Relationships of Parenting Practices, Independent Learning,

Achievement, and Family Structure

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Dissertation submitted to the Faculty of Virginia Polytechnic Institute and State University

in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

in

Educational Research and Evaluation

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March 25, 2009

Blacksburg, Virginia

Keywords: self-regulated learning, independent learning, parenting style, family structure, achievement

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ABSTRACT

An independent learner is one who actively takes responsibility for his or her own acquisition of knowledge, skills, and expertise. The capacity to self-regulate one's own learning is a necessity for success in higher education. Researchers have found that characteristics of independent learners begin to emerge in young children and continue to develop throughout childhood and adolescence as students grow into self-governing adults.

The purpose of this study is to assess students' levels of independent learning attitudes and behaviors and to examine the relationships among parents' actions, family structure, independent learning, and academic achievement. Using a national sample of 10^{th} grade students from the Education Longitudinal Study of 2002, several statistical analyses were performed in order to answer these research questions:

1. How do parents' actions relate to children's independent learning characteristics?
2. How do students' independent learning behaviors and attitudes correlate with their academic achievement?
3. How are parents' actions associated with their children's academic achievement?
4. Are single-parent children less likely to have developed characteristics of independent learning by grade 10 than children living with both of their parents?

Exploratory factor analysis was conducted to arrange the available variables into appropriate subscales to be used in the statistical procedures for this study. Canonical correlations were used to measure the magnitude of relationships between three pairs of concepts: parents' actions and students' independent learning; students' independent learning and academic achievement; and parents' actions and students' academic achievement.

Structural equation modeling was employed to test the hypothesized model of relationships among parents' actions, students' independent learning behaviors, and academic achievement. Finally, multivariate analysis of variance was used to compare the independent learning scores of students living in four different family structures to determine if a significant difference in the development of independent learning between groups exists. Results suggest actions that parents can take to help their children develop as independent learners and succeed in the academic realm.

ACKNOWLEDGMENTS

"With God, nothing shall be impossible."

Without the help of God and a lot of people, I would not have been able to accomplish completing this dissertation and earning a Ph.D. which has been my lifelong dream. A few of the people who helped me along the way are listed below.

My family, especially: my mother, Annie Ford; my children, Sophronia and Melissa Vachon; my sister, Edwina Covington; my brother and sister-in-law, Richard and Doris Ford; and my aunt and godmother, Barbara Torain. Even though my father, Richard Ford Sr., did not live to see this day, he always encouraged me to be a lifelong learner and his life exemplified the characteristics of a lifelong independent learner. This work is dedicated to his memory.

Friends and relatives who helped me in so many ways, including those who looked after my home and/or my pets while I was away taking classes or attending conferences: Ed Ellis, Thomas Graves, Signora Jones, Lakeeta and Larry Mayfield, Kristen Pujari, Kevin and Evelyn Waindel, and Barb Wert; and those who provided moral and other kinds of support: all of the above plus Carlos Lester and the members of my dissertation support group, Carolyn Stuart, Audrey Robinson, and Kelly Oaks.

Everyone (all of the faculty and my fellow students) in the Educational Research and Evaluation program at Virginia Tech, especially: my advisor and chairperson, Dr. Mido Chang, who has been my mentor as well as my teacher; the members of my committee, Drs. Yasuo Miyazaki, Kusum Singh, and Edward Wolfe (of Pearson Educational Measurement); and the program coordinator, Dr. Penny Burge.

And many others, too numerous to name here. Thank you, all of you.

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CHAPTER 1

INTRODUCTION

The capacity to learn independently is very important in higher education as well as in life. The construct of independent learning is a mindset and a skill set consisting of several aspects including metacognition, motivation, volition, and self-regulation (Pintrich, 1995; Zimmerman & Schunk, 1989). It has also been shown to be related to academic self-efficacy, attributions, epistemological beliefs, goal orientation, and strategic help-seeking (Linnenbrink & Pintrich, 2002; Muis, 2007; Zimmerman, 2002). Related terms used in the literature are autonomous learning, self-directed learning, self-initiated learning, and self-regulated learning (Moore, 1973).

