PARENT INVOLVEMENT AND SCIENCE ACHIEVEMENT DURING STUDENTS’ TRANSITION YEARS FROM ELEMENTARY SCHOOL TO MIDDLE SCHOOL: A CROSS-LAGGED PANEL ANALYSIS USING ECLS-K

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PARENT INVOLVEMENT AND SCIENCE ACHIEVEMENT DURING STUDENTS’ TRANSITION YEARS FROM ELEMENTARY SCHOOL TO MIDDLE SCHOOL: A CROSS-LAGGED PANEL ANALYSIS USING ECLS-K

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DISSERTATION
_________________________________

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the College of Education at the University of Kentucky

By
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Lexington, Kentucky

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2015

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ABSTRACT OF DISSERTATION

PARENT INVOLVEMENT AND SCIENCE ACHIEVEMENT DURING STUDENTS’ TRANSITION YEARS FROM ELEMENTARY SCHOOL TO MIDDLE SCHOOL: A CROSS-LAGGED PANEL ANALYSIS USING ECLS-K

Transitioning from elementary school to middle school can be a difficult time for many adolescents. It is a period often correlated with a decline in students’ academic achievement, perceptions of performance, potential, and value in schooling. Research has shown evidence that parents’ involvement in their children’s education significantly influences children’s academic achievement. However, there are many conflicting findings regarding this relationship.

The primary purpose of this study is to extend existing research on academic achievement by examining the causal relationship between parent involvement and science achievement during the transition years, using data from the Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K). The results not only reaffirms that parent involvement and students’ academic achievement are reciprocally correlated but also implies that parent involvement is a multidimensional construct, and has a domain-specific effect. The findings have important implications for parents on how to provide effective support for their children in science learning, especially during the transition years. Results from the analyses reveal that parents get involved in students’ education differently by their race/ethnicity groups. Findings imply that schools should consider moving beyond the traditional methods to get parents involved.

KEYWORDS: Parent involvement, adolescence, ECLS-K, cross-lagged panel analysis, Rasch-Grouped Rating Scale Model, science achievement
PARENT INVOLVEMENT AND SCIENCE ACHIEVEMENT DURING STUDENTS’ TRANSITION YEARS FROM ELEMENTARY SCHOOL TO MIDDLE SCHOOL: A CROSS-LAGGED PANEL ANALYSIS USING ECLS-K

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December 03, 2015
This dissertation is dedicated to my daughter, Olivia S. Liu. You provided the initial inspiration for me to complete this study. I love you!
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# TABLE OF CONTENTS

ACKNOWLEDGMENTS ........................................................................................................... III

LIST OF TABLES .................................................................................................................... VII

LIST OF FIGURES .................................................................................................................. VIII

CHAPTER 1  INTRODUCTION ................................................................................................ 1

Background and Statement of the Problem ................................................................. 1

Purpose of the Study ........................................................................................................... 6

Research Questions ............................................................................................................ 6

Definitions ............................................................................................................................. 7

Significance of Study .......................................................................................................... 8

Overview of Study .............................................................................................................. 11

CHAPTER 2  REVIEW OF CURRENT LITERATURE ............................................................... 12

Theoretical Framework ....................................................................................................... 12

Social Capital Theory ........................................................................................................ 12

Epstein's Six Typologies .................................................................................................... 15

Empirical Research on the Influence of Parent Involvement on Students’ Academic
Achievement ..................................................................................................................... 20

Parent Involvement Practices ......................................................................................... 21

Parenting Style .................................................................................................................. 29

Parental Expectations ....................................................................................................... 33

Reciprocal Relation between Parent Involvement and Student
Academic Achievement ..................................................................................................... 35

Rasch Modeling: A Measurement Approach .............................................................. 37

Summary .............................................................................................................................. 40

CHAPTER 3  METHODOLOGY ............................................................................................ 41

Data Source ........................................................................................................................ 41

Overview of ECLS-K .......................................................................................................... 41

Sampling Design and Data Collection ............................................................................ 42

Analytical Sample .............................................................................................................. 43

Instruments ........................................................................................................................ 45
Variables........................................................................................................................................... 46

Outcome Measures............................................................................................................................ 46

Parent Involvement Measures............................................................................................................ 46

Analysis................................................................................................................................................ 50

Analytic Issues and Techniques........................................................................................................ 54

Sampling Weights............................................................................................................................ 54

Design Effects..................................................................................................................................... 55

Missing Data........................................................................................................................................ 56

Polychoric Correlation ......................................................................................................................... 57

Summary............................................................................................................................................... 58

CHAPTER 4 RESULTS.......................................................................................................................... 59

Descriptive Statistics........................................................................................................................... 60

Exploratory Factor Analysis............................................................................................................... 61

Examine the Psychometric Properties of Parent Involvement Scales ............................................. 71

The Causal Relationship between Parent Involvement and Students’ Science Achievement ......... 90

Relationship between Parent School Involvement and Student’s Science Achievement.................. 90

Relationship between Help with Homework and Student’s Science Achievement......................... 91

Relationship between Family TV Rules and Student’s Science Achievement............................... 93

Relationship between Parent Expectation/Aspiration and Student’s Science Achievement.............. 94

Racial/Ethnic Differences in Parent Involvement When SES Is Controlled ....................................... 95

Summary............................................................................................................................................... 100

CHAPTER 5 DISCUSSION AND CONCLUSIONS............................................................................ 102

Discussion........................................................................................................................................... 102

Limitations of the Study....................................................................................................................... 108

Conclusion........................................................................................................................................... 110

Implications for Future Research...................................................................................................... 111

REFERENCES..................................................................................................................................... 113
LIST OF TABLES

Table 3. 1. Demographic Background of Sample Students. ........................................... 44

Table 3. 2. Parent Involvement Survey Items. .......................................................... 47

Table 4. 1. Descriptive Statistics of Student Science Achievement at 3rd, 5th, and 8th Grade. ................................................................................. 60

Table 4. 2. Factor Loadings for Exploratory Factor Analysis of Parent Involvement Scales at 3rd Grade. ................................................................. 62

Table 4. 3. Factor Loadings for Exploratory Factor Analysis of Parent Involvement Scales at 5th Grade. ................................................................. 65

Table 4. 4. Factor Loadings for Exploratory Factor Analysis of Parent Involvement Scales at 8th Grade. ................................................................. 68

Table 4. 5. Misfit Statistics of Parent School Involvement Items at 3rd Grade. .......... 73

Table 4. 6. Average Measures of Rating Scales of Parent Involvement at School at 3rd, 5th, and 8th Grade ................................................................. 74

Table 4. 7. Misfit Statistics of Parent School Involvement Items at 5th Grade. .......... 79

Table 4. 8. Misfit Statistics of Parent School Involvement Items at 8th Grade. .......... 82

Table 4. 9. Descriptive Statistics of Students’ Science Achievement and Parent Involvement Sub-scales. ................................................................. 90

Table 4. 10. ANCOVA Test of Parent Involvement Sub-scales by Racial/Ethical Groups When SES Is Controlled ......................................................... 96

Table 4. 11. Adjusted Means and Standard Errors of Parent Involvement Sub-scales by Race. ..................................................................................... 97
LIST OF FIGURES

Figure 3.1. Conceptual model of the study. ................................................................. 53

Figure 4.1. EFA eigenvalues screen plot for parent involvement at 3rd grade. ............. 64

Figure 4.2. EFA eigenvalues screen plot for parent involvement at 5th grade. ............. 67

Figure 4.3. EFA eigenvalues screen plot for parent involvement at 8th grade. ............. 70

Figure 4.4. Category probability curves for category structures at 3rd grade. ............... 76

Figure 4.5. DIF plot by race at 3rd grade................................................................. 77

Figure 4.6. DIF plot by gender at 3rd grade............................................................... 78

Figure 4.7. Category probability curves for category structures at 5th grade............... 80

Figure 4.8. DIF plot by race at 5th grade................................................................. 81

Figure 4.9. DIF plot by gender at 5th grade............................................................... 81

Figure 4.10. Category probability curves for category structures at 8th grade............. 84

Figure 4.11. DIF plot by race at 8th grade............................................................... 85

Figure 4.12. DIF plot by gender at 8th grade............................................................ 85

Figure 4.13. Item-person maps at 3rd grade. ......................................................... 87

Figure 4.14. Item-person maps at 5th grade. ......................................................... 88

Figure 4.15. Item-person maps at 8th grade. ......................................................... 89

Figure 4.16. Cross–lagged panel analysis for parent involvement at school.............. 91

Figure 4.17. Cross–lagged panel analysis for help with homework.......................... 93

Figure 4.18. Cross–lagged panel analysis for family TV/game rules.......................... 94

Figure 4.19. Cross–lagged panel analysis for parent expectation/aspiration.......... 95

Figure 4.20. The changes of adjusted parent school involvement from 3rd to 8th grade by racial/ethnic groups.................................................. 98
Figure 4.21. The changes of adjusted help with homework from 3rd to 8th grade by racial/ethnic groups................................. 98

Figure 4.22. The changes of adjusted family TV rules from 3rd to 8th grade by racial/ethnic groups.............................................. 99

Figure 4.23. The changes of adjusted parent expectation from 3rd to 8th grade by racial/ethnic groups.............................................. 99
CHAPTER 1 INTRODUCTION

Background and Statement of the Problem

Transitioning from elementary school to middle school can be difficult for many adolescents. It is a period when most adolescents experience physical, psychological, social, and academic changes that affect their educational performance. (Anderman & Midgley, 1997; Hill & Chao, 2009; LaPlante, 2010; Odegaard & Heath, 1992). Parents are often left out of the transition process (Crosnoe, 2001; Epstein, 1995, 2005; Smalls 2010; Paulson & Sputa, 1996), so the atmosphere at home may become strained as both parents and children struggle redefining roles and relationships (Hill & Tyson, 2009; Steinberg & Silk, 2002). Many parents distance themselves from their children’s school lives as they feel intimidated by the complexity of subject matter in middle school classes, and they think they need to give their child more independence. In addition, parents from minority or low socioeconomic status (SES) backgrounds usually do not have access, or do not know how to access information about schools (Ascher, 1988; Camblin, 2003; Drummond & Stipek, 2004; Portes, 1998). The confluence of developmental and contextual changes during this transition is correlated with a decline in academic achievement, perceptions of performance, motivation, potential, and value in schooling. These changes heighten the need to identify sources of support for learning (Alspaugh, 1998; Anderman, Maehr, & Midgley, 1999; Graham & Hill, 2003; Hill & Tyson, 2009; Mullins & Irvin, 2000; Shoffner & Williamson, 2000).

The influence of family factors on children’s education is well established (Coleman et al, 1966; Darling & Steinberg, 1993; Epstein, 1992; Pomerantz, Moorman, & Litwack, 2007). There is consistent evidence that engaging parents is positively
correlated with children’s academic achievement, even when prior ability and family social context factors are taken into account (Epstein, 2001; Fan & Chen, 2001; Harris & Goodall, 2008). For example, Jeynes (2005) examined 41 studies related to parental involvement in elementary student education. The results indicated a significant relationship between parental involvement and academic achievement, and this relationship held across race/ethnicity and gender of the students. Similarly, Hill and Tyson (2009) did a meta-analysis based on 50 published studies on parent involvement in middle school and found that parental involvement was positively associated with students’ achievements (with the exception of homework help). There is also an association between parent involvement and successful school reform. Shatkin and Gershberg (2007), for example, found that parent participation in school governance can foster activism around school issues and lead to significant improvements in school performance.

The positive findings of parent involvement drives a widely held belief that it plays an important role not only in promoting their own child’s academic performance, but more broadly in closing demographic gaps in achievement and assisting in the performance and governance of the school. One outgrowth of this belief is the rapid development of education policies and programs aimed at promoting school-family partnerships (Epstein, 1992). At the federal level, the No Child Left Behind Act of 2001 (NCLB 2001) reauthorized the Elementary and Secondary Education Act of 1965 (ESEA) to provide a framework through which families, schools, and communities work together to improve learning. Programs that address inequality of education, like Head Start, include parent involvement as a key element to reduce the achievement gap.
between disadvantaged and minority students and their peers (McNeal, 2012). Moreover, national organizations, such as the Parent Teacher Association and the National Coalition for Parental Involvement in Education, have set a primary goal of promoting parents’ involvement in schools.

Although there is an impressive body of literature supporting positive associations between parent involvement and student achievement, there is evidence to suggest a more complex picture of this relationship (Hill & Tyson, 2009; McNeal, 2012). A number of studies have revealed that parental involvement had no significant effect on achievement or adjustment (Domina, 2005, Harris & Goodall, 2008; Lee & Bowen, 2006; White, Taylor, & Moss, 1992), while other studies (e.g., Burcu & Sungur, 2009; Hill & Craft, 2003; Lamborn, Mounts, Steinberg & Dornbusch, 1991; McNeal, 1999) found a negative relationship between parental involvement and student academic performance.

One possible explanation for these contradictory findings are the different definitions and measurements of parent involvement used in the studies (Hill & Tyson, 2009; Keith et al., 1998; Lee & Bowen, 2006). Parent involvement is a broad concept that covers domains from parental aspiration, parenting style, attitudes and values to different direct and indirect methods of involvement (Chen & Gregory, 2009; Epstein, 1995; Hong & Ho, 2005; Adams, 2010). Parental involvement is a multidimensional construct, where different dimensions have varied influences on achievement and differ according to family background factors. For example, in Barnard’s (2004) study, home involvement was measured by reports on how often parents read, cooked, discussed, and went on outings with their children. Results from the study suggested that parent home involvement was not significantly associated with students’ educational attainment (i.e.,
highest grade completed by age 20). Hill and Tyson (2009) found that parents’ help with homework was negatively related to achievement, whereas other types of involvement at home, like home supervision and making educational materials, had significantly positive correlations with achievement.

Adding to the complexity of the relationship between involvement and outcomes is that much of the parent involvement literature relies on cross-sectional studies. Some types of parent involvement have positive influences on academic achievement in early grades, but have no or even negative impacts at higher-grade levels. Indeed, studies have demonstrated that parent involvement declines from elementary school to middle school (Singh, Bickley, Trivette, & Keith, 1995; Smalls, 2010). However, existing literature has failed to show how the decline of parental involvement affects achievement, or the extent to which types of parent involvement are most effective at different developmental stages of students (Hill & Tyson, 2009; Hong, Yoo, You, & Wu, 2010).

Despite mixed findings from the literature, a causal relationship between parent involvement and students’ academic performance is still not clear since most of the studies were based on cross-sectional data and a unidirectional design (Englund, Luckner, Whaley, & Egeland, 2004; McNeal, 2012; Scott-Jones, 1984). To better understand the mechanisms behind parental involvement and to reduce the risk of academic failure during transition years, more research is called for to quantify and measure the latent construct of parent involvement (Chen, 2009; Keith, 1991; McNeal, 2012) and examine how each type of parental involvement and its effects on students’ academic achievement may change over time (Domina 2005; Hong & Ho, 2005; Hong, Yoo, You, & Wu, 2010; Simons-Morton & Crump, 2003). It is also imperative to study how different contextual...
factors like race, gender, parents’ expectation, and students’ prior academic achievement influence the effectiveness of parent involvement (Desimone, 1999; Harris & Goodall, 2008; Jacobs & Harvey, 2005).
Purpose of the Study

The current study was designed first to detect and measure the latent construct of parent involvement using The Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K) dataset; and second, to examine the relationship between parent involvement and student’s science achievement across transition years from elementary school to middle school. Social capital theory and Epstein’s six typologies are used as theoretical frameworks for the study. A set of items from ECLS-K parent interviews at third, fifth, and eighth grade were selected under the theoretical framework in order to detect the latent construct of parent involvement. Previous research suggested that parent involvement and its effects on students’ academic performance could be different across racial/ethnic groups or by gender (Anderman, Maehler, & Midgley, 1999; Lee & Bowen, 2006; Hill & Craft, 2003). Therefore, the impact of demographic factors (e.g., gender, and race/ethnicity) are examined in the present study. The following questions further define the research purposes.

Research Questions

1. a. What is the construct of parent involvement at third, fifth, and eighth grade?
   b. What are the psychometric properties of ECLS-K parent involvement scales from third to eighth grade?

2. a. What is the association between parent involvement scales (i.e., parent involvement in school, help with homework, and family rules) and science achievement?
   b. How does a causal relationship change from elementary school to middle
school?

c. Do group differences (i.e., race/ethnicity) exist in parent involvement when family’s social economic status (SES) is controlled at third, fifth, and eighth grade?

Definitions

To understand the mechanics of parent involvement and provide practical suggestions for educational policies and practice, the present study adopts the definition of parent involvement articulated in the No Child Left Behind Act of 2001 (NCLB):

The participation of parents in regular, two-way, and meaningful communication involving student academic learning and other school activities, including ensuring—

- that parents play an integral role in assisting their child’s learning;
- that parents are encouraged to be actively involved in their child’s education at school;
- that parents are full partners in their child’s education and are included, as appropriate, in decision-making and on advisory committees to assist in the education of their child; and
- that other activities are carried out, such as those described in section 1118 of the Elementary and Secondary Education of Act (ESEA) \[Section 9101 (32), ESEA\].

Based on research findings and the ECLS-K parent involvement instrument, parent involvement for this study is optionally defined as: a) parent involvement at home
which includes home cognitive enrichment activities (e.g., reading to their children, helping with homework) and parent-child discussions on their school performance and school-related issues (e.g., selecting courses or programs at school); b) parent involvement in school, including parent information network, parent participation and voluntary service in school related activities; c) family rules including restrictions on TV and games, privileges, and supervision of homework; d) parent involvement outside of home which includes extracurricular activities and collaboration with educational communities, and e) parent expectation/aspiration for children’s educational performance.

**Significance of Study**

This study addresses gaps in previous research pertaining to causal relationships between parent involvement and student science achievement. Through the lens of parent involvement, the study investigates how parents, school, community and students work together to enhance science performance. Findings from this empirical study have both practical and methodological implications for the nature of parent involvement and the field of early childhood education.

