td>0.107**†</td>
<td>0.028</td>
<td>0.152</td>
<td>0.073**</td>
<td>0.028</td>
<td>0.117</td>
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<td>Transferred school</td>
<td>-0.025</td>
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<td>-0.036</td>
<td>0.005</td>
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<td>Disability</td>
<td>-0.210**†</td>
<td>0.021</td>
<td>-0.299</td>
<td>-0.167**†</td>
<td>0.020</td>
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<td>Number of siblings</td>
<td>School Factors</td>
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<td>-0.0005</td>
<td>0.009 0.028 0.013 0.019 0.027 0.031 -0.035 0.029 -0.053</td>
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<td>50 percent or more being minority</td>
<td>0.006 0.028 0.009 -0.015 0.027 -0.024 0.023 0.027 0.036</td>
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<td>10 percent or more with reduced-price lunch</td>
<td>0.021 0.020 0.030 -0.001 0.021 -0.001 0.004 0.022 0.006</td>
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<td>Percent students eligible for free lunch</td>
<td>0.001 0.001 0.001 -0.0003 0.001 -0.0005 -0.0001 0.001 -0.0001</td>
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<td>Central city</td>
<td>-0.019 0.024 -0.027 -0.043 0.023 -0.069 0.010 0.024 0.015</td>
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<td>Rural and small town</td>
<td>0.043 0.028 0.061 0.008 0.028 0.013 0.032 0.028 0.048</td>
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<td>Class size</td>
<td>0.002 0.002 0.003 0.005* 0.002 0.008 0.003 0.002 0.005</td>
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<td>Teacher experience (in years)</td>
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<td>Interaction Terms</td>
<td>SES*Degree expected</td>
<td>0.047 0.031 0.066 0.032 0.030 0.051 0.007 0.030 0.010</td>
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<td>SES*Belief in reading performance</td>
<td>0.044 0.034 0.063 0.023 0.033 0.036 0.023 0.035 0.034</td>
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<td>SES*Belief in math performance</td>
<td>0.004 0.039 0.005 -0.008 0.038 -0.013 0.003 0.039 0.004</td>
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<td>SES*Time for homework per day</td>
<td>0.0003 0.0003 0.0005 0.0003 0.0003 0.001 0.0004 0.0003 -0.001</td>
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<td>SES*Frequency of reading books – Infrequent</td>
<td>0.012 0.028 0.017 0.001 0.027 0.002 -0.005 0.027 -0.007</td>
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<td>SES*Frequency of reading books – Every day</td>
<td>0.008 0.021 0.012 0.007 0.021 0.011 -0.012 0.021 -0.018</td>
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<tr>
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<td>SES*Home computer for child use</td>
<td>0.081 0.046 0.116 0.054 0.048 0.087 0.068 0.048 0.104</td>
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<td>SES*Home Internet access</td>
<td>-0.062 0.042 -0.088 -0.054 0.043 -0.086 -0.045 0.044 -0.069</td>
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<td>SES*Community library card for child</td>
<td>-0.046* 0.022 -0.065 -0.044* 0.021 -0.070 -0.028 0.022 -0.043</td>
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<td>SES*Child likes parents</td>
<td>-0.005 0.028 -0.008 -0.017 0.027 -0.028 -0.020 0.028 -0.031</td>
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<td>SES*Parent-child interactions</td>
<td>0.002 0.013 0.003 -0.010 0.013 -0.017 -0.009 0.014 -0.014</td>
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<td>SES*Disciplinary methods</td>
<td>0.0003 0.006 0.0004 -0.008 0.006 -0.013 -0.006 0.006 -0.009</td>
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<td>SES*Frequency of spanking in a week</td>
<td>-0.026 0.015 -0.037 -0.020 0.014 -0.031 -0.028 0.015 -0.042</td>
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<td>SES*Number of family rules on TV viewing</td>
<td>0.002 0.012 0.002 -0.007 0.011 -0.011 0.004 0.011 0.006</td>
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<td>SES*Parental involvement in school events</td>
<td>0.008 0.007 0.011 0.007 0.007 0.011 0.009 0.007 0.014</td>
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<td>SES*Frequency of help with reading homework 0.009</td>
<td>0.024 0.013 0.011 0.023 0.018 0.026 0.024 0.040</td>
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<td>SES*Frequency of help with math homework</td>
<td>-0.003 0.024 -0.004 -0.002 0.023 -0.004 -0.002 0.023 -0.002</td>
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<td></td>
<td>SES*Frequency of talking about nature/science</td>
<td>0.005 0.020 0.008 -0.009 0.020 -0.014 -0.008 0.021 -0.012</td>
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<td>SES*Frequency of playing sports or exercising</td>
<td>0.023 0.019 0.033 0.012 0.018 0.018 0.011 0.019 0.016</td>
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<td>SES*Frequency of involving child in chores</td>
<td>0.036 0.026 0.051 0.052* 0.025 0.083 0.018 0.027 0.028</td>
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<tr>
<td>Interceptor</td>
<td>-5.343</td>
<td>6.002</td>
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<td>-0.575</td>
<td>5.459</td>
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<td>Random Effects Parameters</td>
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<td>School random effects – sigma</td>
<td>0.219**</td>
<td>0.010</td>
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<td>0.232**</td>
<td>0.010</td>
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<td>Within-school variability – sigma</td>
<td>0.588**</td>
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<td>0.566**</td>
<td>0.006</td>
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</table>