As school systems struggle to meet the requirements of No Child Left Behind, an unfortunate consequence is that secondary school students are becoming more concerned with passing high-stakes tests (performance goals, extrinsic motivation for learning) than with actual learning (learning or mastery goals, intrinsic motivation for learning) (Linnenbrink & Pintrich, 2002). When students who have become accustomed to this orientation enter college, they may be ill-prepared for the level of initiative expected of them (Pokorny & Pokorny, 2005). They have come to expect their teachers to give them facts that will be on a test. As they progress, they may be dismayed to realize that regurgitation of facts is not the focus of assessment of learning at this level.

In the context of this study, the operational definition of an independent learner is one who actively takes responsibility for his or her own acquisition of knowledge, skills, and expertise. This involves being confident in the ability to learn, setting goals and making viable plans for achieving them, having an internal locus of control, using metacognitive skills to monitor the thinking and learning process, and having motivation and volition to carry him or her through any difficulties or obstacles that may be encountered. An independent learner does more than what may be required by a teacher because the independent learner's aim is to know and understand rather than merely to achieve a grade.

Meichenbaum and Biemiller (1998) suggest that qualities of independent learners may be established by third grade, and this heavily influences academic success in high school and beyond. In recent years, many more students have come to expect to attend college than in previous generations. The bar has been raised in terms of minimum entry level credentials for desirable occupations. To be ultimately successful in higher education, however, students must change their expectations for learning situations from receiving active personal supervision by instructors to functioning as active, independent learners.

Unlike K-12 education systems, where teachers are held responsible for students' achievement, in higher education students are accorded the status of adults and are therefore responsible for their own learning. College-level instructors are not likely to check to make sure students are doing their homework by asking either the students or their parents whereas this is a frequent occurrence in the K-12 arena. It is considered unfair to present content material to children and expect them to pass an assessment on the material without a significant amount of person-to-person involvement between teacher and student and possibly parents. If a K-12 student fails a test, teachers are expected (especially in light of NCLB legislation) to contact the parents and make sometimes extraordinary efforts to help the child succeed. If a college-level student fails a test, the instructor is not likely to get so involved beyond making suggestions of areas where improvement is needed and further study advised. A federal law, the Family Educational Rights and Privacy Act (FERPA) does not even allow instructors of students over 18 or in a post-secondary school to discuss such matters with parents or guardians unless the student consents (U.S. Department of Education, 2007). It is left up to the student to take the initiative to determine specific corrective actions and to implement them in order to be successful in higher education. Students who can do this are independent learners.

Self-regulation, metacognition, intrinsic motivation and volition, intrinsic interest, and academic self-efficacy are components of the independent learning orientation. Prior to college age, both parents and teachers may exert some influence on students' development of independent learning. Parenting practices are expected to have an effect on the development of students' attitudes toward learning as well as other aspects of socialization, as parents model behavior and children emulate their parents' actions (Martinez-Pons, 2002). In addition to modeling, parents and teachers can provide encouragement and support for children's growing sense of autonomy.

One aspect of parenting relevant to this study is parenting style (Baumrind, 1971). Some styles are more conducive to the development of autonomy in children than others. Autonomy, the sense of governing oneself, is necessary for people to become fully functioning, self-supporting adults. Ideally, children should be granted small degrees of responsibility and authority as they grow and mature, so that by the time they are college-age, they should be very close to self-sufficiency.

Parents who use an autocratic or authoritarian style try to maintain tight control of every aspect of their children's lives, not allowing the children to make their own choices and take ultimate responsibility for those choices. In other words, they do not allow the development of autonomy. The other extreme, called the permissive or laissez-faire parenting style, describes parents whose style is so loose that children are given autonomy at earlier ages than appropriate.

This style is just as unlikely as the authoritarian style to produce children who have an understanding of the concept of personal responsibility. Children of laissez-faire parents do not have the benefit of models of responsible behavior, direct person-to-person mentoring and encouragement from their parents, or the gradual process of gaining autonomy at age-appropriate stages (Hoang, 2007).