The current study draws attention to students’ roles in shaping parent involvement. It seeks to understand how parent involvement and academic achievement interact with each other, and if this interaction changes across years during the transition from elementary school to middle school. Findings of this study suggest that not all parents can reconstruct their prior knowledge and experience of parental involvement with the developmental characteristics of teenagers and schools. To prevent losing parent involvement during the transition years, there is an in-depth discussion/explanation of
effective parent/family involvement and its implementation. This provides a way for parents to pay close attention to developmental differences of adolescents, to integrate strategies and practices that are suitable developmentally, to gain a better understanding of parent involvement, and therefore, provide effective support to help students make smooth and successful transitions to middle school.

This study also highlights the influence of contextual factors (i.e., gender and race/ethnicity) in parent involvement. With increasing requirements for parent involvement in various federal and state education programs in the United States, implementing effective parent involvement policies becomes an important issue. For teachers and schools, the misinterpretation or ignorance of grouping differences based on SES, race/ethnicity or gender leads to ineffective practices during the parent involvement policy implementation. The findings from this study display a picture of how different ethnic/gender groups performed in parent involvement activities and how these differences changed during the transition years from elementary school to middle school, which could benefit researchers and educators in improving parent involvement in children’s education.

This study also has methodological implication for the research in early childhood education by applying modern measurement theory. In the field of educational research, the most common method to capture an underlying attribute is to sum or average the raw scores on the individual items. For example, Xu (2008) obtained the measure of students’ self-regulated learning by averaging the Likert scale scores of seven indicators. Although this method dominates research, the results suffer from the limitation that using raw scores misuses ordinal data (i.e., likert scales) as interval or ratio. This approach
violates the many assumptions of statistical analysis (Wright, 1997). This study uses the Rasch model to measure the latent construct of parent involvement. Unlike traditional statistical techniques, the Rasch model corrects this misuse by converting the raw data to logarithmic (logit) scale, where the data are then linearized into interval form.

This study also gives a demonstration on how to track the changes in a construct when different instruments are employed in a longitudinal study. As longitudinal studies are designed to track changes across different time points in educational research, questionnaire items are ideally expected to remain the same from wave to wave. However, items are dropped, added or modified to accommodate practical and age relevant reasons during execution. The Rasch model is a latent-trait model which attempts to examine the underlying trait the instrument measures, rather than the performance on a particular instrument or test. Thus, person calibration estimates are independent of which items are tested as long as the items fit the model. This feature of Rasch model enables the use of both repeated items and wave-specific items at each time point to track the changes of parent involvement.

This study is also psychometrically important. The current research explores the latent construct of parent involvement and how each type of involvement activity is endorsed by parents across different stages from elementary school to middle school. Findings from this study could deepen researchers and practitioners’ knowledge of how to assess parent involvement from a multidimensional perspective, and help educators and policymakers diagnose problems during the implementation of parent involvement policies.
Overview of Study

This study adds supplementary information to the existing body of literature on how parent involvement impacts learning outcomes during transition years from elementary school to middle school. Chapter 1 introduces the legitimacy of studying parent involvement from a longitudinal perspective, and to outline the purpose, research questions, operational definition and significance of this study. Chapter 2 introduces the literature addressing the theoretical and methodological framework of this study, as well as the literature surrounding previous research on the impact of parent involvement on children’s education outcomes. Chapter 3 presents the research design and measures used in this study. The key variables used in the current study along with the variable selection process will be explained. An overview of the Early Childhood Longitudinal Study: Kindergarten Class of 1998-1999 (ECLS-K) and some analytical issues associated with complex survey data, including weighting, design effects, and missing data is addressed in this chapter. A description of research findings will be set forth in Chapter 4. Psychometric properties of the parent involvement instrument will be examined at different waves and an item hierarchy will be visualized in the person-item maps. The results for the casual relationship between parent involvement and science achievement will be displayed. The racial/ethnic differences in parent involvement with a control of SES level at different stages will also be provided in this chapter. Finally, Chapter 5 summarizes the results and discusses the research findings in relation to the research questions of the study. Limitation and recommendations for future research relating to parent involvement and student achievement will be offered followed by the conclusion.
CHAPTER 2 REVIEW OF CURRENT LITERATURE

This chapter addresses theoretical and methodological foundations of the current study. The conceptual framework of the study is guided by social capital theory and Epstein’s six types of family involvement (Epstein, 1992, Epstein & Hollifield, 1996). The second section discusses empirical research addressing parent involvement and its relationship to academic achievement. In particular, the literature of parent involvement practices, parenting style, parent aspiration, and the reciprocal relationship between parent involvement and academic achievement is presented. The third section provides the methodological foundation for measuring parent involvement. The advantages of Rasch measurement in measuring latent constructs is also given.

Theoretical Framework

Social Capital Theory

Social capital was first proposed by Bourdieu (1986) and it has been developed and operationalized in many fields after it was defined (Dika & Singh, 2002; Lin, 2001; McNeal, 1999). McNeal (1999) summarized three distinct elements of social capital after reviewing different definitions: structural form (structural aspects of the social ties and relations), norms of obligation and reciprocity (some sense of investment with the expectation of a return), and resources drawn upon both within and outside a network. These characteristics help to explain how parent involvement can be conceptualized as social capital and have an impact on academic achievement (Adams, 2010). In terms of a structural form, parent involvement can be viewed as the dyadic relationships among parents and child, teacher, or other parents. For the second element, parent involvement can be thought of as investing in children’s development and education according to the
social norms and values, thus resulting in feeling of trust, obligation, and actions of reciprocity. The last feature explains how various levels of resources available to parents can benefit their children’s education.

Like other forms of capital, social capital is a resource based on social relationships that a student can draw upon to facilitate academic productivity (Coleman, 1988, 1990). According to Coleman (1988, 1990), a major contributor to social capital theory in the education context, parents’ background has at least three components: financial capital, human capital, and social capital. Financial capital can be measured by the income or wealth. It provides physical resources such as materials to support learning, or a place at home that is set aside for studying. Human capital provides students the potential cognitive environment for learning. It is indicated by parents’ employment and education. Social capital within the family refers to the relationship between parents and children. It takes forms like parents’ expectation/aspiration for children’s performance, or the frequency of talking between parents and children about personal experiences. Coleman claimed that the time and attention parents spend interacting with children could provide stimulation to promote children’s well-being. Children do not benefit from human capital if the social capital is missing. Social capital is also found outside family, where its effect on outcomes can be seen from accessing additional social resources in the community, such as parents’ networks with other parents.

Coleman’s social capital theory, since it provides a theoretical framework for how parent involvement influences children’s academic achievement, is frequently applied to the field of education (Lee & Bowen, 2006; McNeal, 1999, 2012; Putnam, 2000).
Coleman (1990) argued that social capital is unlike all other forms of capital in being “located” not in the actors or in physical implements of production but in the relationship between or among actors. It is the strength of the relationship between parents and children that determines whether children can take advantage of financial and human capital. Coleman (1988) used data from a national survey to examine the influence of family social capital on the form of human capital and found that students from families with both parents in the household, fewer siblings at home, and higher expectations of parents are less likely to drop out after high school. These components help to determine the opportunity for interactions between parents and children and give shape to the frequency, duration, and quality of such interactions (Smith, Beaulie, & Seraphine, 1995).

Coleman perceived social capital not only as an individual-level concept but also as a property of a community. This was supported by his finding that the number of times a child has changed schools has the strongest effect on student’s education attainment: the dropout rate is 11.8% if the family has not moved, 16.7% if it has moved once, and 23.1% if it has moved twice (Coleman, 1988). Coleman explained this failure of education attainment as a result of disrupting social relations when children moved often. Israel, Beaulieu, and Hartless (2001), using data from the National Educational Longitudinal Study 1988 (NELS), reaffirmed the significant role of community social capital in influencing educational performance. They found that community social capital helps children excel: children who have experienced few if any moves since the first grade, who are engaged in group activities through their church or elsewhere, and whose parents know their friends’ parents tend to do better in school. These findings
suggest that policies designed to improve educational achievement must extend beyond the school and family. They need to seek to strengthen social capital in the community as well.

Social capital theory explains how parent involvement can be an important property of schools. According to Coleman (1988), “…the kinds of social structures that make possible social norms and the sanctions that enforce them do not benefit primarily the person or persons whose efforts would be necessary to bring them about, but benefit all those who are part of such a structure” (p. 116). Parent involvement develops reciprocal trust and shares social norms and values in teacher-parent relationships. These foster teachers’ engagement in innovative practices in classrooms and a higher level of teacher commitment to educating students, which in turn shapes a positive school climate and increases the effectiveness of schools (Adams, 2010; Bryk, Lee, & Holland, 1993; McNeal, 1999). This argument is also supported by studies on schools as communities. For example, Carbonaro (1998) tested whether social closure among parents affects children’s educational outcomes using data from NELS and found that closure was positively associated with mathematics achievement and students with more closure were less likely to drop out of high school. Other researchers have found that parents’ involvement in school organizations such as the PTA can positively influence academic achievement (Pong, Hao, & Gardner, 2005; McNeal, 1999; Parcel, Dufur, & Mikaela, 2001).

**Epstein’s Six Typologies**

Epstein (1987) defined parent involvement as a school, family, and community partnership for addressing shared interests, responsibilities, and the overlapping
influences to promote student learning and development. Epstein (1987; 1992; Epstein & Hollifield, 1996) suggested six types of parent involvement and partnership practices to indicate how parents get involved in children’s education: 1) parenting, 2) school parent communication, 3) volunteering and supporting schools, 4) home learning activities, 5) shared decision-making and governance of schools, and 6) collaboration with community. This framework suggests multiple facets of parent involvement and acknowledges that family, school, and community perform as equal contributors to children’s education (Epstein, 1995, 2001; Epstein & Sanders, 2006).

Epstein’s parent involvement theory has been extensively reviewed by the research community (Jordan, Orozco, & Averett, 2002). A number of studies employed these typologies as their frameworks to operationalize the construct of parent involvement (Hara & Burke, 1998; Sanders, 1998; Shaw, 2008; Sohn, 2007). For example, McWayne, Hampton, Fantuzzo, Cohen and Sekino (2004) examined a multidimensional concept of parent involvement in urban kindergartens and investigated the relationship between parent involvement and social and academic competencies. In this study, parent involvement was measured by the Parent Involvement in Children’s Education Scale (Fantuzzo et al., 2002), which was founded on Epstein’s categories of parent involvement and adapted with parents’ and teachers’ opinions. McWayne et al. found that parents who play an active role in children’s learning in the home, have direct and regular contact with school, and have more successful experiences for involvement have children who demonstrate more positive engagement with their learning.

Despite its wide acceptance, Epstein’s parent involvement model does have limitations. One major criticism of Epstein’s model is that this model places the onus on
school-initiated behaviors rather than parent-initiated behaviors (Kohl, Lengua, & McMahon, 2000). Nevertheless, Epstein’s work is highly regarded and cited in the literature and her theory has been developed and operationalized in various parent involvement policies and programs in school settings. Therefore, it is important to understand what these types of involvement are and how they can be applied in the implementation process.

**Parenting:** This involvement refers to building a positive home environment that accommodates basic levels of support for nutrition, health, and safety to foster students’ learning and development. This type of involvement encourages schools to develop training programs to assist parents with parenting skills (including supervision, discipline, and guidance), understanding child and adolescent development, fostering self-confidence and self-concept, and providing home environments more conducive to the development of a child’s learning potential and academic success.

**School Parent Communication:** This involvement requires schools to design a two-way (school-to-home and home-to-school) communication system about school programs, policies, events, and children’s progress. The communication system needs to be reciprocal, understandable, effective and properly received by parents. The communication channels can take many forms including parent-teacher conferences, home-school notes, phone calls, newsletters, report cards, and open houses. Additional communication strategies include parents visiting and observing in the classroom to see how instruction is conducted, and parent participation with the teacher to plan classroom activities (Marcon, 1999; Moles, 1993).
Volunteering and Supporting Schools: This type of involvement emphasis parents engagement at school. It refers to parents assisting students and teachers in classroom setting. The positive outcomes of parents volunteering are well addressed in the literature. Research has found that parents volunteering at school is positively associated with students school readiness, test performance, and attitudes toward school and learning (Epstein, 1992, 1995; Griffith, 1996; Marcon, 1999). Therefore, schools need to provide the time, training, and adequate schedules to recruit and retain parents who are willing to help and support their children’s learning at school by assisting with class/school activities as volunteers.

Home Learning: Learning at home includes practices such as helping with homework, reading, talking about school issues with children, prompting goal-setting and other learning activities in which the parent assist their children with curriculum-related work in a home environment. Epstein (1987) found that interactive homework, communication between parent, student, and teacher, and interactive strategies that encourage students to talk about schoolwork with their parents are the most effective way to enhance achievement. Epstein (1995) emphasized that assisting learning at home should be a process encouraging, listening, reacting, praising, guiding, monitoring, and discussing, not teaching or preaching at the students. Therefore, it is crucial that schools provide parents with parenting skills, curriculum information, and materials to help them work with their children at home. Schools can help encourage parent involvement at home by designing homework activities that feedback is required from family, or sponsoring curriculum nights and developing summer learning packets (Wright, 2009; Crowl, 2008). Theses learning-at-home activities designed by schools and teachers
should be clear, meaningful, and coordinated with students’ curricular work at school (Epstein, 2008).

Decision Making and Governance of Schools: According to Epstein (1995, 2001), decision making indicates a partnership between parents and schools that works under the umbrella of shared views, actions, and goals, rather than a power struggle between the two groups. Parents’ governance of school includes taking part in decision-making forums such as advisory councils, on-going planning meetings with school administration, parent-teacher organizations, and local school councils. This kind of involvement includes the voices of families in helping schools to develop mission statements, designing, reviewing, and improving school policies, and helping to create positive environments and climate for learning (Epstein, 2008). Therefore, schools need to provide parents with training and information to enable them to understand what roles to adopt.

Collaboration with Community: This involvement refers to working collaboratively with community events, organizations, local businesses, social service agencies, religious groups and other members of the community to help meet the goal of providing a well-rounded, positive academic experience for all students (Epstein, 2008). This connection with community enables students, families, teachers, community members, and administrators to become engaged in a meaningful and reciprocal relationship that improves the school, parent practices and the quality of life in the community (Epstein, 1992; Henderson & Mapp, 2002; Wright, 2009). Schools need to identify and integrate resources and services from the community into their education programs and provide information about what resources services are available and how to
access to them. These include such things as tutoring services, after school programs, book fairs, community events, and other academic and skill-based enrichment opportunities.

Epstein and Sanders (2006) suggested that each type of parent involvement should be addressed for schools to reach out to and become partners with all families, including those whose primary language is not English, single-parent families, low SES families, and other families with whom schools traditionally have limited interaction. According to Epstein (1995, 2001), each type of involvement includes many different practices of partnership and the activities for each type lead to different results. Schools must choose which partnership activities are likely to produce certain goals and also choose how to implement those selected activities effectively.

Although Epstein’s theoretical model is promising, it is criticized because its framework is not based on the empirical evidence of what parents actually do in supporting their children. Rather, it is based on reflection about the general sort of things parents could or might do. Thus, it is still unclear how the major elements in the model can be operationally defined and empirically measured (Fan & Chen, 2001; Desforges & Abouchaar, 2003). Empirical research is needed to uncover the latent components of parent involvement and how they influence learning outcomes.

**Empirical Research on the Influence of Parent Involvement on Students’ Academic Achievement**

A large number of studies have been conducted in order to better understand how parent involvement facilitates academic achievement (Duncan & Magnuson, 2005; Epstein & Hollifield, 1996; Fan & Chen, 2001; Hill & Taylor, 2004). The definition of
parent involvement has been operationalized differently in the research (Spera, 2005; Sy, Rowley, & Schulenberg, 2007). Some studies focused on contextual aspects of parent involvement, such as assistance with homework or attendance of school activities. Other studies focused on attitudinal and emotional components of parent involvement by defining it as parenting style or family interaction patterns. In other cases, parent involvement was conceptualized as parental aspirations or expectations for their children's educational performance (Baker & Soden, 1998; Hill & Tyson, 2009; Lee & Bowen, 2006). Empirical evidence suggests that parent involvement, whether focused on specific behaviors or more general attitudes, helps children achieve in school. A review of research on each major component of parent involvement is presented and discussed below.

**Parent Involvement Practices**

Parent involvement practices refer to specific behaviors, strategies and activities that parents use to foster their children’s learning (Begum, 2007; Darling & Steinberg, 1993). According to the literature, parent involvement practices can directly influence academic outcomes through cognitive enrichment activities like reading to children (Clark & Pillion, 2002, Sénéchal & LeFevre, 2002), help with homework (Clark, 1993; Sepra, 2005), and/or taking children to the library or museums (Gutman & McLoyd, 2000; Reynolds & Gill, 1994). These educational experiences can stimulate intellectual growth and development of critical thinking (Hill and Tyson, 2009; Hoover-Demopsey et al., 2001). Parent involvement practices also influence learning through psychological processes (Gonzalez-DeHass, Willems, & Doan Holbein, 2005; Grolnick & Slowiaczek, 1994; Hill & Craft, 2003; Machen, Wilson, & Notar, 2005). When parents show their
interests in their child’s education by getting involved in their learning activities, students adopt a mastery goal of learning where they are more likely to seek challenging tasks, persist through academic challenges, demonstrate greater self-efficacy and motivation in learning, and experience satisfaction in their schoolwork. Students’ motivation to study and their positive feelings of school also increase when parents share their positive attitude and high value for education. Lastly, parents can contribute to learning outcomes through the social capital that is generated from parent involvement practices. For instance, parent involvement practices at school can shape a positive school climate and increase school effectiveness, which in turn, contributes positively to students’ learning outcomes (Adams, 2010; Begum, 2007; Bryk, Lee, & Holland, 1993; McNeal, 1999).