NOTE: * indicates significance at .05 level, ** indicates significance at .01 level. † indicates significance at .05 false discovery rate.
Table 2. H. 4.  
Tobit Coefficients of Interaction Models (SES) for Externalizing Problem Behaviors and Internalizing Problem Behaviors

<table>
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<th>Variable</th>
<th>Externalizing Problem Behaviors</th>
<th>Internalizing Problem Behaviors</th>
</tr>
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<td>Estimate</td>
<td>S.E.</td>
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<td>SRS Scales at Kindergarten</td>
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</tr>
<tr>
<td>Externalizing problem behaviors</td>
<td>0.362**†</td>
<td>0.012</td>
</tr>
<tr>
<td>Internalizing problem behaviors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental Expectations and Beliefs</td>
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<td></td>
</tr>
<tr>
<td>Degree expected</td>
<td>-0.063**†</td>
<td>0.019</td>
</tr>
<tr>
<td>Belief in reading performance</td>
<td>-0.036</td>
<td>0.025</td>
</tr>
<tr>
<td>Belief in math performance</td>
<td>-0.030</td>
<td>0.028</td>
</tr>
<tr>
<td>Learning Structure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doing homework more than 2 times a week</td>
<td>0.003</td>
<td>0.022</td>
</tr>
<tr>
<td>Place set aside for homework</td>
<td>-0.039</td>
<td>0.040</td>
</tr>
<tr>
<td>Time for homework per day</td>
<td>-0.0002</td>
<td>0.0002</td>
</tr>
<tr>
<td>Frequency of reading books – Infrequent</td>
<td>0.049**</td>
<td>0.019</td>
</tr>
<tr>
<td>Frequency of reading books – Every day</td>
<td>-0.020</td>
<td>0.015</td>
</tr>
<tr>
<td>Home computer use 3 times a week or more</td>
<td>0.009</td>
<td>0.015</td>
</tr>
<tr>
<td>Resource Availability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home computer for child use</td>
<td>-0.039</td>
<td>0.037</td>
</tr>
<tr>
<td>Home Internet access</td>
<td>-0.011</td>
<td>0.029</td>
</tr>
<tr>
<td>Number of books child has at home</td>
<td>0.00003</td>
<td>0.00004</td>
</tr>
<tr>
<td>Family resources</td>
<td>0.005</td>
<td>0.010</td>
</tr>
<tr>
<td>Community library card for child</td>
<td>-0.036*</td>
<td>0.016</td>
</tr>
<tr>
<td>Home Affective Environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Having warm, close times with child</td>
<td>0.009</td>
<td>0.019</td>
</tr>
<tr>
<td>Child likes parents</td>
<td>-0.045*</td>
<td>0.022</td>
</tr>
<tr>
<td>Sacrifice to meet child’s needs</td>
<td>0.020</td>
<td>0.024</td>
</tr>
<tr>
<td>Parents feeling child harder to care</td>
<td>0.013</td>
<td>0.076</td>
</tr>
<tr>
<td>Parent-child interactions</td>