According to Baumrind (Baumrind, 1971, 2005) and other researchers (Grolnick & Ryan, 1989; Hoang, 2007; Strage, 1998), the most effective parenting style is one in which parents have a warm, close relationship with their children, encourage children to form and express their own opinions, and explain the decisions or rules they make rather than just saying, "Because I said so." This style is called authoritative and it is placed between authoritarian and laissez-faire on a continuum. Parents whose style is authoritative keep an appropriate level of control over their children and grant autonomy when they see that a child is ready to take responsibility in a particular area.

Baumrind (1971) differentiated between authoritarian and authoritative parenting styles by the psychological autonomy/psychological control dimension. Both types were firm on control as opposed to lax control, but the authoritarian style was high on psychological control also, and authoritative was high on psychological autonomy. With authoritative parents, children are taught to think for themselves, not to just obey unquestioningly. Authoritative parenting contributes to self-reliance and independence in children.

Researchers using Baumrind's typology have found that the authoritative parenting style is associated with higher academic achievement (Grolnick & Ryan, 1989; Hoang, 2007). As will be seen in the review of the literature, some specific actions may be associated with particular styles of parenting. In turn, these actions can be correlated with measures of self-regulation and academic achievement to suggest ways in which parents may help their children develop as independent learners.

In terms of the parent factors identified in this study (see Chapter 3), parenting styles will be defined operationally as follows. An authoritarian parenting style will be characterized by high scores on parental involvement, advice-giving, and parental control, with low to moderate scores on family fun. Authoritative parents will exhibit moderate to high scores on involvement, advice-giving, and family fun, and a low to moderate score on parental control. A laissez-faire parenting style will be evidenced by low scores on involvement, advice, and control; family fun could range from low to high.

With single parenthood on the increase, there is also a concern as to whether the absence of one parent in the home environment may affect children's educational outcomes, in terms of development of independent learning, educational persistence, and academic achievement. As Zimmerman (1986) asked in the case of single-parent families, "…are children being provided with requisite social interaction opportunities with adults to acquire needed self-regulated learning skills?" (p. 312). When there is only one parent present, that parent must fulfill many roles: homemaker, income provider, nurturer, mentor, disciplinarian, etc. In a two-parent family with the workload shared by the adults, parents have more time available to spend with the children and be actively involved in the children's socialization. In addition, children in traditional two-parent families have the benefit of interaction with both genders, along with their associated roles and viewpoints. This may help a child become more well-rounded (Downey, 1994; Downey & Powell, 1993). Researchers also have found differences in achievement between children in two-parent families and children in step-families, where one of the adults is not the child's biological or adoptive parent (Ham, 2004; Zimiles & Lee, 1991).

The purpose of this study is to assess students' levels of independent learning attitudes and behaviors and to examine the relationships among parents' actions, family structure, independent learning, and academic achievement in a national sample of 10^{th} grade students. This is an age at which students are still dependent upon their parents but have achieved a degree of autonomy. Differences seen in the independent learning characteristics of students may be related to many factors, known and unknown. In this study, the focus will be on aspects of the home environment (specifically, parents' actions towards students and family structure) that may be associated with independent learning and achievement.

Research Questions

The focus of this study is to explore how certain actions and conditions of parents relate to the development of independent learning characteristics and academic achievement in their children. Specifically, the following four questions will be addressed:

(1) How do parents' actions relate to children's independent learning characteristics?

(2) How do students' independent learning behaviors and attitudes correlate with their academic achievement?

(3) How are parents' actions associated with their children's academic achievement?

(4) Are single-parent children less likely to have developed characteristics of independent learning by grade 10 than children living with both of their parents?

The first three questions will be addressed by canonical correlations based on the results of factor analysis. Structural equation models (SEM) will be used to test the models described in the next section. The fourth research question will be addressed by a multivariate analysis of variance (MANOVA). Details of these procedures will be described in Chapter 3.