Research on parent involvement suggests that parent involvement practices should be treated as a multidimensional construct and different constructs may have different effects on academic achievement (Epstein, 1995, 2001; Fan & Chen, 2001; McNeal, 1999; 2012; Reynolds & Clements, 2005; Sui-Chu & Willms, 1996). In a meta-analysis, Jeynes (2005) examined 41 studies to determine the impact of parental involvement on the academic achievement of urban students. The specific components of parent involvement practices in his study included the parents-children communication about school, the extent to which parents checked their children’s homework, whether parents read regularly with their children, and whether parents attended or participated in school functions. The results indicated that parental reading, parent-student communication, and parental participation or attendance of school activities are important predictors of students’ academic outcomes. However, parents checking on student homework did not yield statistically significant results. Jeynes argued that the non-
significant finding of homework checking did not necessarily suggest this practice is ineffective. It is possible that students whose homework was more often checked by their parents were students who were experiencing difficulty in school.

Similarly, Hill and Tyson (2009) conducted a meta-analysis across 50 studies to determine whether and which types of parental involvement practices/strategies are related to students’ achievement in middle school. In their study, three types of parent involvement strategies were found to be positively associated with student’s academic achievement in middle school. Home-based involvement includes strategies like parent-children communication about school, engagement with school work (e.g., help with homework), taking children to events and places (e.g., museums or libraries) that foster academic success and creating a learning environment at home (e.g., making educational materials accessible, like books and educational toys). School-based involvement includes participation of school events (e.g., PTA meetings and open houses), involvement in school governance, volunteering at school, and parent-teacher communication. Academic socialization includes sharing values, attitudes, and expectations for education, fostering educational and occupational aspirations, discussing learning strategies with children, and making preparations and plans for the future. Academic socialization was found to have the strongest positive correlation with academic achievement in middle school, followed by school-based involvement and home-based involvement. However, parental help with homework was found to have significant but negative association with academic performance. The authors explained this negative correlation may be due to “parental interference with students’ autonomy, to excessive parental pressure, or to differences between parents and schools in how they
present the material” (p. 757). Another interpretation is that parental engagement in homework was elicited by poor school performance, which resulted in a negative relationship between homework help and achievement.

In general, forms of parent involvement practices in children’s education from previous empirical research can be classified as:

1) Home involvement in children’s cognitive stimulation.

Parents influence academic achievement through home cognitive stimulation activities like reading to their children, telling stories, singing songs, playing cognitive enrichment games, and tutoring on school projects ((Derrick-Lewis, 2001; McWayne, Fantuzzo, Cohen, & Sekino, 2004; Hoover-Dempsey et al., 2001; Pomerantz, Moorman, & Litwack, 2007; ) This type of parent involvement practice has been consistently found as a positive effect on academic achievement (Hill & Craft, 2003; Lzzo, Weissberg, Kasprow, & Fendrich., 1999; Eamon, 2005). Parents who are actively involved in their children’s learning at home provide a stimulating learning environment that fosters children’s intellectual growth and skill, help develop feelings of competence, confidence, curiosity, produce positive attitudes about academics, and have better sense of their children’s academic strength and weakness (Usher, 2012).

2) Parent-child communication on academic matters.

Parents can engage in their children’s learning through communication about school experiences, learning strategies, plans for the future, parental expectations for education and its value, and educational/occupational aspirations. This type of involvement scaffolds children’s burgeoning autonomy, independence, cognitive
abilities, fosters and builds upon the development of internalized motivation for achievement. It also provides students with the tools to make semiautonomous decisions about their academic pursuits (Hill & Tyson, 2009). Some studies found that parents who communicate more frequently with children on academic matters positively affect their academic performance (Clark & Pillion, 2002; Keith et al., 1993; Simon, 2000) while others found parent-child communication has no or even negative effect on students’ academic achievement (Astone & McLanahan, 1991; Catsambis, 1998).

3) Helping with homework.

Parents get involved in their children’s homework because they believe they have the responsibility to help, and their help will positively influence in their children’s academic performance, and perceive that their efforts are expected and valued by school personnel (Hoover-Demopsey et al., 2001; Patall, Cooper, & Robinson, 2008). Studies on the effect of parent involvement with homework on achievement produced mixed findings. Some studies found that parent participation in homework significantly enhanced students’ academic performance (Balli, Demo, & Wedman, 1998; Epstein, Simon, & Salinas, 1997; Van Voorhis, 2003). Others found that parents’ involvement in children’s homework was negatively correlated with academic achievement (Hill & Tyson, 2009; Pomerantz, Moorman, & Litwack, 2007). Researchers interpreted the negative relationship as indicating efforts to provide interventions and help to mainly struggling children (Fan and Chen, 2001; Jeynes, 2005; Shumow & Miller, 2001)

4) Collaborating with the community.

Parents can get involved in children’s learning activities by taking children to cultural activities, libraries, museums, concerts, and plays to enhance educational
experience and resources (Derrick-Lewis, 2001; Gutman and McLoyd, 2000; Pomerantz, Moorman, & Litwack, 2007; ). Students who have access to community resources were found more likely to gain academic success at school (Clark & Pillion, 2002). For example, Swan (2014) examined the influence of libraries and museums on academic achievement using national representative data and found that children who visited a museum during kindergarten had higher academic achievement scores than children who did not.

5) School involvement.

Parents’ school related involvement (i.e., volunteering in the classroom, attending parent meetings like PTA, and being members of various school committees or boards) has positive impact on academic performance (Clark & Pillion, 2002; Fan & Chen, 2001; Lzzo et al., 1999). Parent involvement at school allows parents and teachers to share their thoughts and expectations, which can help them to understand the strength, weakness, and needs of students. In addition, parents gain opportunities to interact with other parents, share their experience in improving students’ academic performance and become knowledgeable about the community resources. Parent involvement at school will not only benefit parents by getting advice from the school personnel and other parents about children’s education, but can also improve the quality of teaching in schools, which in turn promotes the academic achievement of the students (Begum, 2007; Derrick-Lewis, 2001). However, some studies found that parent participation in school activities had no or negligible effects on academic achievement in middle schools (Sui-Chu & Willms, 1996; Singh, Bickley, Trivette, Keith, 1995).
6) Family rules like creating routines for watching TV, playing video games, and using computer for leisure-related activities.

Setting family rules for TV viewing or video gaming provides opportunities for parents to model good time management, learning environment arrangement and self-regulation skills. Research found that greater television viewing and frequent leisure-related computer use are negatively associated with school performance (Dorr, Rubin, & Irlen, 2002; Woessmann & Fuchs, 2004; Ponzo, 2011; Livazovic, 2010). It was also found that children perform better on achievement tests when their families have rules about TV watching or computer using (Bembenutty, 2006; Clark & Pillion, 2002; Hancox, Milne, & Poulton, 2005; Zimmerman & Christakis, 2005). Therefore, family rules that restrict TV viewing and leisure-related media use enhance children’s academic performance and well-being (Davis, 2004; Odland, 2004; Van Zutphen, Bell, Kremer, & Swinburn, 2007).

7) Managing extracurricular activities.

Children’s participation in extracurricular activities depends on not only the availability of extracurricular programs, but also on family’s SES, parents’ time, values, support and other resources (Xu, 2008; Hancock, Dyk, & Jones, 2012). In general, participation in extracurricular activities positively influence academic performance by transforming additional learning experiences, gaining better self-esteem and self-confidence (Lin, 2003; Reaney, Denton, & West, 2002; Massoni, 2011; Wickery, 2010). However, some types of extracurricular activities may have no effect or even hinder students’ academic achievement (Fjjita, 2006; Roberts, 2006; Francisco, 2010). Therefore, mentoring, monitoring, helping with program selection and time management
in children’s extracurricular activities are essential in fostering academic success (Hancock, Dyk, & Jones, 2012)

8) Other parental monitoring activities.

Parents’ monitoring of after-school activities, such as checking on the completion of homework, supervising activities with peers, or monitoring their school progress impact academic performance (Catsambis, 1998). Clark (1993) found that parents who monitor their children’s behavior after school were more likely to have high achieving children than parents who do not monitor their children’s after school activities. Similarly, Muller (1993) found that parents’ knowledge of their adolescent’s friends was positively related to standardized achievement scores. In general, parents who better manage children’s home activities and who encourage leaning activates positively affect cognitive performance.

In summary, findings from empirical research on the relationship between family involvement practice and academic achievement are mixed and inconclusive. Inconsistent research findings may be due to the demographic differences of the students under investigation (e.g., different age, race, and SES groups), different analytical strategies, and different selection and measurement of family practice variables (Catsambis, 1998). In terms of analytical methods, many studies suffer from methodological limitations such as small sample sizes, potential omitted variable biases, use of cross sectional data for analysis, and/or examining only one or two dimensions of parent involvement.
Parenting Style

Research on the influence of family involvement on the educational outcomes has found a significant relationship between parenting style and academic achievement. Parenting styles can be described as “a constellation of attitude in the child, of which they are informed and, together, form an emotional environment in which parents’ behaviors are exposed” (Raya, Ruiz-Olivares, Pino, & Herruzo, 2013, pp. 703). It provides another lens by which to view the effectiveness of parent involvement.

The concept of parenting style that incorporated emotional and behavioral processes was first introduced by Baumrind in the 1960s (Baumrind, 1966, 1991). Maccoby and Martin (1983) later defined this concept as a two-dimensional framework of demandingness and responsiveness, where parental demandingness refers to the degree to which parents expect and demand their children to behave in a desirable manner and parental responsiveness refers to the extent to which parents flexibly attend to their children’s needs and opinions in an accepting and supportive way (Darling & Steinberg, 1993; Kang, & Moore, 2011). Based on these two dimensions, Baumrind (1991) divided parenting style into four categories: authoritative parents (both responsive and demanding), authoritarian parents (demanding and directive, but not responsive), permissive parents (responsive but not demanding) and rejecting-neglecting parents (neither demanding nor responsive).

According to Baumrind (1991), authoritative parents monitor and impart clear standards for their children’s conduct. They are democratic, warm and responsive. They provide their children with unconditional love and support them to explore and pursue their interests. These parents have high maturity demands (e.g., they want their children
to be confident, socially responsible, self-regulated, and cooperative) for their children but foster these maturity demands through bidirectional communication, induction (e.g., explanations of their behavior), and encouragement of independence (Spera, 2005). For example, authoritative parents will explain the rationale for actions or priorities when helping children with schoolwork. This parenting style has been proven to benefit children in social adjustment and cognitive development (Durkin, 1995; Steinberg, Dornbusch, & Brown, 1992).

Durkin (1995) provided three possible explanations of why authoritative parenting is related to high academic achievements. First, he suggested that authoritative parents provide a high level of emotional security to their children. Emotional support reinforces a sense of comfort and independence and enhances educational attainment. Second, authoritative parents tend to provide the rationale or reasons behind their actions. Explanations enable their children to know and understand the values, morals, and expectation/goals of parents. The transmission or internalization of these goals and values prepares the students with the tools needed to perform well in school. Third, Durkin suggested that authoritative parents communicate with their children in a bidirectional way. This communication style fosters skills in interpersonal relations and produces better adjusted and more popular children, which helps children succeed socially and academically.

Authoritarian parents are strict, status-oriented and value obedience (Baumrind, 1991). They monitor their children’s activities meticulously, but they are neither warm nor responsive to their children. They have high maturity demands for their children primarily because they are intolerant of selfishness or inappropriate behavior (Spera,
Authoritarian parents interact with their children with high order and structure. They expect their children to obey them without asking for an explanation or giving excuses for misbehavior. They impose rules and set clear requirements but refrain from providing rationale on why things should go in a certain way. For example, authoritarian parents might insist, “you better do well in school…because I said so.” (Spera, 2005, p. 134). The effects of authoritarian parents on children’s cognitive development varies by culture and ethnicity. Research by Cohen and Rice (1997) and Steinberg, Elmen and Mount (1989) showed lower academic performance is associated with having authoritarian parents among American students. However, studies (e.g., Kang & Moore, 2011; Sue & Okazaki, 1990) that looked at Chinese or Asian Americans students indicate those with authoritarian parents perform significantly better than those with authoritative parents.

Permissive parents are nontraditional and lenient (Baumrind, 1991). They exhibit high level of tolerance toward their children even when they misbehave or act immaturely. They allow considerable self-regulation and avoid confrontation. Permissive parents are usually dismissive and unconcerned with their children’s activities and they are moderate in their responsiveness toward their children’s needs. Children who are raised by permissive parents tend to be less self-reliant, less likely to persist on learning tasks (Baumrind, 1971; Maccoby & Martin, 1983), and are less likely to be intrinsically motivated (Ginsburg & Bronstein, 1993). As far as academic success is concerned, children with permissive parents are less successful because they do not get enough discipline and structure to help them develop self-direct abilities required for academic success (Keshavarz & Baharudin, 2009).
Rejecting-neglecting parents do not structure or monitor their children’s activities. They are neither supportive nor responsible, and they may actively reject or neglect their responsibilities during the process of their children’s growing and education (Baumrind, 1991; Pong, Hao, & Gardner, 2005). Rejecting-neglecting parents have a negative impact on academic outcomes and participation in school (Pong, Hao, & Gardner, 2005). Most of the time, it is hard to find samples of parents with rejecting parenting style because the population is small (Shaffer & Kipp, 2001).

Even though Baumrind’s parenting style typologies have been widely adopted and some impressive consistencies were found in parental involvement literature, research has shown that the relationship between parenting style and academic achievement is not consistent across families from diverse ethnic, culture, and socioeconomic backgrounds (Spera, 2005). For example, studies have found that authoritative parenting is most strongly associated with academic achievement among European-American adolescents but is least effective in Asian- and African American youths (Lamborn, Mounts, Steinberg & Dornbusch, 1991). Kang & Moore (2011) found that students with authoritarian parents scored significantly higher than those with authoritative parents in China. In a study with low-income African American mothers, Kelley, Power, and Wimbush (1992) found that younger, less educated, and single mothers were more likely to emphasize obedience (i.e., authoritarian) than parents who were older, educated, and raising their child in a two-parent family.

Despite the reason that the effects of parental involvement are often confounded with other contextual factors like parents’ education level, SES, genetic factors, and peer influence, the inconsistency may be also due to how parents become involved.
Parents might have opposite involvement styles for school-based activities and home-based activities. For school-based involvement, the parents can get involved through the events that are designed by school to promote parental participation (e.g., open house, festivals), but such activities usually emphasize little about academic performance. For home-based involvement, some parents might overestimate their obligation to become involved in children’s education. They may sometimes feel pressed, frustrated with their children’s schoolwork, and become involved in negative ways.

**Parental Expectations**

Another aspect of parent involvement is parent expectations (parent aspirations). Parent expectations can be described as “internal representations of desired states or outcomes that parents hold for their children” (Spera, 2005). Parent expectations can directly influence academic performance by facilitating children’s internalization process of parent’s education values. Children will interpret and internalize parent’s values, goals, and aspiration as their own. This process will influence students’ own motivation and attitude to learning and achievement, ultimately creating a lasting impact on children’s academic performance (Marchant, Paulson, & Rothlisberg, 2001). Parent expectations can also indirectly influence children’s academic achievement through organized and direct behaviors toward children (Austin & Vancouver, 1996; Wentzel, 1998). Parents with higher expectations are more likely to involve and invest a great deal in their children’s education, such as create a study-friendly home environment, organize and restrict children’s after-school activities, and maintain interest in children’s
schoolwork. All of these practices contribute to children’s positive school performance (Chao, 1996; Darling & Steinberg, 1993; Kim, 2002).

Parent expectations have been found to be a significantly predictor in explaining academic achievement in the literature (Clark & Pillion, 2002; Halle, Kurtz-Costes, & Mahoney, 1997; Reynolds, 1998; Yamamoto & Holloway, 2010). For example, Hoge, Smit, and Crist (1997) investigated the relationship between family process factors (i.e., parental expectations, parental interest in school, parental involvement in school, and family communication) and academic achievement of 300 students in 6th and 7th grade in a longitudinal study, and found parental expectations of students’ capabilities in a specific discipline were especially influential on mathematics achievement. The significant role of parent expectations on achievement is also supported by Jeynes (2005, 2007) who found that parental expectations were the strongest family-level predictor of student achievement outcomes in two meta-analyses.

Although the nature of this association is generally positive, the strength of these associations varies across different racial/ethnic groups (Bates, 2009; Farbers, 2005; Okagaki & Frensch, 1998). For example, Seyfried and Chung (2002) found that the association between parents’ expectations/aspirations for their children’s educational attainment and their children’s actual academic achievement was stronger for White American families than it was for African American families. In addition, studies have found that African American and Hispanic parents generally have similar or higher expectations for their children’s educational attainment than non-Hispanic Whites parents but African American and Hispanic students have lower academic achievement and
higher drop-out rates from high school than White students (Bates, 2009; Fan, 2001; Reynolds & Gill, 1994; Wentzel, 1998).

Inconsistent associations between parent expectations and achievement make some researchers call for further studies to understand the process by which parental expectations affect children’s school performance (Gill & Reynolds, 1999). These findings also raise important questions as to whether minority students and their parents have equal educational opportunities to actualize their aspirations (Schneider, Martinez, & Ownes, 2006; Solorzano, 1992). Despite strong values and high expectations minority parents place on their children’s education, it is possible they do not have adequate educational experiences or parenting skills to assist their children in attaining those expectations on a day-to-day basis (Entwisle and Hayduk, 1982; Farber, 2005; Seginer, 1983). Therefore, further research should focus on parent intervention strategies and programs designed to help minority parents set realistic expectations and translate their strong values towards education into everyday parenting practices.

**Reciprocal Relation between Parent Involvement and Student Academic Achievement**

Most previous studies on the effectiveness of parent involvement treat the relationship between parent involvement and academic achievement as a unidirectional process. For example, Xu (2008) designed parent involvement variables as exogenous variables and reading achievement as endogenous variables in a path analysis. In a similar approach, Johnson (2011) used parent involvement as a predictor of achievement in math and science. Even though there is a significant relationship between parent involvement and student achievement, there is no agreement in regard to the direction of the relationship. Some researchers suggest that parent involvement and student’s
academic achievement can be reciprocally linked (Domina, 2005; Fan, 2001; Hong, Yoo, You, & Wu, 2010; McNeal, 2012). This claim is theoretically supported from the approach of parents’ involvement focusing on the process of learning versus focusing on children’s innate ability or outcome (Hokoda & Fincham, 1995; Mueller & Dweck, 1998).