<td>-0.015</td>
<td>0.011</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td><strong>Talk with child about school every day</strong></td>
<td>0.033</td>
<td>0.018</td>
</tr>
<tr>
<td><strong>Parenting and Disciplinary Practices</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disciplinary methods</td>
<td>0.009</td>
<td>0.005</td>
</tr>
<tr>
<td>Frequency of spanking in a week</td>
<td>0.035**</td>
<td>0.012</td>
</tr>
<tr>
<td>Number of family rules on TV viewing</td>
<td>0.010</td>
<td>0.008</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekday</td>
<td>0.0005</td>
<td>0.006</td>
</tr>
<tr>
<td>Hours of TV viewing on a weekend</td>
<td>-0.002</td>
<td>0.002</td>
</tr>
<tr>
<td><strong>Parental Involvement</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental involvement in school events</td>
<td>-0.006</td>
<td>0.006</td>
</tr>
<tr>
<td>Contact with parents of child’s peers</td>
<td>0.001</td>
<td>0.002</td>
</tr>
<tr>
<td>Frequency of help with reading homework</td>
<td>-0.011</td>
<td>0.017</td>
</tr>
<tr>
<td>Frequency of help with math homework</td>
<td>0.015</td>
<td>0.017</td>
</tr>
<tr>
<td>Frequency of talking about nature/science</td>
<td>0.012</td>
<td>0.015</td>
</tr>
<tr>
<td>Frequency of playing games/puzzles</td>
<td>0.002</td>
<td>0.014</td>
</tr>
<tr>
<td>Frequency of playing sports or exercising</td>
<td>0.008</td>
<td>0.014</td>
</tr>
<tr>
<td>Frequency of involving child in chores</td>
<td>0.045*</td>
<td>0.020</td>
</tr>
<tr>
<td>Involvement in artistic/cultural activities</td>
<td>0.007</td>
<td>0.007</td>
</tr>
<tr>
<td>Library visit with child in last month</td>
<td>0.008</td>
<td>0.014</td>
</tr>
<tr>
<td><strong>Family Status Factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>0.165**†</td>
<td>0.028</td>
</tr>
<tr>
<td>SES</td>
<td>0.051</td>
<td>0.075</td>
</tr>
<tr>
<td>Single-parent household</td>
<td>0.052**†</td>
<td>0.018</td>
</tr>
<tr>
<td>Other type of household</td>
<td>0.091</td>
<td>0.049</td>
</tr>
<tr>
<td><strong>Child Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>-0.194**†</td>
<td>0.014</td>
</tr>
<tr>
<td>Age at assessment</td>
<td>-0.055</td>
<td>0.079</td>
</tr>
<tr>
<td>Age at assessment squared</td>
<td>0.0002</td>
<td>0.0003</td>
</tr>
<tr>
<td>Speak non-English at home</td>
<td>-0.084**†</td>
<td>0.025</td>
</tr>
<tr>
<td>Transferred school</td>
<td>0.021</td>
<td>0.019</td>
</tr>
<tr>
<td>Disability</td>
<td>0.112**†</td>
<td>0.019</td>
</tr>
<tr>
<td>Number of siblings</td>
<td>0.001</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td><strong>School Factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public</td>
<td>0.009</td>
<td>0.024</td>
</tr>
<tr>