Theoretical Framework

Parent Influences on Children's Development

The earliest source of help in learning situations is likely to be a child's parents. Young children are known to have a great amount of curiosity, and it is said that a three-year-old child's favorite word is the interrogative "why?" It seems plausible that parental encouragement rather than discouragement of this natural curiosity would increase subsequent motivation for learning. In addition, a warm, close but not overly controlling relationship with parents has been shown to be associated with successful adjustment in school (Bembenutty, 2005; Grolnick & Ryan, 1989; Meichenbaum & Biemiller, 1998).

One of several well-known typologies of parenting styles was developed by Baumrind (1971) and uses three classifications: authoritarian, authoritative, and permissive (laissez-faire), in order by their relative strictness. These have been described above. The preferred style is the authoritative style, which has also been referred to as democratic or moderate. It involves a relationship between parents and children of strong communication and mutual respect. Parents using this style explain the rationale for family rules rather than demanding unquestioning obedience. Authoritative parenting has been linked to positive outcomes in overall development as well as academic self-regulation and achievement (Strage, 1998). In contrast, authoritarian parenting is considered excessively strict, and laissez-faire may be tantamount to neglect. Some behaviors included in the parent variables in this study will be indicative of a tendency towards a particular parenting style.

Parents are expected to be responsible for exercising control over children's behavior in early childhood, but ideally they should progressively allow children to become more independent and self-disciplined as they grow older. Both parents and teachers can help support the development of autonomy in children as they gradually loosen the reins on children's activities and allow them more responsibility for their actions as well as for their learning (Grolnick & Ryan, 1989; Vallerand, Fortier, & Guay, 1997). The authoritative parenting style is characterized by its support for age-appropriate autonomy development (Hoang, 2007).

Parents' involvement in school has been hypothesized by several researchers to contribute to positive outcomes for students (Cherian & Malehase, 2000; Gonzalez-Pienda et al., 2002; Griffith, 1996; Hoover-Dempsey & Sandler, 1995; Seginer, 2006). It is conceivable that different types of involvement may have different effects, some positive and some negative. In this study, level of involvement and types of involvement will be examined for their association with evidence of independent learning development and academic achievement in 10^{th} grade students. Findings of other researchers on this aspect of the topic will be presented in Chapter 2.

Aspects of Independent Learning

Curiosity may be the beginning of intrinsic interest, and intrinsic interest is in turn related to motivation, which enables a student to make an intentional choice to learn something. Intrinsic interest, as opposed to extrinsic interest, has been shown to be positively correlated with achievement (Lepper, Corpus, & Iyengar, 2005). Corno (1989) explained the distinction between motivation and volition. Both are necessary components of independent or self-regulated learning and both are required for successful learning. Motivation provides a reason for making a decision and enables a student to commit to achieving a learning goal, but volition encompasses the frame of mind and actions used by the student to persist in reaching for that goal. Volition includes employing strategies for dealing with distractions, as well as maintaining the willpower to carry out each step or task along the path to the goal (Kuhl, 1987).

Kuhl (1987) refers to the concept of action control, which is the essence of volition. Action control can be passive or active. In passive action control, whatever motivation is strongest at a given time will determine what actions the individual takes. An individual with passive action control may be prone to succumbing to distractions that are more attractive in the short term (and that are reinforced by existing habits or familiar behavior patterns) than a goal that the person has set which may take sustained effort to achieve. In active action control, the individual makes an effort to adhere to the commitment even when faced with a more attractive course of action or intense external forces.

Action orientation versus state orientation is another distinction made by Kuhl (1981; 1987). A person with an action orientation has a realistic plan to follow to accomplish an achievable goal. People with a state orientation basically have an external locus of control and do not focus on what they can realistically do. Self-regulated learners are action oriented in learning situations. Action-oriented learners have a sense of self-efficacy for learning, but state-oriented learners lack self-efficacy in this area. Interestingly, Kuhl notes that state-oriented learners do not lack motivation or volition. Instead, state orientation may be maladaptive because once a commitment is made to a plan, it will be followed slavishly even in the event of situational changes or repeated failures. Monitoring of the plan's efficacy does not occur, and strategy use is not applied effectively. Action oriented learners monitor the plan's progress and are able to make adjustments to their actions in response to environmental factors. This aspect of volition involves metacognition.