Process focused involvement emphasizes the importance and pleasure of effort and learning. In contrast, outcome focused involvement emphasizes the importance of stable attributes (e.g., intelligence) and performance (Mueller & Dweck, 1998; Pomerantz, Ng, & Wang, 2006). Process focused and outcome focused involvement can be found in both school-based activities (e.g., parents discuss children’s effort rather than ability with teacher during the meetings) and home-based activities (e.g., when helping students with their homework, parents direct children’s attention to the efforts and process of learning rather than their performance).

The impact of process-focused and outcome-focused involvement on students’ academic achievement has been investigated in many studies. The former benefits children’s school performance (Hokoda & Fincham, 1995). For example, in Mueller and Dweck’s (1998) study, children who received process-focused praise were found to have more positive attitudes after failure, adopt mastery over performance goals, display more task persistence and better performance. A possible explanation is that process-focused parents may highlight the importance of effort (Pomerantz, Ng, & Wang, 2006), paying more attention to the time, learning strategies, and emotions when getting involved fosters children’s development of knowledge, motivation, and confidence (Hokoda & Fincham, 1995; Mueller & Dweck, 1998).
Studying the reciprocal relationship between parent involvement and student academic achievement has policy implications for considering the role of students in shaping parent involvement. In addition, this relationship provides two plausible alternatives to explain the inconsistent findings of parent involvement. First, parent involvement might enhance achievement, as much of the existent literature contends. Second, lower level of performance at school might cause parents to check in via increased parent involvement (McNeal, 2012).

**Rasch Modeling: A Measurement Approach**

In the field of parent involvement research, the most common method to capture the underlying attribute of parent involvement is to sum or average the raw scores on the individual items. Although predominantly used, this method threatens the validity of results based on the following limitations. First, using raw scores misuses ordinal data (i.e., likert scales) as interval or ratio, where the distance among response categories (e.g., strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree) are assumed to be equal. Moreover, each individual item under the latent construct of parent involvement is mistakenly assumed to contribute equally to the latent attribute and has common error estimates (e.g., attended a meeting of a PTA/PTO has equal importance as volunteered at the school in constructing parent involvement). Another limitation of this traditional approach is that the person ability and item difficulty are “circular dependent”, meaning the person measures are inherently linked to the items, and vice versa. If the same test is administered to a different sample drawn from the target population, item difficulty measures would not remain the same. Likewise, if the same person takes a test with another subset of items chosen from a larger item pool, the person ability would not
remain invariant. These weaknesses threaten the generalizability of the study. Researchers should be aware of limitations and pitfalls with using raw scores in the research and should rely on methods that are both theoretically and methodologically sound to measure the changes over time (Dimitrov & Rumrill, 2003).

The Rasch model (Rasch, 1960) provides researchers with analytical tools in social science to carry out detailed analyses of latent traits such as performance or perceptions. The Rasch model is built around the idea that item responses should be governed by the gap between person ability and item difficulty (Andrich, 1978; Bond & Fox, 2001). If a person’s ability is much higher relative to the item difficulty, this person would have a high probability to endorse this item; if a person’s ability is located at the same point of item difficulty, this person will have 50% of chances to endorse this item; if a person’s ability is much lower than the item difficulty, this person would have a low probability to endorse that item. Like other IRT models, the Rasch model provides information on the pattern of responses to individual items. However, the Rasch model is usually preferred over other IRT models due to its simplicity. Unlike other IRT models that incorporate additional properties of items (i.e., discrimination and guessing), the Rasch model primarily considers only one property of item, which is item difficulty. (Bond & Fox, 2007, de Ayala, 2009; Oh, 2012).

The Rasch model provides a methodologically sound alternative to traditional approaches to survey research analysis (Wright, 1997). First, the Rasch model corrects problems associated with ordinal data when measuring the latent trait. Specifically, the Rasch model corrects this misuse by converting the raw data to the logarithmic (logit) scale, where the data are then linearized into interval form. For rating scale data, the
ability score of a person is determined by the probability of choosing a higher category over a lower one on any given item. It is important to note that item difficulties and person ability scores are located on the same logit scale.

Second, Rasch model is invariant, meaning sample/item-free calibrations remain stable across time and populations. Longitudinal studies designed to measure changes across different time points expect questionnaire items to remain the same from wave to wave. However, items are dropped, added or modified to accommodate practical and age relevant reasons. Such changes influence the interpretation of results of measurement of change over time. As mentioned earlier, the Rasch model is item-free, which means person calibration estimates are independent of which items are tested as long as the items fit the model. Therefore, administering the same items to the same sample at different time points is not required for tracking changes so one can use both repeated items and wave-specific items for each wave.

Third, the Rasch model provides a flexible means to analyze items with different response formats. In survey research, it is common to find items with different response formats. For instance, some items are dichotomous and others might have four or five Likert categories. The Rasch model transforms the probability of responses into a linear interval measure of the latent attribute, providing a way to analyze the varied response formats.

Forth, the Rasch model overcomes the assumption of equivalent items and errors. The Rasch model produces estimated parameters and standard errors for each person and item. Items vary in terms of how likely they are to be endorsed or how likely higher response categories are to be chosen. This feature provides a more accurate measure of
the latent trait and enable the implications like hypothesis testing, construct stability testing, etc. In addition, threshold calibrations can tell the appropriateness of item response categories, which can be used to provide the rationale for collapsing across response categories. Statistical analyses will be effective only if fundamental measures have been constructed in the first place (Bond & Fox, 2007).

Last but not least, the Rasch model overcomes problems associated with missing data. When there is missing data, researchers have to either intentionally enter new data in its place through imputation or remove an entire observation. While screening for missing data is a common strategy in research, it is not necessary with the Rasch model analyses.

**Summary**

This chapter reviews the theoretical frameworks and empirical research related to parent involvement and its influence on academic achievement. Specifically, the social capital theory and Epstein’s typology of parent involvement were introduced as the theoretical foundations of this study. Previous research on the effect of parent involvement on academic achievement, including parent involvement practices, parenting style, parent aspiration, and the reciprocal relationship between parent involvement and academic achievement were discussed. The Rasch model was introduced as the methodological foundation to measure parent involvement. The research design guided by this evidence is introduced in the next chapter.
CHAPTER 3 METHODOLOGY

This chapter introduces the research design and methodology for the study. The first section provides an overview of the Early Childhood Longitudinal Study: Kindergarten Class of 1998-1999 (ECLS-K), with a focus on its background, sample design and data collection. The second section presents the sample selection, instrumentation and choice of variables. The third section introduces analytical procedures and the conceptual model of the study. Addressed in the last section are analytical issues associated with complex survey data and categorical data including sampling weights, design effects, missing data and polychoric correlations.

Data Source

Overview of ECLS-K

The Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K), sponsored by the U.S. Department of Education, National Center for Education Statistical (NCES), is the latest completed longitudinal study that followed children from kindergarten through the eighth grade. ECLS-K collected information on children’s early school experience from a nationally representative cohort of kindergarteners across the United States. This provides a rich amount of information related to students’ academic and social progress from kindergarten through the eighth grade. In addition, separate questionnaires were administered during each wave to parents, teachers, and school administrators to provide a full picture of family background and the school environment.

The ECLS-K data are released in public-use and restricted-use versions. Public-use files include kindergarten (base year), first grade, the longitudinal kindergarten-first
grade, third grade, the longitudinal kindergarten through third grade, fifth grade, the longitudinal kindergarten through fifth grade, and the longitudinal kindergarten through eighth grade. The restricted-use files include base year, first grade, third grade, fifth grade, and eighth grade. The restricted data contain confidential information about children, their families and schools. Due to NCES regulations, a restricted data license is required to access the restricted data. Unlike the public use data, the restricted-use ECLS-K data are released only as cross-sectional, grade-level files. This study focuses on the general condition of parent involvement during students’ transition from elementary school to middle school in the U.S. and does not use sensitive information about children and their families; therefore, the longitudinal kindergarten through eighth grade full sample public-use data was used to examine the relationship between students’ academic growth and their parents’ involvement from elementary school to middle school.

**Sampling Design and Data Collection**

In order to obtain a nationally representative sample of children attending kindergarten in 1998-99, ECLS-K study employed a multi-stage probability sampling design. The multistage probability sampling design is a complex sampling design that considers multiple levels of sampling units in order to gain a representative sample proportional to the size of the desired study population. In the base year, 100 geographic areas consisting of counties or groups of counties, called the primary sampling unites (PSUs), were selected throughout the United States in the first stage. In the second stage of sampling, 1,280 public and private schools offering kindergarten programs were selected from sampled PSUs. In the third and final stage, an average of 23
kindergarteners was selected within each sampled schools. In order to obtain a minimum sample size required for accurate estimates, small subpopulations like Asian and Pacific Islander (API) children were oversampled.

The ECLS-K collected data through direct child assessments, parent interviews, teacher and administrator questionnaires, student records, and school facilities checklists. The ECLS-K data includes seven waves: kindergarten year (fall 1998 and spring 1999), the first grade (fall 1999 and spring 2000), the third grade (spring 2002), the fifth grade (spring 2004), and the eighth grade (spring 2007). The sample design of ECLS-K was modified for each wave of data collection. For example, in order to obtain a nationally representative sample of all first graders, the sample was refreshed in spring 2000 by including first graders who were not enrolled in kindergarten in the base year of 1998-1999. These students were not selected in the base year sample because they either skipped kindergarten, attended kindergarten outside of the U.S., or repeated first grade in the academic year of 1999-2000. The ECLS-K study did not recruit new students after the first-grade year. Thus, estimates from the ECLS-K third- to eighth-grade data are representative of the population cohort rather than all the students at third, fifth, and eighth grades. A total of 21,260 nationally representative sample of students enrolled in kindergarten programs during the 1998-1999 school year participated in the ECLS-K, and 9,725 of them were followed longitudinally.

**Analytical Sample**

The sample for this study includes students with parents who were retained and repeatedly completed the parent interview when their children attended third grade in 2001-02, fifth grade in 2003-04 and were in eighth grade in 2006-07. Since the ECLS-K
employed complex sampling design, weights are used throughout the analyses to account for oversampling of certain subgroup of populations (e.g., Asians and Pacific Islanders, private schools) and non-response adjustments (National Center for Educational Statistics [NCES], 2001). After excluding observations with zero weights, unavailable science achievement scores, and large missing variables (more than 50% of the variables are missing), the resulting sample consists of 7,229 students, who represent approximately 2,997,218 students nationwide. Demographic background of the analytical sample is shown in Table 3.1.

Table 3.1. Demographic Background of Sample Students.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>3,636</td>
<td>50.30</td>
</tr>
<tr>
<td>Female</td>
<td>3,593</td>
<td>49.70</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White (Non-Hispanic)</td>
<td>4,775</td>
<td>66.05</td>
</tr>
<tr>
<td>Black or African American (Non-Hispanic)</td>
<td>616</td>
<td>8.52</td>
</tr>
<tr>
<td>Hispanic (Race Specified and Non-Specified)</td>
<td>1,124</td>
<td>15.55</td>
</tr>
<tr>
<td>Asian</td>
<td>345</td>
<td>4.77</td>
</tr>
<tr>
<td>Native Hawaiian, Other Pacific Islander,</td>
<td>204</td>
<td>2.82</td>
</tr>
<tr>
<td>American Indian or Alaska Native</td>
<td></td>
<td></td>
</tr>
<tr>
<td>More than One Race (Non-Hispanic)</td>
<td>162</td>
<td>2.24</td>
</tr>
<tr>
<td>Not Ascertained</td>
<td>3</td>
<td>0.04</td>
</tr>
</tbody>
</table>
Instruments

The information on parent involvement in children’s education at third, fifth and eighth grade was collected through parent interviews. Parent interviews were conducted using a computer-assisted interview (CAI). Trained interviewers used a hard-copy questionnaire and then entered the answers into the CAI program. The parent interviews were conducted primarily in English, but Spanish, Hmong, Lakota, and Mandarin CAI instruments were also available for parents who spoke other languages. Most of the interviews were conducted by telephone, but a small percentage were conducted in person. Only one parent for each child completed the parent questionnaire. The order of preference for the parent respondent was: (1) the respondent from the previous round (if there was one), (2) the child’s mother, (3) another parent or guardian, or (4) some other adult household member. In a majority of the cases (above 91%), the respondent was the same as the respondent from the previous round. Parent interviews collected information of child school experiences, child care, parent characteristic, child health. Parent income, employment, education, are measured at least once in each school year. Family structure, parent involvement in school, child’s home environment and cognitive stimulation are covered in most rounds. The general content areas are similar across the questionnaires, though some topics were added, modified, or dropped to accommodate for practical or age appropriateness. For example, in spring-fifth grade, topics of home learning activities, social support, and parental emotional well-being were dropped. Whereas in the eighth grade, questions about family routines and parent discipline were added.
Variables

Outcome Measures

The dependent variables of this study are science achievement scores taken from the ECLS-K direct cognitive assessment. The science assessment was designed to measure knowledge and skills in the domains of earth and space science, physical science, and life science. Children needed to demonstrate understanding of physical and natural world, draw inferences, and comprehend relationships. All direct cognitive outcome measures in the ECLS-K were obtained through a two-stage, adaptive process. Children were initially given a short, first stage routing test. Performance on the routing items guided the selection and administration of one of three second-stage forms. The second-stage form contained items of appropriate difficulty for the level of ability indicated by the routing items. Because children did not take the identical exam, a raw scoring method is not appropriate for measuring children’s performance on two-stage adaptive assessments. Therefore, the IRT scale scores in third, fifth, and eighth grade were selected as the measure of science achievements.

Parent Involvement Measures

Through a careful review of the items in the ECLS-K parent interview and previous literature, items that cover different domains of parent involvement (e.g., cognitive stimulation at home, parent-child communication, involvement at school, family rules, aspirations of education, etc.) were selected. Since previous research on the component of parent involvement was based on different empirical research, and there is no common accepted theory of parent involvement, all parent involvement items from the ECLS-K were screened and examined through a series of exploratory factor analyses.
The primary purposes of factor analyses are to 1) determine the latent dimensions of the components of parent involvement, and 2) determine which of the previously identified items should be deleted from those composites. The final retained components of parent involvement include 27 items at third grade, 15 items at fifth grade, and 26 items at eighth grade. Table 3.2 shows a complete list of parent involvement variables selected at each grade.

Since the ECLS-K applied complex sampling design for its data collection, weighting variables, strata, and cluster variables at third, fifth, and eighth grade will be used throughout the study in order to adjust for differential probabilities of selection, nonresponses, and design effects. In addition, the impact of context factors like gender, race/ethnicity, and SES on parent involvement were examined to explore parent’s involvement in children’s education during the transition years from elementary school to middle school.

Table 3.2 Parent Involvement Survey Items.

<table>
<thead>
<tr>
<th>Parent Interview Items</th>
<th>Waves of data collection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3rd</td>
</tr>
<tr>
<td>PIQ.010 During this school year, have you or another adult in your household taken it upon yourself to contact {CHILD}’s teacher or school for any reason having to do with {CHILD}?</td>
<td>X</td>
</tr>
<tr>
<td>PIQ.020 Since the beginning of this school year have you or the other adults in your household….</td>
<td>X</td>
</tr>
<tr>
<td>a1. Attended an open house or back-to-school night</td>
<td>X</td>
</tr>
<tr>
<td>b1. Attended a meeting of a PTA, PTO, or Parent-Teacher Organization</td>
<td>X</td>
</tr>
<tr>
<td>c1. Gone to a regularly scheduled parent-teacher conference with {CHILD}’s teacher or meeting with {CHILD}’s teacher</td>
<td>X</td>
</tr>
</tbody>
</table>
Table 3. 2. Continued.

<table>
<thead>
<tr>
<th>HEQ.010 Now I'd like to talk with you about {CHILD}'s activities with family members. In a typical week, how often do you or any other family members do the following things with {CHILD}?</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROBE: Would you say not at all, once or twice, 3-6 times, or every day?</td>
</tr>
<tr>
<td>a. Tell stories to {CHILD}?</td>
</tr>
<tr>
<td>b. Sing songs with {CHILD}?</td>
</tr>
<tr>
<td>c. Help {CHILD} to do arts and crafts?</td>
</tr>
<tr>
<td>d. Involve {CHILD} in household chores, like cooking, cleaning, setting the table, or caring for pets?</td>
</tr>
<tr>
<td>e. Play games or do puzzles with {CHILD}?</td>
</tr>
<tr>
<td>f. Talk about nature or do science projects with {CHILD}?</td>
</tr>
<tr>
<td>g. Build something or play with construction toys with {CHILD}?</td>
</tr>
<tr>
<td>h. Play a sport or exercise together?</td>
</tr>
<tr>
<td>i. Practice reading, writing or working with numbers?</td>
</tr>
<tr>
<td>j. Read books to {CHILD}?</td>
</tr>
</tbody>
</table>

HEQ.017 In the past month, that is, since {MONTH} {DAY}, has anyone in your family done the following things with {CHILD}? |

| a. Gone to a play, concert, or other live show? | X |
| b. Visited an art gallery, museum, or historical site? | X |
| c. Visited a zoo, aquarium, or petting farm? | X |
| d. Attend an athletic or sporting event in which {CHILD} was not a player? | X |
| HEQ.095 | During this school year, how often have you {or any of the people we just mentioned} helped {CHILD} with {his/her} reading, language arts or spelling homework? Would you say… | X X X |
| HEQ.098 | During this school year, how often have you or another adult helped {CHILD} with {his/her} math homework? Would you say… | X X X |
| HEQ.101 | During this school year, how often did someone help {CHILD} with {his/her} science homework? Would you say… | X |
| HEQ.026 | In the past month, that is, since {MONTH} {DAY}, has anyone in your family visited a library with {CHILD}? | X X |
| *HEQ.130 | Now I would like to ask you about some things you might talk with {CHILD} about. In the past month, how often have you talked with {CHILD} about… PROBE: Would you say not at all, a few times a month, a few times a week, or every day? | |
| a. {His/her} day at school? | X X |
| b. What {he/she} does with {his/her} friends? | X X |
| c. Talked about {his/her} school work or grades? | X |
| d. Talked about things {he/she} is doing at school? | X |
| e. Talked about (his/her) future | X |
| HEQ.076 | How often do you … PROBE: Would you say never, rarely, sometimes, or always? | |
| a. Check that {CHILD} has completed all homework? | X |
| b. Discuss {CHILD}’s report card with {him/her}? | X |
| c. Know where {CHILD} is when {he/she} is not at home or in school? | X |
| d. Make and enforce curfews for {CHILD} | X |
| e. Require {CHILD} to do work or chores | X |
Table 3. 2. Continued.

| HEQ.075 Are there family rules for {CHILD} about any of the following… |
|---------------------------------|---|---|---|
| a. What programs {CHILD} can watch | X | X | X |
| b. How early or late {he/she} may watch television? | X | X | X |
| c. How many hours {he/she} may watch television on weekdays? | X | X | X |
| d. How many hours {he/she} may watch television each week? | X | X | X |
| e. Maintaining a certain grade point average? | | | X |
| f. Doing homework? | | | X |
| g. How many hours {he/she} may spend on the computer or playing | | | X |

| PIQ.065 About how many parents of children in {CHILD}'s class do you talk with regularly, either in person or on the phone? | X | X | X |
| PIQ.070 How far in school do you expect {CHILD} to go? Would you say you expect {him/her} … | X | X | X |

*Note.* *This item was HEQ.420 in 5th grade parent interview questionnaire.*

**Analysis**

The analysis proceeded in four separate sections. The first two sections of the analysis dealt with the construct and measure of parent involvement. The primary purpose of this study is to examine the longitudinal causal relationship between parent involvement and science achievement during transition years from elementary school to middle school. To better detect the relationship between the two, it is important to develop reliable and valid constructs of parent involvement and accurately measure its levels across the waves.