<td>50 percent or more being minority</td>
<td>0.034</td>
<td>0.024</td>
</tr>
<tr>
<td>10 percent or more with reduced-price lunch</td>
<td>-0.005</td>
<td>0.018</td>
</tr>
<tr>
<td>Percent students eligible for free lunch</td>
<td>-0.00002</td>
<td>0.0004</td>
</tr>
<tr>
<td>Central city</td>
<td>0.051*</td>
<td>0.020</td>
</tr>
<tr>
<td>Rural and small town</td>
<td>-0.008</td>
<td>0.025</td>
</tr>
<tr>
<td>Class size</td>
<td>-0.004*</td>
<td>0.002</td>
</tr>
<tr>
<td>Teacher experience (in years)</td>
<td>-0.001</td>
<td>0.001</td>
</tr>
<tr>
<td><strong>Interaction Terms</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES*Degree expected</td>
<td>-0.009</td>
<td>0.027</td>
</tr>
<tr>
<td>SES*Belief in reading performance</td>
<td>0.013</td>
<td>0.031</td>
</tr>
<tr>
<td>SES*Belief in math performance</td>
<td>0.001</td>
<td>0.035</td>
</tr>
<tr>
<td>SES-Time for homework per day</td>
<td>-0.0002</td>
<td>0.0003</td>
</tr>
<tr>
<td>SES*Frequency of reading books – Infrequent</td>
<td>-0.017</td>
<td>0.025</td>
</tr>
<tr>
<td>SES*Frequency of reading books – Every day</td>
<td>0.008</td>
<td>0.019</td>
</tr>
<tr>
<td>SES*Home computer for child use</td>
<td>-0.032</td>
<td>0.044</td>
</tr>
<tr>
<td>SES*Home Internet access</td>
<td>0.007</td>
<td>0.038</td>
</tr>
<tr>
<td>SES*Community library card for child</td>
<td>0.026</td>
<td>0.020</td>
</tr>
<tr>
<td>SES*Child likes parents</td>
<td>-0.019</td>
<td>0.026</td>
</tr>
<tr>
<td>SES*Parent-child interactions</td>
<td>-0.003</td>
<td>0.012</td>
</tr>
<tr>
<td>SES*Disciplinary methods</td>
<td>0.002</td>
<td>0.006</td>
</tr>
<tr>
<td>SES*Frequency of spanking in a week</td>
<td>0.014</td>
<td>0.013</td>
</tr>
<tr>
<td>SES*Number of family rules on TV viewing</td>
<td>0.012</td>
<td>0.011</td>
</tr>
<tr>
<td>SES*Parental involvement in school events</td>
<td>-0.012</td>
<td>0.007</td>
</tr>
<tr>
<td>SES*Frequency of help with reading homework</td>
<td>-0.022</td>
<td>0.022</td>
</tr>
<tr>
<td>SES*Frequency of help with math homework</td>
<td>0.00003</td>
<td>0.021</td>
</tr>
<tr>
<td>SES*Frequency of talking about nature/science</td>
<td>0.025</td>
<td>0.019</td>
</tr>
<tr>
<td>SES*Frequency of playing sports or exercising</td>
<td>-0.013</td>
<td>0.017</td>
</tr>
<tr>
<td>SES*Frequency of involving child in chores</td>
<td>-0.036</td>
<td>0.023</td>
</tr>
<tr>
<td><strong>Intercept</strong></td>
<td>4.767</td>
<td>5.318</td>
</tr>
<tr>
<td>Random Effects Parameters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>School random effects – sigma</td>
<td>0.183**</td>
<td>0.010</td>
</tr>
<tr>
<td>Within-school variability – sigma</td>
<td>0.532**</td>
<td>0.005</td>
</tr>
</tbody>
</table>