Metacognition is a vital component to self-regulation of learning because it is the ability to observe and control one's own thought processes. Self-regulated or independent learners use metacognitive skills when they can accurately assess whether or not they understand some aspect of what they are trying to learn. Without the ability to recognize when critical information is lacking, motivation alone will not enable a learner to self-regulate effectively. Because independent learners are more likely to have goals of learning and understanding instead of earning rewards (such as grades, privileges, or recognition) for appearing to have learned, they are more likely than performance-oriented learners to willingly admit that they need help (Martinez-Pons, 2002). Seeking help, for independent learners, is not considered a blow to the self-esteem, but instead is purposely used to bring about mastery of knowledge and/or skills and ultimately better measurable achievement. The topic of adaptive help-seeking has been investigated by several researchers (Karabenick, 1998; Marchand & Skinner, 2007; McCombs, 1989; Newman, 1990, 2002; Newman & Schwager, 1995).

Meichenbaum and Biemiller (1998) described a theory of mastery involving three dimensions: skill, planning/application (strategy), and self-direction. They posited that children have failed to achieve and have been left behind their classmates because of two faulty assumptions. First, the view of children as passive learners whose empty minds are filled by active teachers has traditionally been prevalent in much of elementary education. Current pedagogical views acknowledge the constructive nature of learning and the importance of active participation by the learner (Baxter-Magolda, 1999; Weimer, 2002). Secondly, it has been believed that all children should be able to learn in the same way at the same rate of speed. This notion has largely been debunked in recent decades as research on learning styles has emerged (Denig, 2004; Hall & Moseley, 2005; McCarthy, 1997; Wilkerson & White, 1988).

Children's learning is more likely to resemble a constructivist model. If the goal of education is authentic learning that can be applied to new, previously unknown situations and problems, transferability of learned skills and use of strategies must occur. This is not something that can be taught in a rote manner. Because each student's learning process is different, the more active and proactive the student is, the more likely it is that genuine learning will take place.

Family Structure

Earlier studies have documented lower average achievement for single-parent children (Gouke & Rollins, 1990; Hargreaves, 1991; Jeynes, 2002), yet some children in this family structure have realized great academic success. A previous study (Murphy, 2007) examined the possible effect of a child living with a single parent of the same or the opposite gender on academic achievement. This was not shown to have a significant relationship to achievement in the National Education Longitudinal Study (NELS) database. However, the results suggest that parenting practices affect achievement, whether directly or indirectly through a construct such as independent learning. Therefore, there may be a difference for children whose parents do not have someone to help with parenting tasks. In addition to concerns about single parents, some researchers have found a difference in outcomes for children who are raised by two adults when at least one of them is not the child's parent (Boggess, 1998; Zimiles & Lee, 1991). The current study will compare independent learning and academic achievement for four family structures: both parents (biological or adoptive), single parents, stepfamilies (one parent and one step-parent), and other structures such as those in which neither parent is present.

Proposed Model

The objective of this study was to identify parent factors associated with the development of students as independent learners and to illustrate the relationship between independent or self-regulated learning and academic achievement. An independent learning composite score was created and these ratings were compared for children with different family structures. Composite scores for parent factors and student independent learning were used as indicators in a structural equation model.

The model proposed in this study involves hypotheses that parental actions and attitudes are associated with the presence of independent learning characteristics in students, and that independent learning is related to academic achievement. In addition, parental actions may have a direct relationship with academic achievement. These relationships are illustrated in Figure 1.1.

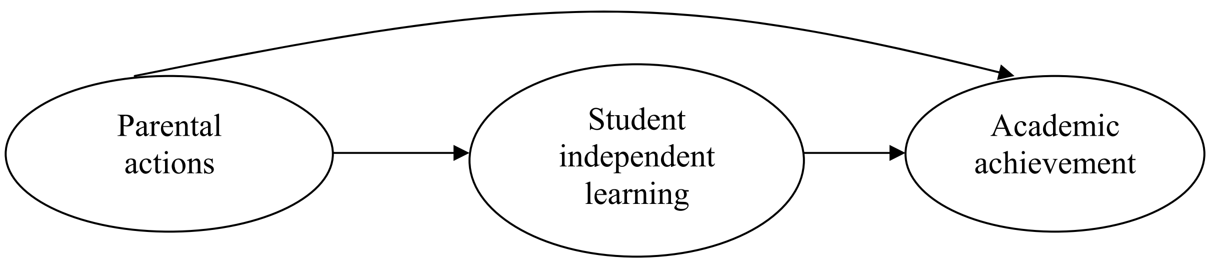

Figure 1.1: Proposed model of relationships among parent actions, independent learning, and academic achievement