Exploratory factor analysis (EFA) was used to uncover the latent structure of a set of parent involvement items selected from the ECLS-K database. Since responses to
most items were categorical and they failed to meet the assumption of multivariate normality, the variance-adjusted robust weighted least squares (WLSMV) in Mplus was used to adjust parameter estimates for data with a non-normal distribution (Muthén, 1993). The number of extracted factors was based on Mplus suggestions. Factor loadings were checked using oblique rotation since factors were assumed to be correlated. Items were eliminated when: (1) their component loadings were smaller than 0.32, (2) items cross-loaded on more than one factor, and (3) items don’t provide a conceptually vital meaning to the measure. Statisticians conventionally consider a factor loading of 0.32 or above as meaningful (Hair, Anderson, & Tatham, 1987; Tabachnick & Fidell, 2007). Also, it is commonly suggested that each factor should contain at least 3 items to be properly identified (Anderson & Rubin, 1956; Gorsuch, 1983). However, these criteria were adjusted for at least 2 items due to the limitation of items. For example, at third grade only two items (i.e., P5OFHLPR and P5OFHLPM) were given to measure the frequencies of help with homework. This process was repeated until all items loaded under only one factor with loadings greater than 0.3 and every factor contained at least 3 items (except for the component of helping with homework). The fit of each EFA model was considered using criteria like Root Mean Square Error of Approximation (RMSEA), comparative fit index (CFI), Tucker-Lewis index (TLI), as well as model chi-square test ($\chi^2$).

After factors was chosen, a Rasch model analysis (Rasch, 1960) was conducted to investigate the appropriateness of items and measure the level of each factor of parent involvement across all 3 waves. Winsteps version 3.75.0 (Linacre, 2012) was used to test the overall data to model fit and measure the level of parent involvement. Since some
subsets of parent involvement items do not share a common response structure, the Rasch-Grouped Rating Scale Model (Linacre, 2012) was applied to them. The formula for the model is:

$$\ln \left( \frac{P_{nij}}{P_{ni (j-1)}} \right) = B_n - D_{gi} - F_{gj}$$

where, $P_{nij}$ is the probability that person $n$ encountering item $i$ is observed in category $j$, $B_n$ is the “endorsability” measure of person $n$, $D_{gi}$ is the “difficulty” measure of item $i$ in group $g$. $F_{gj}$ is the “calibration” measure of category $j$ relative to category $j-1$ in group $g$, the point where categories $j-1$ and $j$ are equally probable relative to the measure of the item. The subscript $g$ specifies the group of items to which item $i$ belongs, and also identifies the ratio scale structure that belongs to the group.

Fit statistics were evaluated to determine overall data to model fit, as well as person and item fit. Item maps at third, fifth, and eighth grade were visually compared to find if the construct was sufficiently stable across different times. To explore the gender and race differences on parent involvement at each wave, a series of Differential Item Functioning (DIF) analyses to compare item calibrations across different samples were conducted to detect any statistically significant differences. The goal of DIF is to ascertain if there are substantial differences among varying groups. If an item shows evidence of DIF, it could be potentially biased (Holland & Thayer, 1986). If results of the DIF analysis confirmed the items were functioning in a comparable manner in both samples, then there is evidence of systematic validity.

The third section of the analysis applied structural equation modeling (SEM). Cross-lagged panel analysis was used to study the reciprocal relationship between parent
involvement and science achievement during the transition years. The conceptual path-diagram of the cross-lagged model is shown in Figure 3.1. Mplus version 6.12 was used to estimate all the parameters. Robust maximum likelihood (MLR) was used to estimate parameters when all variables in the model were continuous and robust weighted least squares (WLSMV) was used when there were categorical variables in the model. Factor scores were saved and analyzed to track the changes of parent involvement from third to eight grade. The last section was conducted using a series of analysis of covariance (ANCOVA) at third, fifth, and eighth grade to further explore if there is any parent involvement differences caused by racial/ethnical groups when SES is controlled. SPSS version 22 was used for this type of analysis.

Figure 3.1. Conceptual model of the study.
*Note.* There is a reciprocal relationship between parent involvement and academic achievement.
Analytic Issues and Techniques

Sampling Weights

The ECLS-K study applied a multi-stage probability sampling design to gain a nationally representative sample of children attending kindergarten in 1998-99. In the base year, the primary sampling units (PSUs) were geographic areas consisting of counties or groups of counties. The second stage units were schools within sampled PSUs. The third- and final-stage units were children within schools. Even though a complex sample design is an effective way to obtain a representative sample proportional to the size of the desired population, the precision of population estimates is affected by the use of this method. Specifically, there are two main issues that cause loss in precision: (1) differential sampling rates/weights for subgroups of the population (e.g., Asians and Pacific Islanders were over sampled), and (2) clustering of schools and students within the sampled geographic areas (e.g., children attending private schools were oversampled). The loss in precision of population estimates can be adjusted by using the ECLS-K weights. Analyses based on unweighted data produce findings that represent only those in the sample who provide data. Therefore, it is important to apply weights for all analyses with the ECLS-K data to get population estimates.

The Early Childhood Longitudinal Study, Kindergarten Class of 1998-1999 (ECLS-K) dataset provides weights for both cross-sectional and longitudinal analyses to compensate for differential probabilities of selection, use of diverse instruments, and nonresponses. The cross-sectional weights include teacher weights and school weights for the base year, parent and child weights across all years of data collection. They are used for single time point analyses. The longitudinal weights include child level weights
only, and they are used to estimate differences between data in two or more years. Deciding which weights to use in the analyses was a two-step process: 1) decide what time points are the focus of the analysis, and 2) consider the source of data. For the current investigation on the relationship between parental involvement and science achievement during students’ transition from elementary school to middle school, the appropriate weight variable is C567PW0, the longitudinal third to eighth grade parent weights.

**Design Effects**

Students in the ECLS-K were not a simple random sampling (SRS) of the target population. During the sampling procedure, students were clustered within PSUs to reduce field costs. Students were selected in closer geographical proximity than would occur in an SRS. This procedure leads to a grouping effect that students within a cluster are more similar to one another for many characteristics than the same number of students selected in an SRS would be. The ECLS-K sample design makes the data less variable than what would be found in an SRS of the same size. Therefore, software like SPSS which assumes SRS tends to underestimate the standard errors for estimates from complex samples. Inaccurate standard errors lead to type I or type II errors when identifying significant findings. Special adjustment methods must be applied in order to get precise standard errors from a complex survey design.

The precise estimates of standard error can be obtained from three options: using paired jackknife replication method (JK2), using Taylor Series method or using approximation method. The JK2 method calculates appropriate standard errors based on differences between estimates from the full sample and a series of created subsamples.
(replicates). The JK2 method is the most appropriate technique to be used for variance estimation. However, it requires the use of specialized software (e.g., WesVar, AM, and SUDAAN), which is often not available. Taylor Series method uses PSU and Strata identifiers to calculate appropriate standard errors, and they can be used with both the specialized software (e.g., SUDAAN, Stata, and AM) and the popular general-purpose statistical packages (e.g., SAS and Mplus). In the current study, Taylor Series method was adopted to calculate variance estimate in the procedure of EFA and SEM (i.e., cross-lagged panel analyses). Standard errors can also be approximately adjusted based on design effects (DEFF), and this method is used when the software does not allow replication or Taylor Series methods. Specifically, standard errors will be adjusted by multiplying the standard error produced by SRS statistical software (when using normalized weights) by the square root of the DEFF.

**Missing Data**

In order to conduct valid analyses, all variables selected were screened for the missing data, and the pattern of missing data was examined. Cases and variables with large missing data (i.e., more than 50% missing data) were deleted prior to the analyses. Considering the complex sample design of ECLS-K and the categorical nature of the variables containing missing data, the parameters and fit indices from EFA and the SEM were estimated using robust weighted least squares (WLSMV). WLSMV provides better overall Type I error control (Lei, 2009), and it is recommended by researchers (Asparouhov & Muthén, 2006; Brown, 2006; L. K. Muthén & Muthén, 2004) to handle categorical variables with missing data. WLSMV uses a diagonal weight matrix with robust standard errors and mean- and variance- adjusted $\chi^2$ test statistics in the estimation,
which allows the residuals to be closer to zero than other estimation techniques. Therefore the estimates are more consistent (Muthén, 1993; Yu, 2002).

Unlike a traditional approach (i.e., classical test theory) that requires a complete data set to calculate the true score-based statistics, the Rasch model requires only sufficient density of data to permit calculations. The Rasch model does not require a perfectly complete matrix of values as the starting point for calculation, which makes it quite robust in the face of missing data (Bond & Fox, 2007; Wright & Mok, 2004). Therefore, all missing data were treated as missing in the process of parent involvement estimation since the Rasch model can overcome the problems of missing data.

**Polychoric Correlation**

This study uses exploratory factor analysis (EFA) to uncover the latent structure of a set of parent involvement items. Given that EFA is based on correlations between measured variables, a correlation or covariance matrix of the variables has to be computed. Some software (e.g., SPSS) only produces Pearson correlation matrix for factor analysis even when the data are nominal or ordinal. This default procedure incorrectly treats nominal and ordinal data as interval or ratio, which always produces misleading results. Several studies have explained the scale problem and suggested that polychoric correlations should be used when dealing with ordinal variables (Muthén & Kaplan, 1985; Flora & Curran, 2004).

Polychoric correlation coefficients estimates the correlation between two unobserved bivariate normal latent variables assumed to underlie the observed ordinal variables. The polychoric correlation coefficient is a generalization of the tetrachoric correlation coefficient, a statistic used to estimate correlation based on two dichotomous
variables. Under assumptions, the polychoric correlation provides an estimate that is entirely free of the attenuation caused when two normally distributed variables are “crudely categorized”—that is, when they are reduced to sets of ordinal categories. In this study, most of the items that measure parent involvement were either dichotomous or polychotomous (e.g., Likert scales). Taking into consideration the nature of dichotomous/ordinal variables, Mplus 6.12 was selected to calculate polychoric correlation between those variables and to estimate the parameters in the EFA analysis.

Summary

This chapter provided a detailed description of the data source, research methods, statistical approaches, conceptual model, as well as the analytical techniques that were used. The analytical procedures described provided a sound framework to investigate the causal relationships between parent involvement and student academic achievement during the transition years from elementary school to middle school. Findings from the quantitative analyses and model structure will be reported and interpreted in the following chapter.
CHAPTER 4 RESULTS

In order to explore the causal relationship between parent involvement and students’ academic achievement during the transition years from elementary school to middle school, the following main research questions guided this exploratory study: (1) what are the latent constructs of parent involvement at third, fifth, and eighth grade? (2) what is the relationship between parent involvement and science achievement from third grade to eighth grade? (3) how does each type of parent involvement change during the transition years from elementary school to middle school? (4) is there any group differences of parent involvement at third, fifth, or eighth grade?

Factor analysis and Rasch modeling approaches were applied to investigate the appropriateness of items and to measure the levels of parent involvement from third to eighth grade. The causal relationship between parent involvement and science achievement was examined through cross-lagged panel analysis, and the results were presented in the figure model. The changes of parent involvement from third to eighth grade are shown in line charts and the significance of those changes were tested by repeated ANOVA analysis. In addition, the item-person maps from a Rasch analysis are displayed to show how each parent involvement item changed during the transition years from elementary school to middle school. Last, an ANCOVA analysis was conducted to exam if there are parent involvement differences related to race/ethnic groups when SES is controlled at third, fifth, and eighth grade. Descriptive statistics and quantitative findings are addressed throughout this section.
Descriptive Statistics

Descriptive statistics of student science achievement at third, fifth, and eighth grade are shown in Table 4.1 by gender and race groups. Since the IRT scale scores were used as the measure of student’s science achievement, the negative values representing scores below the mean. In general, male students had higher average science achievement scores than did female students across all three grade levels. The achievement gap between genders is smaller at third grade. White students have the highest science achievement scores compare to other ethnic groups, followed by Asian students. It is noticeable that Asian students have the largest achievement increase (increased 1.12 logits from fifth grade) at middle school. Whereas, Black students have the lowest science achievements scores, and this disadvantage is shown across all the years during the transaction from elementary school to middle school.

Table 4.1. Descriptive Statistics of Student Science Achievement at 3rd, 5th, and 8th Grade.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>3rd grade</th>
<th>5th grade</th>
<th>8th grade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M  SD</td>
<td>M  SD</td>
<td>M  SD</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (n = 3,636)</td>
<td>-0.41 0.66</td>
<td>0.20 0.63</td>
<td>1.16 0.85</td>
</tr>
<tr>
<td>Female (n = 3,593)</td>
<td>-0.55 0.63</td>
<td>0.04 0.63</td>
<td>0.99 0.79</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White (Non-Hispanic) (n = 4,775)</td>
<td>-0.30 0.56</td>
<td>0.28 0.55</td>
<td>1.26 0.73</td>
</tr>
<tr>
<td>Black/African American (Non-Hispanic)</td>
<td>-1.01 0.61</td>
<td>-0.42 0.64</td>
<td>0.35 0.75</td>
</tr>
</tbody>
</table>
Table 4. 1. Continued.

<table>
<thead>
<tr>
<th></th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
<th>Factor 4</th>
<th>Factor 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hispanic (Race Specified and Non-Specified)</td>
<td>-0.88</td>
<td>0.64</td>
<td>-0.20</td>
<td>0.65</td>
<td>0.69</td>
</tr>
<tr>
<td>(n = 1,124)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>-0.50</td>
<td>0.68</td>
<td>0.13</td>
<td>0.68</td>
<td>1.25</td>
</tr>
<tr>
<td>(n = 345)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>-0.66</td>
<td>0.65</td>
<td>-0.11</td>
<td>0.63</td>
<td>0.82</td>
</tr>
<tr>
<td>(n = 369)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>-0.48</td>
<td>0.65</td>
<td>0.12</td>
<td>0.63</td>
<td>1.07</td>
</tr>
<tr>
<td>(n = 7229)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Other include Native Hawaiian, Other Pacific Islander, American Indian or Alaska Native, More than One Race (Non-Hispanic), and race that was missing.

Exploratory Factor Analysis

Exploratory Factor Analysis (EFA) was conducted using Mplus to answer the first research question. At the third grade, 30 items were selected to detect the latent construct of parent involvement. Three items were excluded. Five parent involvement components were extracted from the EFA. Table 4.2 displays 27 items that loaded on the five components.
Table 4. Factor Loadings for Exploratory Factor Analysis of Parent Involvement Scales at 3rd Grade.

<table>
<thead>
<tr>
<th>Component</th>
<th>Variable Name</th>
<th>Item Description</th>
<th>Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent involvement at school (Cronbach’s alpha = 0.60)</td>
<td>P5ATTENB</td>
<td>Attended an open house or back-to-school night</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>P5ATTENP</td>
<td>Attended a meeting of a PTA, PTO, or Parent-Teacher Organization</td>
<td>0.45</td>
</tr>
<tr>
<td></td>
<td>P5PARGRP</td>
<td>Gone to a regularly scheduled parent-teacher conference with {CHILD}’s teacher or meeting with {CHILD}’s teacher</td>
<td>0.36</td>
</tr>
<tr>
<td></td>
<td>P5ATTENS</td>
<td>Attended a school or class event, such as a play, sports event, or science fair</td>
<td>0.67</td>
</tr>
<tr>
<td></td>
<td>P5VOLUNT</td>
<td>Volunteered at the school or served on a committee</td>
<td>0.74</td>
</tr>
<tr>
<td></td>
<td>P5FUNDRS</td>
<td>Participated in fundraising for {CHILD}’s school</td>
<td>0.56</td>
</tr>
<tr>
<td></td>
<td>P5CLASS</td>
<td>About how many parents of children in {CHILD}’s class do you talk with regularly, either in person or on the phone?</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>P5SPTEVT</td>
<td>Attend an athletic or sporting event in which {CHILD} was not a player</td>
<td>0.37</td>
</tr>
<tr>
<td>Parent involvement in community-based activities (Cronbach’s alpha = 0.40)</td>
<td>P5CONCRT</td>
<td>Go to a play, concert, or other live show with {CHILD}</td>
<td>0.32</td>
</tr>
<tr>
<td></td>
<td>P5MUSEUM</td>
<td>Visit an art gallery, museum, or historical site with {CHILD}</td>
<td>0.49</td>
</tr>
<tr>
<td></td>
<td>P5ZOO</td>
<td>Visit a zoo, aquarium, or petting farm with {CHILD}</td>
<td>0.57</td>
</tr>
</tbody>
</table>
Table 4. 2. Continued.