NOTE: * indicates significance at .05 level, ** indicates significance at .01 level. † indicates significance at .05 false discovery rate.
## APPENDIX 3.A. PISA 2006 COUNTRIES AND ECONOMIES

<table>
<thead>
<tr>
<th>Jurisdictions</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Western countries</strong></td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>4,927</td>
</tr>
<tr>
<td>Belgium</td>
<td>8,857</td>
</tr>
<tr>
<td>Canada</td>
<td>22,646</td>
</tr>
<tr>
<td>Denmark</td>
<td>4,532</td>
</tr>
<tr>
<td>Finland</td>
<td>4,714</td>
</tr>
<tr>
<td>Germany</td>
<td>4,891</td>
</tr>
<tr>
<td>Ireland</td>
<td>4,585</td>
</tr>
<tr>
<td>Italy</td>
<td>21,773</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>4,567</td>
</tr>
<tr>
<td>Netherlands</td>
<td>4,871</td>
</tr>
<tr>
<td>New Zealand</td>
<td>4,823</td>
</tr>
<tr>
<td>Norway</td>
<td>4,692</td>
</tr>
<tr>
<td>Sweden</td>
<td>4,443</td>
</tr>
<tr>
<td>Switzerland</td>
<td>12,192</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>13,152</td>
</tr>
<tr>
<td>United States</td>
<td>5,611</td>
</tr>
<tr>
<td><strong>East Asia</strong></td>
<td></td>
</tr>
<tr>
<td>Chinese Taipei</td>
<td>8,815</td>
</tr>
<tr>
<td>Hong Kong – China</td>
<td>4,645</td>
</tr>
<tr>
<td>Japan</td>
<td>5,952</td>
</tr>
<tr>
<td>Korea</td>
<td>5,176</td>
</tr>
<tr>
<td>Macao – China</td>
<td>4,760</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>160,624</strong></td>
</tr>
</tbody>
</table>
## APPENDIX 3.B. VARIABLES MEASURING FAMILY PROCESS FACTORS IN PISA 2006

<table>
<thead>
<tr>
<th>Family Process Factors</th>
<th>Variable</th>
<th>Variable Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Learning Structure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homework routines</td>
<td>A quiet place to study</td>
<td>A dummy with 1 for having a quiet place to study at home and 0 for otherwise</td>
</tr>
</tbody>
</table>
|                        | Time on math homework or studying | Two dummy variables measuring number of hours spent on studying math or doing math homework per week  
  - Never: 1 for no time  
  - Frequent: 1 for 4 or more hours per week  
  - Reference category: more than 0 and less than 4 hours per week |
|                        | Time on science homework or studying | Two dummy variables measuring number of hours spent on studying science or doing science homework per week  
  - Never: 1 for no time  
  - Frequent: 1 for 4 or more hours per week  
  - Reference category: more than 0 and less than 4 hours per week |
| **Resource Availability** |          |                      |
| Home resources         | Home computer to use for school work | A dummy with 1 for having a home computer to use for school work and 0 otherwise |
|                        | Home Internet access | A dummy with 1 for having home Internet and 0 otherwise |
|                        | Number of books at home | Two dummy variables measuring number of books available at home  
  - A few: 1 for 0 to 25 books  
  - Many: 1 for 101 or more books  
  - Reference category: 26 to 100 books |
| **Parental Involvement** |          |                      |
| Parental involvement in learning activities outside of school or home | Time on out-of-school math lessons | Two dummies measuring number of hours spent on attending out-of-school math lessons per week  
  - Never: 1 for no time  
  - Frequent: 1 for 4 or more hours per week  
  - Reference category: more than 0 and less than 4 hours per week |
|                        | Time on out-of-school science lessons | Two dummies measuring number of hours spent on attending out-of-school science lessons per week  
  - Never: 1 for no time  
  - Frequent: 1 for 4 or more hours per week  
  - Reference category: more than 0 and less than 4 hours per week |
### APPENDIX 3.C. ACHIEVEMENT TEST SCORES BY COUNTRY