<table>
<thead>
<tr>
<th>Help with homework</th>
<th>P5OFHLPR</th>
<th>Help {CHILD} with (his/her) reading homework</th>
<th>0.86</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Cronbach’s alpha = 0.81)</td>
<td>P5OFHLPM</td>
<td>Help {CHILD} with (his/her) math homework</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>P5TELLST</td>
<td>Tell stories to {CHILD}</td>
<td>0.57</td>
</tr>
<tr>
<td></td>
<td>P5SINGSO</td>
<td>Sing songs with {CHILD}</td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td>P5HELPAR</td>
<td>Help {CHILD} to do arts and crafts</td>
<td>0.51</td>
</tr>
<tr>
<td></td>
<td>P5CHORES</td>
<td>Involve {CHILD} in household chores, like cooking, cleaning, setting the table, or caring for pets?</td>
<td>0.41</td>
</tr>
<tr>
<td></td>
<td>P5GAMES</td>
<td>Play games or do puzzles with {CHILD}</td>
<td>0.54</td>
</tr>
<tr>
<td>Parent involvement in home-based activities</td>
<td>P5NATURE</td>
<td>Talk about nature or do science projects with {CHILD}</td>
<td>0.50</td>
</tr>
<tr>
<td>(Cronbach’s alpha = 0.72)</td>
<td>P5BUILD</td>
<td>Build something or play with {CHILD} construction toys with {CHILD}</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>P5SPORT</td>
<td>Play a sport or exercise together</td>
<td>0.45</td>
</tr>
<tr>
<td></td>
<td>P5RDWRNM</td>
<td>Practice reading, writing or working with numbers</td>
<td>0.52</td>
</tr>
<tr>
<td></td>
<td>P5READBO</td>
<td>Read books to {CHILD}</td>
<td>0.48</td>
</tr>
<tr>
<td>TV rules</td>
<td>P5TVRULE</td>
<td>What programs {child} can watch</td>
<td>0.54</td>
</tr>
<tr>
<td>(Cronbach’s alpha = 0.66)</td>
<td>P5TVRUL2</td>
<td>How early or late{he/she} may watch television</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td>P5FRNUMH</td>
<td>How many hours {he/she} may watch television on weekdays?</td>
<td>0.94</td>
</tr>
<tr>
<td></td>
<td>P5FRHRWK</td>
<td>How many hours {he/she} may watch television each week?</td>
<td>0.96</td>
</tr>
</tbody>
</table>

*Note.* The sampling weights, stratum, and first-stage unit were used in the exploratory factor analysis.
The final 5-factor model extracted is consistent with the findings from previous research. There is a good overall model-data fit with RMSEA = 0.014, which is less than the criteria of 0.05 (Browne & Cudeck, 1992); CFI = 0.976, TLI = 0.962, which are above the good fit criteria of 0.95 (Kline, 2005; Schumacker & Lomax, 2004); SRMR (Standardized Root Mean Square Residual) = 0.033, which is less than 0.08, indicating a good fit to the data (Hu & Bentler, 1999); \( \chi^2 \) (226) = 537.654, \( p < .001 \). The significant result of chi-square test is due to the large sample size (n = 7,229) of current study. Chi-square model fit is very sensitive to sample size. Since the sample size is above 200, it is highly unlikely to obtain a non-significant test statistic (Kellway, 2015; Kline, 2005; Schumacker & Lomax, 2004). In addition, this result is supported by the eigenvalues scree plot (See Figure 4.1).

![EFA eigenvalues screen plot for parent involvement at 3rd grade.](image)

Following the EFA, Cronbach’s alpha was calculated to test the internal consistency of the five parent involvement factors. It is important to conduct reliability tests when derivative variables are used in subsequent analyses (Santos, 1999). As shown in Table 4.2, the 27 items were divided into five parent involvement factors, and
two of them have acceptable levels of reliability (Cronbach’s alpha > 0.70) according to the widely used rule of thumb suggested by Nunnally (1978). The scale of parent involvement at school and TV rules have lower reliability (0.60 and 0.66), but they are still acceptable in the social science and humanities according to DeVellis (2003). Parent involvement in community-based activities has a very low reliability (Cronbach’s alpha = 0.40), however, this factor was retained for further analysis because it captured an important dimension of parent involvement.

At the fifth grade, 18 items were selected to detect the latent construct of parent involvement. Three items were excluded. Four parent involvement components were extracted from the EFA. Table 4.3 displays the 15 items that loaded on the four components.

Table 4.3. Factor Loadings for Exploratory Factor Analysis of Parent Involvement Scales at 5th Grade.

<table>
<thead>
<tr>
<th>Component</th>
<th>Variable Name</th>
<th>Item Description</th>
<th>Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent involvement at school</td>
<td>P6ATTENB</td>
<td>Attended an open house or back-to-school night</td>
<td>0.69</td>
</tr>
<tr>
<td></td>
<td>P6ATTENP</td>
<td>Attended a meeting of a PTA, PTO, or Parent-Teacher Organization</td>
<td>0.45</td>
</tr>
<tr>
<td></td>
<td>P6PARGRP</td>
<td>Gone to a regularly scheduled parent-teacher conference with {CHILD}'s teacher or meeting with {CHILD}'s teacher</td>
<td>0.47</td>
</tr>
<tr>
<td></td>
<td>P6ATTENS</td>
<td>Attended a school or class event, such as a play, sports event, or science fair</td>
<td>0.64</td>
</tr>
<tr>
<td></td>
<td>P6VOLUNT</td>
<td>Volunteered at the school or served on a committee</td>
<td>0.80</td>
</tr>
</tbody>
</table>
Table 4. 3. Continued.

<table>
<thead>
<tr>
<th>(Cronbach's alpha = 0.58 )</th>
<th>P6FUNDRS</th>
<th>Participated in fundraising for {CHILD}'s school</th>
<th>0.52</th>
</tr>
</thead>
<tbody>
<tr>
<td>P6PCLASS</td>
<td></td>
<td>About how many parents of children in {CHILD}'s class do you talk with regularly, either in person or on the phone?</td>
<td>0.54</td>
</tr>
<tr>
<td>Parent-child discussion (Cronbach’s alpha = 0.51)</td>
<td>P6OFTTLK</td>
<td>Talk with {CHILD} about {His/her} day at school</td>
<td>0.52</td>
</tr>
<tr>
<td>P6TLKFRD</td>
<td></td>
<td>Talk with {CHILD} about what {he/she} does with {his/her} friends</td>
<td>0.98</td>
</tr>
<tr>
<td>TV rules (Cronbach’s alpha = 0.64)</td>
<td>P6TVRULE</td>
<td>What programs {child} can watch</td>
<td>0.56</td>
</tr>
<tr>
<td>P6TVRUL2</td>
<td></td>
<td>How early or late {he/she} may watch television</td>
<td>0.65</td>
</tr>
<tr>
<td>P6FRNUMH</td>
<td></td>
<td>How many hours {he/she} may watch television on weekdays?</td>
<td>0.95</td>
</tr>
<tr>
<td>P6FRHRWK</td>
<td></td>
<td>How many hours {he/she} may watch television each week?</td>
<td>0.95</td>
</tr>
<tr>
<td>Help with homework (Cronbach’s alpha = 0.76)</td>
<td>P6OFHLPR</td>
<td>Help {CHILD} with (his/her) reading homework</td>
<td>0.87</td>
</tr>
<tr>
<td>P6OFHLPM</td>
<td></td>
<td>Help {CHILD} with (his/her) math homework</td>
<td>0.79</td>
</tr>
</tbody>
</table>

Note. The sampling weights, stratum, and first-stage unit were used in the exploratory factor analysis.

All factors extracted at the fifth grade are supported by the findings from previous research. The 4-factor model has a good fit with RMSEA = 0.013, CFI = 0.995, TLI = 0.990, and SRMR = 0.033. $\chi^2 (51) = 117.222$, $p < .001$, the significant result of p-value is due to the large sample size of this study. The 4 factor model is also supported by the eigenvalues scree plot (See Figure 4.2).
Cronbach’s alpha was calculated to test the internal consistency of each extracted parent involvement factor. As shown in Table 4.3, TV rules and help with homework have acceptable levels of reliability (0.64 and 0.76). Parent involvement at school and parent-child discussion have a bit low reliability (0.58 and 0.51), however, these factors were retained because they captured important dimensions of parent involvement.

At the eighth grade, 29 items were selected to detect the latent construct of parent involvement. EFA analyses suggested a 5-factor model with 26 items. Table 4.4 displays the items that loaded on the five components. All five components are supported by the literature of parent involvement. The model has a good overall model-data fit with $\text{RMSEA} = 0.013$, $\text{CFI} = 0.986$, $\text{TLI} = 0.978$, $\text{SRMR} = 0.036$. $\chi^2 (205) = 438.1$, $p < .001$, where the large sample size might cause the significance of chi-square test. The eigenvalues scree plot in Figure 4.3 supports the 5-factor model.
### Table 4. Factor Loadings for Exploratory Factor Analysis of Parent Involvement Scales at 8th Grade.

<table>
<thead>
<tr>
<th>Component</th>
<th>Variable Name</th>
<th>Item Description</th>
<th>Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P7ATTENB</td>
<td>Attended an open house or back-to-school night</td>
<td>0.69</td>
</tr>
<tr>
<td></td>
<td>P7ATTENP</td>
<td>Attended a meeting of a PTA, PTO, or Parent-Teacher Organization</td>
<td>0.59</td>
</tr>
<tr>
<td>Parent</td>
<td>P7PARGRP</td>
<td>Gone to a regularly scheduled parent-teacher conference with {CHILD}'s teacher or meeting with {CHILD}'s teacher</td>
<td>0.54</td>
</tr>
<tr>
<td>involvement</td>
<td></td>
<td>(Cronbach's alpha = 0.70)</td>
<td></td>
</tr>
<tr>
<td>at school</td>
<td>P7ATTENS</td>
<td>Attended a school or class event, such as a play, sports event, or science fair</td>
<td>0.71</td>
</tr>
<tr>
<td></td>
<td>P7VOLUNT</td>
<td>Volunteered at the school or served on a committee</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>PFUNDRS</td>
<td>Participated in fundraising for {CHILD}'s school</td>
<td>0.70</td>
</tr>
<tr>
<td></td>
<td>P7PCLASS</td>
<td>About how many parents of children in {CHILD}'s class do you talk with regularly, either in person or on the phone?</td>
<td>0.43</td>
</tr>
<tr>
<td></td>
<td>P7OFTTLK</td>
<td>Talk with {CHILD} about {His/her} day at school</td>
<td>0.74</td>
</tr>
<tr>
<td>Parent-child</td>
<td>P7TLKFRD</td>
<td>Talk with {CHILD} about what {he/she} does with {his/her} friends</td>
<td>0.63</td>
</tr>
<tr>
<td>discussion</td>
<td></td>
<td>(Cronbach’s alpha = 0.72)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P7TLKGRD</td>
<td>Talk with {CHILD} about {his/her} school work or grades?</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td>P7TLKSch</td>
<td>Talked with {CHILD} about things {he/she} is doing at school?</td>
<td>0.86</td>
</tr>
<tr>
<td></td>
<td>P7TLKFUT</td>
<td>Talked with {CHILD} about (his/her) future</td>
<td>0.46</td>
</tr>
</tbody>
</table>
Table 4. 4. Continued.

<table>
<thead>
<tr>
<th>Code</th>
<th>Item</th>
<th>Cronbach’s alpha</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>P7TVRULE</td>
<td>What programs {child} can watch</td>
<td>0.73</td>
<td>0.59</td>
</tr>
<tr>
<td>P7TVRUL2</td>
<td>How early or late{he/she} may watch television</td>
<td></td>
<td>0.70</td>
</tr>
<tr>
<td>TV rules</td>
<td>P7FRNUMH</td>
<td>How many hours {he/she} may watch television on weekdays?</td>
<td></td>
</tr>
<tr>
<td>(Cronbach’s alpha = 0.73)</td>
<td>P7FRHRWK</td>
<td>How many hours {he/she} may watch television each week?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P7VIDHRS</td>
<td>How many hours {he/she} may spend on the computer or playing video games each week?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P7GPARUL</td>
<td>Family rules for {CHILD} about maintaining a certain grade point average</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P7CHKHWK</td>
<td>Check that {CHILD} has completed all homework</td>
<td></td>
</tr>
<tr>
<td>Parent monitoring activities</td>
<td>P7RPTCRD</td>
<td>Discuss {CHILD}'s report card with {him/her}</td>
<td></td>
</tr>
<tr>
<td>(Cronbach’s alpha = 0.39)</td>
<td>P7CHDLOC</td>
<td>Know where {CHILD} is when {he/she} is not at home or in school</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P7CURFEW</td>
<td>Make and enforce curfews for {CHILD}</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P7CHORES</td>
<td>Require {CHILD} to do work or chores</td>
<td></td>
</tr>
<tr>
<td>Help with homework</td>
<td>P7OFHLPR</td>
<td>Help {CHILD} with (his/her) reading homework</td>
<td></td>
</tr>
<tr>
<td>(Cronbach’s alpha = 0.82)</td>
<td>P7OFHLPM</td>
<td>Help {CHILD} with (his/her) math homework</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P7OFTSCI</td>
<td>Help {CHILD} with (his/her) science homework</td>
<td></td>
</tr>
</tbody>
</table>

*Note. The sampling weights, stratum, and first-stage unit were used in the exploratory factor analysis.*
All subdomains of parent involvement were examined for internal consistency. As shown in Table 4.4, acceptable reliabilities were found in the scales of parent involvement at school (0.70), parent-child discussion (0.72), TV rules (0.73), and help with homework (0.82). The measures of parent monitoring activities had lower reliability (0.39), however, this factor was retained in this study since it captured an important dimension of parent involvement.

Parent expectation items were dropped from the EFA analyses at third, fifth, and eighth grade due to low factor loadings. However, parent expectation had been repeatedly studied in previous research as a form of parent involvement (Clark, 2002; Reed, 2012). Considering the unique characteristics of parent expectation in predicting academic achievement, these items were analyzed in the later cross-lagged panel analysis to test if there is any reciprocal relationship between parent expectation and academic achievement from third grade to eighth grade.

Figure 4.3. EFA eigenvalues screen plot for parent involvement at 8th grade.
Examine the Psychometric Properties of Parent Involvement Scales

The current study focuses on the longitudinal impact of parent involvement on achievement. Only parent involvement subscales from all three waves included in what follows. Parent involvement subscales containing more than five items were examined for their psychometric properties at third, fifth, and eighth grade using the Rasch model. Calibrating a small number of items causes bigger standard errors and less robust estimates (Kruyen, 2012; Linacre, 1994).

At third grade, all eight school activity related items suggested from previous EFA were used to measure parent involvement at school using Rasch-Grouped Rating Scale Model. Unlike traditional statistical approaches of data analysis that involve producing a model to describe data, Rasch models is static and is imposed upon the data (Bond & Fox, 2007).

Investigating fit statistics is an essential quality control procedure. Evidence of data adequately fitting the model is a key indicator of validity (Sun, Bradley, & Smith, 2014). Rasch analysis provides two types of item fit statistics: infit statistic and outfit statistic. Infit statistic is influenced by an unexpected pattern of responses near a person’s ability estimate (e.g., a person incorrectly responds to an item near his/her ability estimate). Outfit statistic, on the other hand, is influenced by unexpected responses to items (e.g., a person of low ability gets a very difficult item correct). The results of model mean square fit statistics (MNSQ) showed that the average person infit is .97, and average person outfit is 1.03. The average item infit is 1.00, and average item outfit is 1.08. In general, MNSQ near 1.0 indicates little distortion of the measurement system (Linacre, 2002). These results show that both the infit and outfit MNSQ meet this requirement,
indicating very good data to model fit. Item misfit statistics are listed in Table 4.5. Most of the items shown a good fit to the model with infit/outfit MNSQ within the range of 0.6-1.4 (Linacre, 1994). However, P5PARGRP is suggested as a misfitting item with outfit MNSQ of 1.79.

Winsteps reports reliability and separation statistics for both persons and items. Person reliability is analogous to Cronbach’s alpha reliability in Classical Test Theory while item reliability has no traditional equivalent. Low values for item reliability indicate a narrow range of item measures or a small sample. Person separation is used to classify people and item separation is used to verify the item hierarchy. In the current model, the reliability based on non-extreme persons is .57 and item reliability is 1.00. Person separation is 1.15 and item separation was 38.01. The low person separation implies that the instrument may not be sensitive enough to distinguish between high and low performers, more items may be needed. In addition, the dimensionality test from the Principal Component Analysis (PCA) indicated that the model explained about 47% of the variance and the eigenvalue for the first contrast was less than 2, suggesting a unidimensional measurement. These estimates indicate highly reproducible scores and provide evidence of the generalizability aspect of the results.
To check the quality of rating scales, the function of each Likert rating scale/dichotomous scale was examined separately. Response categories should function as “step calibrations” that increase in ascending order. In other words, the threshold calibrations and category measures should increase in value, indicating respondents appropriately distinguished the ordinal pattern of response options (Linacre, 2002).

Results show that the average observed category measures are increased monotonically as the rating scale increases (See Table 4.6) for each rating scale. In addition, the peak for each Likert-scale category in the Rasch category probability/dichotomous curves indicates that the rating scale is functioning as expected (See Figure 4.4).

Table 4.5. Misfit Statistics of Parent School Involvement Items at 3rd Grade.

<table>
<thead>
<tr>
<th>Item</th>
<th>Measure</th>
<th>Infit</th>
<th>Outfit</th>
</tr>
</thead>
<tbody>
<tr>
<td>P5ATTENB</td>
<td>-1.44</td>
<td>0.94</td>
<td>0.90</td>
</tr>
<tr>
<td>P5ATTENP</td>
<td>1.37</td>
<td>1.11</td>
<td>1.16</td>
</tr>
<tr>
<td>P5PARGRP</td>
<td>-2.11</td>
<td>1.14</td>
<td>1.79</td>
</tr>
<tr>
<td>P5ATTENS</td>
<td>-0.98</td>
<td>0.93</td>
<td>0.92</td>
</tr>
<tr>
<td>P5VOLUNT</td>
<td>0.83</td>
<td>0.86</td>
<td>0.79</td>
</tr>
<tr>
<td>P5FUNDRS</td>
<td>-0.14</td>
<td>0.99</td>
<td>0.95</td>
</tr>
<tr>
<td>P5PCLASS</td>
<td>1.39</td>
<td>0.91</td>
<td>0.90</td>
</tr>
<tr>
<td>P5SPTEVT</td>
<td>1.08</td>
<td>1.12</td>
<td>1.19</td>
</tr>
</tbody>
</table>
Table 4.6. Average Measures of Rating Scales of Parent Involvement at School at 3rd, 5th, and 8th Grade.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Item</th>
<th>Scale</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>3rd Grade</td>
<td>P5ATTENB,</td>
<td>No</td>
<td>-0.26</td>
</tr>
<tr>
<td></td>
<td>P5ATTENP,</td>
<td>Yes</td>
<td>1.93</td>
</tr>
<tr>
<td></td>
<td>P5PARGRP,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P5ATTENS,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P5VOLUNT,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P5FUNDRS,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P5SPTEVT</td>
<td>Zero</td>
<td>-0.34</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1st quartile</td>
<td>0.69</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2nd quartile</td>
<td>1.76</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3rd quartile</td>
<td>2.42</td>
</tr>
<tr>
<td>5th Grade</td>
<td>P6ATTENB,</td>
<td>No</td>
<td>-0.30</td>
</tr>
<tr>
<td></td>
<td>P6ATTENP,</td>
<td>Yes</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td>P6PARGRP,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P6ATTENS,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P6VOLUNT,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P6FUNDRS</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Zero</td>
<td>-0.37</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1st quartile</td>
<td>0.64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2nd quartile</td>
<td>1.85</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3rd quartile</td>
<td>2.52</td>
</tr>
</tbody>
</table>
Table 4.6. Continued.

<table>
<thead>
<tr>
<th>8th Grade</th>
<th>P7FUNDERS</th>
<th>Zero</th>
<th>-1.01</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P7PCLASS</td>
<td>1st quartile</td>
<td>-0.11</td>
</tr>
<tr>
<td>2nd quartile</td>
<td>1.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3rd quartile</td>
<td>2.06</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 4.4. Category probability curves for category structures at 3rd grade.

Note. Probability curve (A) is for item P5PCLASS. Probability curve (B) is for items of P5ATTENB, P5ATTENP, P5PARGRP, P5ATTENS, P5VOLUNT, P5FUNDRS, and P5SPTEVT.
Racial differences in parent school involvement was found from the DIF analysis. As shown in Figure 4.5, it is noticeable that P5ATTENP is hard to endorse by White parents, but is easier to endorse by Black parents. P5ATTENS and P5SPTEVT are items that are hard to endorse by Asian parents, but are easier for White parents. P5FUNDRS is an easy item to Black parents but it is a difficult item for Hispanic parents. Both White and Black parents have low endorsement on P5PARGRP. In addition, three items were found to have significantly different function from the DIF test by gender ($p < .05$). Particularly, P5PARGRP and P5SPTEVT are more difficult to endorse by parents of female students. P5PCLASS is more difficult to endorse for parents of male students (See Figure 4.6).

Figure 4.5. DIF plot by race at 3rd grade.
At fifth grade, seven school involvement items that extracted from the EFA were examined and measured using the Rasch model. The mean MNSQ statistics suggest a good overall model-data fit (person infit = 0.96, person outfit = 1.04, item infit = 1.00, item outfit = 1.08). The seven item scale has good item reliability of 1.00 and separation of 38.45, however, the person reliability is moderate with a value of 0.55, and the separation is 1.10. The Principal Component Analysis (PCA) indicates that the seven item scale explained about 50% of the variance and the eigenvalue for the first contrast was less than 2, suggesting a unidimensional measurement.

Table 4.7 lists the misfit statistics of all seven items. Most of the school parent involvement items show a good fit to the model except P6PARGRP, which is a misfit item with outfit MNSQ of 1.64. The response categories of the seven items were
examined and the results indicate both the Likert rating scale and the dichotomous scale functioned appropriately. The measure of each response category is shown in Table 4.6, and the Rasch category probability curves and dichotomous curves are shown in Figure 4.7.

Table 4. 7. Misfit Statistics of Parent School Involvement Items at 5th Grade.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Infit</th>
<th>Outfit</th>
</tr>
</thead>
<tbody>
<tr>
<td>P6ATTENB</td>
<td>-1.26</td>
<td>0.95</td>
</tr>
<tr>
<td>P6ATTENP</td>
<td>1.63</td>
<td>1.16</td>
</tr>
<tr>
<td>P6PARGRP</td>
<td>-1.78</td>
<td>1.11</td>
</tr>
<tr>
<td>P6ATTENS</td>
<td>-0.83</td>
<td>0.95</td>
</tr>
<tr>
<td>P6VOLUNT</td>
<td>1.11</td>
<td>0.85</td>
</tr>
<tr>
<td>P6FUNDERS</td>
<td>-0.31</td>
<td>1.05</td>
</tr>
<tr>
<td>P6PCLASS</td>
<td>1.45</td>
<td>0.92</td>
</tr>
</tbody>
</table>

Through the DIF test, five of the seven items were found to function quite differently between the race groups. Particularly, P6PARGRP, P6VOLUNT, and P6PCLASS are the most difficult items for Black parents to endorse, but they easily endorse items P6ATTENP and P6FUNDERS. For White parents, the most difficult items are P6ATTENP and P6PARGRP. The most difficult item for Asian parents to endorse is P6ATTENS. The most difficult item for Hispanic parents is P6FUNDERS. Item P6ATTENB shows no significant DIF between the race groups. The DIF test also found items that functioned differently between the gender groups. For example, P6PARGRP is more difficult to endorse by parents of female students at fifth grade. The DIF plots by race and gender groups are shown in Figure 4.8 and Figure 4.9.
Figure 4.7. Category probability curves for category structures at 5th grade.

Note. Probability curve (A) is for item P6PCLASS. Probability curve (B) is for items P6ATTENB, P6ATTENP, P6PARGRP, P6ATTENS, P6VOLUNT, and P6FUNDRS.
Figure 4.8. DIF plot by race at 5th grade.

Figure 4.9. DIF plot by gender at 5th grade.
Seven school involvement items were examined at the eighth grade. The data fits the model with average person infit of 0.92, person average outfit of 0.94, item average infit of 0.99, and item average outfit of 0.98 (misfit statistics is MNSQ). The seven item scale has good item reliability of 1.00 and separation of 24.68. The person reliability is low with a value of 0.41. The separation is 0.83. The low values of person reliability indicate a narrow range of person measure, or a small number of items. The Principal Component Analysis (PCA) indicates that the seven item scale explained about 42.5% of the variance and the eigenvalue for the first contrast was less than 2, suggesting a unidimensional measurement. All of the school parent involvement items at eighth grade fit the model. The misfit statistics of parent school involvement items are listed in Table 4.8.

Table 4. 8. Misfit Statistics of Parent School Involvement Items at 8th Grade.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Infit</th>
<th>Outfit</th>
</tr>
</thead>
<tbody>
<tr>
<td>P7ATTENB</td>
<td>-1.17</td>
<td>1.01</td>
</tr>
<tr>
<td>P7ATTENP</td>
<td>1.78</td>
<td>1.08</td>
</tr>
<tr>
<td>P7PARGRP</td>
<td>-0.40</td>
<td>1.14</td>
</tr>
<tr>
<td>P7ATTENS</td>
<td>-0.72</td>
<td>0.93</td>
</tr>
<tr>
<td>P7VOLUNT</td>
<td>0.41</td>
<td>0.80</td>
</tr>
<tr>
<td>P7FUNDRS</td>
<td>-0.64</td>
<td>0.96</td>
</tr>
<tr>
<td>P7PCLASS</td>
<td>0.74</td>
<td>1.02</td>
</tr>
</tbody>
</table>
The response categories for each item were also examined. The results indicate both the Likert rating scale of P7PCLASS and the dichotomous scale functioned appropriately. The measure of each response category is shown in Table 4.6 and the Rasch category probability curves and dichotomous curves are shown in Figure 4.10.

The DIF plot by race is shown in Figure 4.11. P7ATTENP and P7PARGRP, have the largest DIF across race groups. Compare to other race groups, White parents have difficulty endorsing P7ATTENB, P7ATTENP, and P7PARGRP, but they easily endorse P7FUNDRS and P7PCLASS. Black parents had difficulty endorsing P7VOLUNT and P7PCLASS, but they endorsed easily on P7ATTENP, P7PARGRP and P7FUNDRS. Hispanic parents could endorse P7ATTENB and P7PARGRP most easily, but they had difficulty endorsing P7ATTENS and P7FUNDRS. The parents of “Other” race (e.g., Native Hawaiian, Other Pacific Islander, American Indian or Alaska Native, and More than One Race) endorse P7ATTENS and P7VOLUNT most easily compare to other groups. All parent school involvement items at eighth grade functioned equivalently for female and male students. The DIF plot by gender groups is shown in Figure 4.12.
Figure 4.10. Category probability curves for category structures at 8th grade.

Note. Probability curve (A) is for item P7PCLASS. Probability curve (B) is for items of P7ATTENB, P7ATTENP, P7PARGRP, P7ATTENS, P7VOLUNT, and P7FUNDRS.
Figure 4.11. DIF plot by race at 8th grade.

Figure 4.12. DIF plot by gender at 8th grade.
The item-person maps at third, fifth, and eighth grades are shown in Figure 4.13 to 4.15. Item-person map displays distribution for both item difficulty and person ability estimates on a single line of logit scale to facilitate the graphical representation of the relationships. The person measures are shown on the left side and the item difficulty locations are shown on the right side of the scale ruler. Person ability and item difficulty increase as one moves towards the top of the figure. Overall, these maps show that the majority of person measure distribution fall inside of the range of the item difficulty distribution. Across all three waves at third, fifth and eighth grades, persons’ ability scoring around 1.5 logits and below are found to be well measured by the school involvement items. Most item difficulty estimates are clustered within +/- 1 logits. The person measure distribution is higher overall than the item difficulty distribution, which indicates that persons with higher ability are not accurately measured by the items.

Most of the parent school involvement items were stable with minor changes across each wave from elementary school to middle school. There are some items, however, have significant changes of difficulty. For example, item “Gone to a regularly scheduled parent-teacher conference with child's teacher or meeting with child's teacher” was the easiest item to endorse by parents at third and fifth grade. However, it became a middle difficult item to endorse at eighth grade (The difficulty raised about 1.5 logits from fifth grade to eighth grade). On the contrary, item “how many parents of children in child’s class do you talk with regularly, either in person or on the phone” was the most difficult item to endorse at third grade and it was still a difficult item to endorse at fifth grade. It became easier at eighth grade where about half of the parents could endorse this item (The difficulty dropped about 0.71 logits from fifth grade to eighth grade).
Figure 4.13. Item-person maps at 3rd grade.
Figure 4.14. Item-person maps at 5th grade.
Figure 4.15. Item-person maps at 8th grade.
The Causal Relationship between Parent Involvement and Students’ Science Achievement

Relationship between Parent School Involvement and Student’s Science Achievement

The descriptive statistics of parent school involvement and students’ science achievement scores from third grade to eighth grade are listed in Table 4.9. Even though the science achievement scores increase as students go into higher grade levels, the level of parent involvement at schools decrease from 5th grade to eighth grade. The results from the cross-lagged panel analysis suggest a good model data fit, with $\chi^2 (3) = 17.132$ ($p < .001$), RMSEA = 0.026, CFI = 0.998, TLI = 0.993, SRMR = 0.009, AIC = 109073.112, BIC = 109238.373.

Table 4.9. Descriptive Statistics of Students’ Science Achievement and Parent Involvement Sub-scales.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Science Achievement $M$</th>
<th>Science Achievement $SD$</th>
<th>Parent School Involvement $M$</th>
<th>Parent School Involvement $SD$</th>
<th>Help with Homework $M$</th>
<th>Help with Homework $SD$</th>
<th>Family TV Rules $M$</th>
<th>Family TV Rules $SD$</th>
<th>Parent Expectation $M$</th>
<th>Parent Expectation $SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td>3rd Grade</td>
<td>-.48</td>
<td>.65</td>
<td>1.24</td>
<td>1.58</td>
<td>-.62</td>
<td>7.37</td>
<td>-.05</td>
<td>1.23</td>
<td>4.10</td>
<td>1.01</td>
</tr>
<tr>
<td>5th Grade</td>
<td>.12</td>
<td>.63</td>
<td>1.32</td>
<td>1.71</td>
<td>.50</td>
<td>3.06</td>
<td>-.03</td>
<td>1.23</td>
<td>4.08</td>
<td>1.01</td>
</tr>
<tr>
<td>8th Grade</td>
<td>1.07</td>
<td>.82</td>
<td>0.89</td>
<td>1.90</td>
<td>.14</td>
<td>2.19</td>
<td>-.03</td>
<td>1.36</td>
<td>4.12</td>
<td>1.03</td>
</tr>
</tbody>
</table>

Note. The estimator used to calculate factor scores of help with homework and family TV rules was Maximum Likelihood with robust standard errors (MLR), which was suggested by Muthén (2013, 2015).

The standardized factor loadings are shown in Figure 4.16. Standardized model solutions suggest that there is a reciprocal relationship between parent school involvement and science achievement at elementary school: parent school involvement at ele...
third grade positively influence students’ science achievement at fifth grade (standardized factor loading is 0.04, \( p < 0.001 \)). Students’ science scores at third grade positively influence parent involvement at fifth grade (standardized factor loading is 0.13, \( p < 0.001 \)). However, this reciprocal relationship disappears during the transition years from elementary school to middle school: parent school involvement at fifth grade positively influences science achievement at eighth grade (standardized factor loading is 0.03, \( p = 0.002 \)). But science scores at fifth grade have no significant influence on parent school involvement at eighth grade. (standardized factor loading is 0.002, \( p = 0.91 \)).

Figure 4.16. Cross–lagged panel analysis for parent involvement at school. 

Note. All listed effects are standardized. Error terms were omitted for simplicity. 

** \( p < .01 \).

**Relationship between Help with Homework and Student’s Science Achievement**

Figure 4.17 presents the relationship between help with homework and science achievement. The cross-lagged model fitted the data well with RMSEA = 0.013, CFI = 0.998, TLI = 0.997, \( \chi^2 \) (27) = 59.350, \( p < .001 \). The large sample size influences the chi-square test. The estimated levels of help with homework from third grade to eighth grade are shown in Table 4.9. It is found that the level of help with homework increased from
third grade to fifth grade, but decreased from fifth grade to eighth grade. All the changes are statistically significant from the repeated ANOVA test ($F(2) = 158.675, p < .001$) and the Post Hoc pairwise comparisons ($p < .001$).

The lagged effects indicate a reciprocal, but negative relationship between help with homework and science achievement during the transition years from elementary school to middle school. This negative relationship is supported by previous researches that as students struggle academically parents are more likely to help with their child’s homework. The impact of student’s third grade academic performance on help with homework at fifth grade (-0.22, $p < .001$) is stronger than the influence of homework help at third grade on academic performance at fifth grade (-0.03, $p = .03$). It is stronger than the relationship between student’s fifth grade academic performance and homework help at eighth grade (-0.11, $p < .001$). This indicates parents are more involved in children’s education when students are in lower grades. In addition, the negative effect of homework help at fifth grade on eighth grade academic performance (-0.09, $p < .001$) is stronger than the relationship between homework help at third grade and student’s fifth grade academic performance.
Figure 4.17. Cross–lagged panel analysis for help with homework.  
*Note.* All listed effects are standardized.  Ovals represent latent factors.  Error terms were omitted for simplicity.  
* * $p < .05$.  ** $p < .01$.  

**Relationship between Family TV Rules and Student’s Science Achievement**

The relationship between family TV rules and student’s science achievement during transition years is shown in Figure 4.18.  Overall, the cross-lagged model fitted well with $RMSEA = 0.030$, $CFI = 0.972$, $TLI = 0.965$, $\chi^2 (96) = 714.088$, $p < .001$.  Again the large sample size influences the chi-square test.  The cross-lagged effects between family TV rules and science achievement were negative; however, only the effects from fifth grade science achievement to family TV rule at eighth grade is statistically significant ($-0.06$, $p = 0.013$).  This negative relationship suggests that parents are more likely to set up TV/game rules when students underperform academically. The estimated levels of family TV rules are shown in Table 4.9. The average levels of family TV rules had changed from 3th grade through eighth grade, but these changes are not statistically significant. Repeated ANOVA test ($F(2) = 1.59$, $p = 0.20$).
Figure 4.18. Cross–lagged panel analysis for family TV/game rules.  
Note. All listed effects are standardized.  Ovals represent latent factors.  Error terms were omitted for simplicity.  
* $p < .05$.  ** $p < .01$.

**Relationship between Parent Expectation/Aspiration and Student’s Science Achievement**

The relationship between parent expectation and science achievement from third grade to fifth grade is shown in Figure 4.19.  The cross-lagged model has a good model data fit, with RMSEA = 0.027, CFI = 0.998, TLI = 0.990, SRMR = 0.012, $\chi^2 (3) = 18.400$ ($p < .001$),  

AIC = 89370.752, BIC = 89536.012.  A positive reciprocal relationship between parent expectation and academic achievement was found at the elementary school level.  Parent expectation positively predict later science achievement, and the effect is stable across the years from third to eighth grade.  Student’s third grade science scores significantly predicted parent expectation at fifth grade, whereas this relationship became not significant during the transition years from fifth grade to eighth grade.  On average,
parent expectation on children’s education decreased from third grade to fifth grade in elementary schools. But their expectation significantly increased when students moved to middle schools ($F(2) = 8.146, p < .001$).