<table>
<thead>
<tr>
<th>Country</th>
<th>Mathematics</th>
<th>Science</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Western countries</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>505.48</td>
<td>510.84</td>
</tr>
<tr>
<td>Belgium</td>
<td>520.35</td>
<td>510.36</td>
</tr>
<tr>
<td>Canada</td>
<td>527.01</td>
<td>534.47</td>
</tr>
<tr>
<td>Denmark</td>
<td>513.03</td>
<td>495.89</td>
</tr>
<tr>
<td>Finland</td>
<td>548.36</td>
<td>563.32</td>
</tr>
<tr>
<td>Germany</td>
<td>503.79</td>
<td>515.65</td>
</tr>
<tr>
<td>Ireland</td>
<td>501.47</td>
<td>508.33</td>
</tr>
<tr>
<td>Italy</td>
<td>461.69</td>
<td>475.40</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>490.00</td>
<td>486.32</td>
</tr>
<tr>
<td>Netherlands</td>
<td>530.65</td>
<td>524.86</td>
</tr>
<tr>
<td>New Zealand</td>
<td>521.99</td>
<td>530.38</td>
</tr>
<tr>
<td>Norway</td>
<td>489.85</td>
<td>486.53</td>
</tr>
<tr>
<td>Sweden</td>
<td>502.36</td>
<td>503.33</td>
</tr>
<tr>
<td>Switzerland</td>
<td>529.66</td>
<td>511.52</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>495.44</td>
<td>514.77</td>
</tr>
<tr>
<td>United States</td>
<td>474.35</td>
<td>488.91</td>
</tr>
<tr>
<td><strong>East Asia</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chinese Taipei</td>
<td>549.36</td>
<td>532.47</td>
</tr>
<tr>
<td>Hong Kong – China</td>
<td>547.46</td>
<td>542.21</td>
</tr>
<tr>
<td>Japan</td>
<td>523.10</td>
<td>531.39</td>
</tr>
<tr>
<td>Korea</td>
<td>547.46</td>
<td>522.15</td>
</tr>
<tr>
<td>Macao – China</td>
<td>525.00</td>
<td>510.84</td>
</tr>
<tr>
<td><strong>International Average</strong></td>
<td>498.44</td>
<td>506.50</td>
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</tbody>
</table>
### APPEXIX 3.D. COEFFICIENTS OF UNCONDITIONAL MODELS

Table 3.D.1. Coefficients of Unconditional Model for Mathematics Achievement

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>S.E.</th>
</tr>
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<tbody>
<tr>
<td>Intercept</td>
<td>498.917**</td>
<td>1.084</td>
</tr>
<tr>
<td>Random-Effects Parameters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between-school random effects variance</td>
<td>1460.280**</td>
<td>187.095</td>
</tr>
<tr>
<td>Within-school variance</td>
<td>8145.114**</td>
<td>320.660</td>
</tr>
</tbody>
</table>

NOTE: * indicates significance at .05 level, ** indicates significance at .01 level.

Table 3.D.2. Coefficients of Unconditional Model for Science Achievement

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>507.831**</td>
<td>0.860</td>
</tr>
<tr>
<td>Random-Effects Parameters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between-school random effects variance</td>
<td>1539.220**</td>
<td>145.366</td>
</tr>
<tr>
<td>Within-school variance</td>
<td>9502.453**</td>
<td>298.814</td>
</tr>
</tbody>
</table>

NOTE: * indicates significance at .05 level, ** indicates significance at .01 level.
## Appendix 3.E. Coefficients of Interaction Models

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mathematics Effect</th>
<th></th>
<th>Science Effect</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>S.E.</td>
<td>Size</td>
<td>Estimate</td>
</tr>
<tr>
<td>Learning Structure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A quiet place to study</td>
<td>-1.990</td>
<td>3.769</td>
<td>-0.022</td>
<td>-0.405</td>
</tr>
<tr>
<td>Time on math homework/studying</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>-16.753**†</td>
<td>3.628</td>
<td>-0.186</td>
<td></td>
</tr>
<tr>
<td>Frequent: 4 or more hours per week</td>
<td>-3.535</td>
<td>4.417</td>
<td>-0.039</td>
<td></td>
</tr>
<tr>
<td>Time on science homework/studying</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>-19.607**†</td>
<td>3.583</td>
<td>-0.201</td>
<td></td>
</tr>
<tr>
<td>Frequent: 4 or more hours per week</td>
<td>5.110</td>
<td>3.895</td>
<td>-0.052</td>
<td></td>
</tr>
<tr>
<td>Resource Availability</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home computer for school work</td>
<td>8.434</td>
<td>5.183</td>
<td>0.093</td>
<td>15.387**†</td>
</tr>
<tr>
<td>Home Internet access</td>
<td>4.254</td>
<td>4.632</td>
<td>0.047</td>
<td>-2.108</td>
</tr>
<tr>
<td>Number of books at home</td>
<td>-19.851**†</td>
<td>2.497</td>
<td>-0.220</td>
<td>-28.741**†</td>
</tr>
<tr>
<td>A few: 0-25 books</td>
<td>23.034**†</td>
<td>2.622</td>
<td>0.255</td>
<td>28.335**†</td>
</tr>
<tr>
<td>Many: 101 or more books</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Parental Involvement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time on out-of-school math lessons</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>26.908**†</td>
<td>2.629</td>
<td>0.298</td>
<td></td>
</tr>
<tr>
<td>Frequent: 4 or more hours per week</td>
<td>-25.805**†</td>
<td>5.361</td>
<td>-0.286</td>
<td></td>
</tr>
<tr>
<td>Time on out-of-school science lessons</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>18.543**†</td>
<td>2.829</td>
<td>0.190</td>
<td></td>
</tr>
<tr>
<td>Frequent: 4 or more hours per week</td>
<td>-34.486**†</td>
<td>9.209</td>
<td>-0.353</td>
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<tr>
<td>Family Status Factors</td>
<td></td>
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<tr>
<td>SES</td>
<td>16.489**†</td>
<td>0.973</td>
<td>0.183</td>
<td>17.392**†</td>
</tr>
<tr>
<td>Child Characteristics</td>
<td></td>
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<td></td>
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<tr>
<td>Female</td>
<td>-18.916**†</td>
<td>1.044</td>
<td>-0.210</td>
<td>-10.019**†</td>
</tr>
<tr>
<td>Grade</td>
<td>16.761**†</td>
<td>1.177</td>
<td>0.186</td>
<td>15.545**†</td>
</tr>
<tr>
<td>Language at home</td>
<td>-6.993**†</td>
<td>2.536</td>
<td>-0.077</td>
<td>-17.546**†</td>
</tr>
<tr>
<td>Immigration status</td>
<td>-2.404</td>
<td>1.887</td>
<td>-0.027</td>
<td>-10.434**†</td>
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<tr>
<td>School Factors</td>
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<tr>
<td>Public</td>
<td>-7.627**†</td>
<td>2.422</td>
<td>-0.085</td>
<td>-2.556</td>
</tr>
<tr>
<td>Class size</td>
<td>1.157**†</td>
<td>0.223</td>
<td>0.013</td>
<td>1.361**†</td>
</tr>
<tr>
<td>Quality of educational resources at school</td>
<td>4.390**†</td>
<td>1.043</td>
<td>0.049</td>
<td>5.002**†</td>
</tr>
<tr>
<td>Time on regular math lessons at school</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrequent: less than 2 hours per week</td>
<td>-28.077**†</td>
<td>1.835</td>
<td>-0.311</td>
<td></td>
</tr>
<tr>
<td>Very frequent: 4 or more hours per week</td>
<td>18.213**†</td>
<td>1.285</td>
<td>0.202</td>
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</tr>
<tr>
<td>Time on regular science lessons at school</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Infrequent: less than 2 hours per week</td>
<td>-23.271**†</td>
<td>1.563</td>
<td>-0.238</td>
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</tr>
<tr>
<td>Very frequent: 4 or more hours per week</td>
<td>25.636**†</td>
<td>1.592</td>
<td>0.263</td>
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<tr>
<td>Country Group Fixed Effects&lt;sup&gt;80&lt;/sup&gt;</td>
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<tr>
<td>Western</td>
<td>-5.873</td>
<td>6.332</td>
<td>-0.065</td>
<td>-1.018</td>
</tr>
</tbody>
</table>