![Cross–lagged panel analysis for parent expectation/aspiration.](image)

**Note.** All listed effects are standardized. Error terms were omitted for simplicity.

**p < .01.**

**Racial/Ethnic Differences in Parent Involvement When SES Is Controlled**

All four types of parent involvement vary significantly across racial/ethnic groups during the transition years from elementary school to middle school when family SES is controlled. The ANCOVA test results are shown in Table 4.10. The adjusted means of parent involvement by racial/ethnic group are shown in 4.11. From Figure 4.20, on average, White parents had the highest level of school involvement and Asian parents had the lowest level of school involvement. Figure 4.21 shows the adjusted levels of help with homework. On average, Black students got help with homework most often and White students had the lowest level of help. This difference was consistent across all three waves. Figure 4.22 shows the levels of family TV rules when SES is controlled. Black and Hispanic parents were more likely to set TV rules at home and White parents
had the lowest level of TV control. Adjusted parent expectations are shown in Figure 4.23. When family SES is controlled, parents of Whites and Other had low expectation of their children, whereas Asian and Hispanic parents had higher expectation of their children.

Table 4. 10. ANCOVA Test of Parent Involvement Sub-scales by Racial/Ethical Groups When SES Is Controlled.

<table>
<thead>
<tr>
<th></th>
<th>School Involvement</th>
<th>Help with Homework</th>
<th>Family TV rules</th>
<th>Parent Expectation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$F(4)$</td>
<td>$F(4)$</td>
<td>$F(4)$</td>
<td>$F(4)$</td>
</tr>
<tr>
<td>3rd grade</td>
<td>50.74***</td>
<td>19.07***</td>
<td>53.34***</td>
<td>87.47***</td>
</tr>
<tr>
<td>5th grade</td>
<td>32.45***</td>
<td>24.88***</td>
<td>58.54***</td>
<td>83.79***</td>
</tr>
<tr>
<td>8th grade</td>
<td>31.16***</td>
<td>11.20***</td>
<td>58.13***</td>
<td>81.34***</td>
</tr>
</tbody>
</table>

*Note.***$p < .001$*
Table 4.11. Adjusted Means and Standard Errors of Parent Involvement Sub-scales by Race.

<table>
<thead>
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Figure 4.20. The changes of adjusted parent school involvement from 3rd to 8th grade by racial/ethnic groups.

Figure 4.21. The changes of adjusted help with homework from 3rd to 8th grade by racial/ethnic groups.
Figure 4.22. The changes of adjusted family TV rules from 3rd to 8th grade by racial/ethnic groups.

Figure 4.23. The changes of adjusted parent expectation from 3rd to 8th grade by racial/ethnic groups.
Summary

This chapter presents the results of the statistical analyses conducted for this study. Several key findings emerged from the cross-lagged panel analyses and the ANCOVA test. In addition, the psychometric properties of parent school involvement scales were examined through a series of Rasch analysis. Among the parent involvement dimensions as extracted and defined in this study, help with homework and academic achievement are reciprocally correlated. This relationship is negative and statistically significant across the three waves from elementary school to middle school. The relationship between parent involvement at school and science achievement was found positive. A reciprocal relationship between them was found from third grade to fifth grade. However, this relationship became unidirectional during transition years to middle school, as parent school involvement positively predict academic achievement at eighth grade. Similar results were found between parent expectation and academic achievement. Parent expectation positively predicted later science achievement from third grade to eighth grade. Science achievement was found positively influence parent expectation, however, this impact was not statistically significant from fifth grade to eighth grade. No reciprocal relationship was found between family TV rules and academic achievement, and the panel analysis results suggested that parent’s control of TV watching/game playing at home was not an effective predictor of student’s academic achievement. Racial/ethnic differences were found in parent involvement when family’s SES was controlled. White parents are more likely to get involvement in school activities and Black parents are more likely to help their children with their homework. The findings
help us to understand how parents get involved in their children’s learning in multiple ways. More discussion and implementations will be addressed in the next chapter.
CHAPTER 5 DISCUSSION AND CONCLUSIONS

Typically it is assumed that parent involvement positively impacts academic achievement of students; however, there is a growing literature suggesting that parent engagement can be outcomes of, rather than antecedents of academic achievement (Baumeister, Campbell, Krueger, & Vohs, 2003; McNeal, 2012). This study addressed this issue by examining the reciprocal relationship between parent involvement and science achievement using a nationally representative longitudinal dataset. Parent involvement activities at third, fifth, and eighth grade were examined to investigate the latent constructs of parent involvement, and how they react with academic achievement during the transition years from elementary school to middle school.

Discussion

This study identified seven types of parental practices that might influence children’s achievements from elementary school to middle school: parent involvement in home-based activities, parent involvement in community-based activities, parent involvement at school, family TV/game rules, parent-child discussion, parent monitoring activities, and help with children’s homework. There are other dimensions of parent involvement, like academic socialization (e.g., discussed or shared information with child about selecting courses or programs at school) or management of extracurricular activities that were not investigated. Because parents were asked about those activities in the past year, the items cannot be used to measure parent involvement at a certain grade level.

Items measuring parent involvement at school were examined for their psychometric properties at 3rd, 5th, and 8th grade. The Rasch analysis suggested that most
of the items functioned properly across all there grade levels. An exception was the item asking parents if they have gone to a regularly scheduled parent-teacher conferences with child’s teacher or meeting with child’s teacher. That item shows larger outfit at the 3rd and 5th grade, suggesting some unexpected responses (e.g., parents with very low level of school involvement endorsed this item). Low person reliability at each grade suggests that amount of parent school involvement items is small. This is also proved from the item-person map, as there were no items to differentiate abilities above 1.5 logits. More items are needed to improve the construct validity of parent school involvement scales. For example, no face-to-face parent-teacher communications should be included in future as an indicator of parent school involvement.

Gender differences were found at the elementary school level. Parents of male students are more likely to attend parent-teacher conference and sporting events at 3rd grade and 5th grade. Those differences were not found in 8th grade. There were race differences in involvement activities across all three waves. White parents were more likely to volunteer at school or serve on a committee, and attend school/class events, but they were likely to attend a meeting of PTA, PTO, or parent-teacher conference. Black parents were more likely to attend the meetings of parent-teacher organization/association, but they were least likely to volunteer at school. Asian parents attend school or class events less often, and Hispanic parents had the most difficulty to participating in fundraising for school. These results suggest that cultural and social economic differences between race groups have an impact on parent school involvement.

A positive reciprocal relationship between parent involvement at school and science achievement was found from 3rd grade to 5th grade. Contrary to previous research
that assumes the causal predominance of parent school involvement over academic achievement (Clark & Pillion, 2002; Mo & Singh, 2008), this study found that prior academic achievement is an effective predictor of later parent involvement at elementary school level. The standard path coefficients of each direction suggest that students’ previous achievement is more influential on parent school involvement, as opposed to parent school involvement as an influence on achievement. This impact was absent as the grades increased. Similar to previous findings, parent school involvement positively influenced science achievement, and this effect was stable across the years from elementary to middle school.

A negative reciprocal relationship between help with homework and science achievement was found across the transition years from elementary school to middle school. A causal predominance of achievement over homework help was found across the years from third grade to eighth grade. This negative relationship supports previous findings that parents are more likely to engage in homework interventions when children struggle with their studies. The effect of academic achievement on later help with homework is stronger at 3rd grade than at 5th grade. Possible explanations for these findings are parents are more involved in children’s education when they are in lower grades, or parents know better how to help children with their homework in elementary school than in middle school. Previous research found that parent involvement in homework negatively influences math achievement (Desimone, 1999; Hill & Tyson, 2009; Xu, 2008), and this study support this negative effect of help with homework in science achievement. Previous research suggested that parent involvement can influence academic achievement through supporting the development of independency, motivation,
and self-regulation (Martinez-Pons, 2002; Xu & Corno, 2003). Therefore, the negative impact might be due to parental interference with students’ initiative, or to differences between parents and school in presenting the material. Moreover, students may feel controlled, under excessive parental pressure, or develop a dependency on parents instead of interests of learning.

No reciprocal relationship was found between family TV/game rules and science achievement. Science achievement negatively influenced family TV rules, however, only the impact of 5th grade science scores on later family TV rules was statistically significant, suggesting parents are more likely to monitor children’s performance when they underperform academically. Contrary to previous research that restricting TV watching promotes mathematics achievement (Bembenutty, 2006; Ridley-Johnson, Cooper, & Chance, 1983), the current study found that Family TV rules hinder science achievement, even though this impact was not statistically significant. This finding suggests that understanding the effects of controlling TV watching on academic achievement is complicated. Differences in subjects, measures, and grade levels might lead to the mixed findings. Future research on family restrictions should include rules guiding children’s use of other technologies, like computers or tablets. The variety of technology use at home makes parenting more complex. Parents need to think about how to enrich children’s learning at home through the using of technology, and at the same time, reduce the distractions associated with them (Xu, 2008).

Parent expectation/aspiration had no significant factor loadings from the exploratory factor analysis, and this remained stable across all three waves in this study. This finding suggests that parental expectations have unique characteristics that differ
from general parent involvement practices. Parent expectation/aspiration may indirectly influence academic achievement through the mediation of parent involvement activities (Cooper, 2006; Eccles & Harold, 1993). A reciprocal relationship between parent expectation and science achievement was found from 3rd grade to 5th grade, but not from 5th grade to 8th grade. Third grade science scores significantly predicted later parent expectations, however, the relationship was not significant during the transition years from 5th grade to 8th grade. The influence of parent expectation on later science achievement is positive, and the effect is stable across the years from 3rd to 8th grade. The findings support that parent expectation, as a form of parent involvement, has positive effects on academic achievement.

In sum, the reciprocal relationship between parent involvement and academic achievement is more salient at elementary school level with previous achievement being more predictive of later parent involvement. This suggests that parent involvement during this period can be both process focused and outcome focused. According to Hokoda and Fincham (1995), process focused parenting can foster learning by optimizing motivation, promoting mastery of task-oriented behaviors and reassuring children of their high ability. Outcome focused parent involvement can both accelerate and interfere with academic achievement (Cooper, 2007). The effects of outcome focused parenting might be influenced by different strategies and parenting styles (Hokoda & Fincham, 1995; Mueller & Dweck, 1998). This finding also has implications on policy and practice as it highlights the role of students in shaping parent involvement. Teachers are encouraged to talk about concerns, advantages, as well as academic potential of students when communicating with parents. This strategy helps create a welcoming, stimulating, and
caring environment which will increase parents’ sense of belonging, and therefore, increase parent involvement in school activities.

The impact of parent involvement on academic achievement differs across race/ethnic groups in many studies using ECLS-K (Johnson, 2011). However, little has been done to test the association between domain-specific parent involvement and demographic backgrounds (e.g., race/ethnicity, gender). The current study examined racial differences in parent involvement controlling for family SES. The results indicate that White parents had initially high school involvement but low level of help with homework, TV watching restrictions and parent expectation. Black parents were more likely to involved in children’s homework and set up TV rules. Black and Hispanic parents had initially high education expectations, but when they realized their educational opportunities are limited (either from low SES or poor grades), they were more likely to make downward adjustments to their expectations. Asian parents had initially low school involvement and moderate level of family rules on TV/game. However, their involvement was significantly influenced by SES, as they had highest educational expectations. They also had high levels of school involvement and family TV rules at third and fifth grade when SES is not considered.

Parents with different backgrounds may display different types of involvement because they differ with respect to habits or culture (i.e., preconceptions toward certain types of behaviors, attitudes, or perceptions). Variations in habits or culture that relate to parent involvement may derive from differences in financial resources, educational knowledge, and experiences with and confidence in the educational system (Grenfell & James, 1998). Based on this scenario, parents from non-dominant groups may exhibit
less parent involvement at school. For example, parents from immigrant families or parents with low education levels may have less school involvement, because they lack knowledge of the school system, have negative educational experiences, or have less confidence about communicating with schools. Parents from different cultures may value home educational involvement more than involvement at school. The current study provides information on how parent involvement varies by racial/ethnic groups at different waves. Based on this information, teachers should be aware that cultural values influence parents’ decisions to become involved at home and/or school. With this knowledge, they can more effectively support and encourage involvement practices that appropriate in the cultural context (Lee & Manning, 2001). This is especially important in light of the No Child Left Behind Act, which requires schools to increase parental involvement in children’s education (U.S. Department of Education, 2005).

Limitations of the Study

The results of this study are subject to limitations. First, The ECLS-K is not designed to assess parent involvement in the United States. Using ECLS-K dataset to identify optimal items to measure domains of parent involvement are limited with the information provided from the questionnaires. Only three components of parent involvement, for example, can be examined for reciprocal relationships. Other important components, especially items in the domains of parent-child interaction at home and monitoring were not provided in the ECLS-K across all the waves. Even though the Rasch model was applied to overcome the weakness of time-specific items, the small number of items within each domain at different waves threaten the reliability and
validity of the parent involvement construct. Therefore, findings from this study will not provide a comprehensive understanding of parent involvement within some domains.

The second concern is the instruments used in this study. While this study provides the strengths of a longitudinal cross-panel design, it includes the weaknesses of self-report biases: self-report or response bias many inflate correlations of constructs across time and reduce unexplained variance available for other latent variables (Marsh, 1993). The measures of parent involvement in this study are based on self-report. Because one cannot confirm that reported behavior is comparable to actual behavior, the association between perceived behavior and actual behavior is in question. Nevertheless, the self-report measures are generally based on closed-ended questions, such as questions asking if parents have attended a school or class event and if parents had contacted teacher. The dichotomous responses to these items could only be coded as yes or no, which makes it difficult to fully capture the dynamic transactional nature of parents’ involvement in their children’s education. Expansion of the responses to Likert-scale may improve the reliability and validity of the measurement.

The last concern has to do with the study design. Parent involvement and science achievement during transition years were measured at fifth and eighth grade in this study. There was a three-year span between the two waves, thus only long-lasting effects were able to be detected. This relatively large gap between waves may cause conservative estimates of the reciprocal effects. Though this study represents a significant advance over cross-sectional studies in a quasi-experimental design, it is desirable for additional studies replicating this with a more current sample, and more measurement occasions.
This would increase the power to investigate causal relationships between parent involvement and science achievement during the transition years.

**Conclusion**

Prior research on parent involvement and its relationship with academic achievement have been limited by the number of measurement occasions and analytical strategies. Cross-sectional research cannot answer questions about directionality (Berrington, Smith, & Sturgis, 2006; Curran, 2000). And most of the existing longitudinal research on this topic utilized only two waves of data and does not consider possible reciprocal effects of parent involvement and academic achievement (Hong, Yoo, You, & Wu, 2010; McNeal, 2012). This study addresses the shortcoming by using a 3-wave longitudinal cross-lagged panel design. The design, therefore, provides a way to make causal inferences and test for effects in both directions simultaneously.

Despite the limitations, the current study takes a significant step toward uncovering the role that parent involvement plays in science learning outcomes during the transition years from elementary to middle school. The findings are consistent with the idea that parent involvement is a multi-dimensional construct with varied effects on academic achievement. Generally, parent involvement at school decreases as students moved to middle school, but both parents and schools need to be aware that parent involvement during transition years still has positive effects on school performance. Based on nationally representative samples, this study provides strong support in favor of parents’ continued support and involvement at middle school.

Adolescence is a critical period of both intrapersonal and interpersonal changes. Despite the common myths about adolescents pulling away from their families and not
wanting their parental involvement in school-related activities (McNeal, 2012), schools are suggested to encourage parents to remain engaged in both formal and informal ways. For example, schools should provide calendars to parents with home-school activities, projects, and co-curricular activities. Schools should conduct surveys for students and parents to provide information about school programs, policies, and practices. Schools can offer family-oriented workshops to provide parents with information on the social and emotional development of their children, content knowledge, skills and expectations in all subjects at different grade levels, and seek their input and guidance in educational decisions about their children. Schools could also use technologies like email, Facebook, or Twitter to bridge the gap between parents and school, and create a positive and ongoing two-way flow of information and care to improve academic achievement of young adolescents.

**Implications for Future Research**

Findings from this study reveal empirical evidence to support the reciprocal relationship between parent involvement and academic achievement. These findings add supplementary information to the existing literature in interpreting the mixed results regarding the role of parent involvement in children’s education. However, due to the limitation of survey instruments, only four dimensions of parent involvement were examined. Previous research suggested that parents use different forms of engagement over time, and some types of parent involvement have significant effects on academic achievement early on, but may have no or opposite effects as students enter higher grades (Hill & Taylor, 2004; Hong, Yoo, You, & Wu, 2010). Future study can replicate this study by including other components of parent involvement and more measurement
waves to further illuminate the reciprocal relationship between parent involvement and academic achievement.

As previously mentioned, family background characteristics can influence parent involvement activities and their impact on academic achievement. This idea is crucially important as school policies and programs are suggested to move beyond the traditional definition of parent involvement and to develop culturally sensitive practices for promoting and enhancing family support for students. Future research can contribute to this field by including gender and race/ethnic factors as covariates to explore if relationships exist in all sub-groups and how the exogenous variables (race/ethnicity, gender, SES) produce different relationships between parent involvement and student science outcomes.

The construct validity of parent school involvement measures in this study were threatened by having a small number of items. The construct validity and person reliability can be improved in the future research by including more items such as informal communication with school or teachers, and other parent school involvement activities. In addition, the dichotomous scales of each involvement item can be expanded to Likert scales, which will provide more accurate information in measuring parent involvement.

The current study also suffers from the limitation of self-report biases. Even though Rasch measurement was applied to improve measurement accuracy, it is impossible to capture the actual behavior of parents engagement in children’s education. Previous research indicates that there were limited number of studies using observational data to examine the effects of parent involvement. Observation methods can reduce
response bias. In order to improve the validity of measurement in parent involvement study, direct observations could be used to provide supplemental information about involvement activities.
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138


### VITA

**Letao Sun**

#### EDUCATION

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#### Peer Reviewed Journal Articles

- Liu, R., Sun, L., Bradley, K. D., & Yuan, J. (Under review). Using the 2006 PISA questionnaire to evaluate the measure of educational resources: A Rasch measurement approach. *Journal of School Effectiveness and School Improvement*


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