<sup>80</sup> U.S. is the reference category for the country fixed effects.
East Asian & 48.939**† & 6.405 & 0.542 & 36.325**† & 7.706 & 0.373 \\
Interaction Terms \\
Western*A quiet place to study & 17.342**† & 4.311 & 0.192 & 14.828**† & 4.983 & 0.152 \\
Western*Time on math homework/studying \\
Never & -5.092 & 3.794 & -0.056 \\
Frequent: 4 or more hours per week & -7.119 & 4.367 & -0.079 \\
Western*Time on science homework/studying \\
Never & -5.529 & 3.705 & -0.057 \\
Frequent: 4 or more hours per week & -13.439**† & 4.369 & -0.138 \\
Western*Home computer for school work & 6.769 & 5.564 & 0.075 & -1.194 & 6.711 & -0.012 \\
Western*Home Internet access & 11.894*† & 4.821 & 0.132 & 12.027* & 5.871 & 0.123 \\
Western*Number of books at home \\
A few: 0-25 books & -5.668* & 2.826 & -0.063 & 0.058 & 3.545 & 0.001 \\
Many: 101 or more books & -0.073 & 2.644 & 0.001 & -4.270 & 3.019 & -0.044 \\
Western*Time on out-of-school math lessons \\
Never & 4.686 & 2.755 & 0.052 \\
Frequent: 4 or more hours per week & 2.319 & 6.123 & 0.026 \\
Western*Time on out-of-school science lessons \\
Never & 11.075**† & 3.007 & 0.114 \\
Frequent: 4 or more hours per week & 8.461 & 9.894 & 0.087 \\
East Asian*A quiet place to study & -1.816 & 4.318 & -0.020 & 0.441 & 4.874 & 0.005 \\
East Asian*Time on math homework/studying \\
Never & -22.788*** & 4.608 & -0.252 \\
Frequent: 4 or more hours per week & 28.939*** & 5.417 & 0.321 \\
East Asian*Time on science homework/studying \\
Never & -8.523* & 4.289 & -0.087 \\
Frequent: 4 or more hours per week & 11.468 & 6.715 & 0.118 \\
East Asian*Home computer for school work & 2.132 & 5.866 & 0.024 & -13.401 & 7.134 & -0.137 \\
East Asian*Home Internet access & 9.135 & 5.483 & 0.101 & 12.024 & 6.777 & 0.123 \\
East Asian*Number of books at home \\
A few: 0-25 books & 4.361 & 3.531 & 0.048 & 10.826*† & 4.215 & 0.111 \\
Many: 101 or more books & -8.719**† & 3.374 & -0.097 & -15.864**† & 3.683 & -0.163 \\
East Asian*Time on out-of-school math lessons \\
Never & -26.637*** & 2.884 & -0.295 \\
Frequent: 4 or more hours per week & 30.789*** & 5.834 & 0.341 \\
East Asian*Time on out-of-school science lessons \\
Never & 2.069 & 3.287 & 0.021 \\
Frequent: 4 or more hours per week & 31.847**† & 9.554 & 0.327 \\
Intercept & 259.171*** & 16.308 & --- & 270.927*** & 17.447 & --- \\
Random-Effects Parameters \\
Between-school random effects variance & 777.030** & 107.519 & --- & 744.862** & 89.679 & --- \\
Within-school variance & 5575.497** & 133.268 & --- & 6887.915** & 154.373 & --- \\

NOTE: * indicates significance at .05 level, ** indicates significance at .01 level. † indicates significance at .05 false discovery rate.