Boundaries of the Study

The field of independent or self-regulated learning relates to many different constructs, including cognition, metacognition, attributions, interest, self-efficacy, goal orientation, motivation, volition, locus of control, learning styles, strategic help-seeking, and others. To adequately address the research questions in this dissertation, it will be necessary to limit reference to these related areas. The focus will be on parental actions that exemplify the relationship between parent and student, students' domain-specific academic self-efficacy, self-regulation in schoolwork, motivation, volition, and metacognition. All of these will be correlated with academic achievement as measured by two outcome variables: math item response theory (IRT) estimated number right and reading IRT estimated number right.

Organization of the Study

A review of relevant literature is presented in Chapter 2, covering both theoretical and empirical sources. Details about the data source and statistical analysis methods are given in Chapter 3. Chapter 4 will present the results of the various analyses described in Chapter 3. Finally, Chapter 5 will contain a summary and discussion of the results, limitations, and implications of the research.

CHAPTER 2

REVIEW OF THE LITERATURE

Empirical research on aspects of independent and self-regulated learning has spanned a wide range of foci and methods. Factors may be categorized as intrapersonal and interpersonal. Intrapersonal factors include self-efficacy, motivation, volition, and metacognition. In turn, those intrapersonal factors may have been influenced by or had their genesis in interpersonal exchanges with parents, other family members, teachers, and peers. These interpersonal factors may include relationships, communication, and extrinsic rewards.

In this review of the literature, I will first discuss studies pertaining to parents' practices and children's outcomes of self-regulation and achievement. This will be followed by consideration of theories and studies concerned with the components of the construct of independent learning and the relationship of independent learning to academic achievement. Finally, studies involving family structure and its relationship to independent learning and achievement will be discussed.

Parents' Practices and Children's Outcomes

Parental Actions and Independent Learning

There are a number of ways in which parents' actions contribute to children's social and educational development, including involvement in school, behavioral modeling, communication, and facilitation of appropriate behaviors and habits. The importance of and barriers to parents' involvement in their children's school were described by Eccles and Harold (1993). Hoang (2007) investigated the influence of parenting styles (using Baumrind's typology) and involvement in school on students' goal orientation and level of autonomy with a sample of secondary school students. Significant predictors of a mastery goal orientation were the authoritative and laissez-faire parenting styles, but a performance-approach goal orientation was predicted by parent involvement, laissez-faire parenting, and authoritarian parenting. The maladaptive performance-avoidance goal orientation was positively predicted by parent involvement in school and negatively predicted by mother's education level. Significant predictors of student autonomy were mother's education level and an authoritative parenting style.

Martinez-Pons (2002) stated, "Parents need to become aware that the methods they use to learn and solve problems in the presence of their children influence how their children study" (p. 130). In a Canadian study, Nader-Grosbois, Normandeau, Ricard-Cossette, and Quintal (2008) used repeated measures analysis to examine the progression from parent regulation of learning activities to student self-regulation. Parental directiveness was initially observed more in mothers than in fathers, but both genders of parents reduced their level of control as the study progressed. Parents modeled regulatory behavior and as the task continued, students were observed to exhibit more self-regulation. Another study (National Institute of Child Health and Human Development Early Child Care Research Network, 2008) found that autonomy supportive actions by parents of young children were associated with reading and math achievement and increased self-reliance in elementary school for boys, but there was no significant association for girls.

Strage (1998) surveyed 465 college students about their family backgrounds and self-regulated learning practices. She found a high correlation between an authoritative parenting style characterized by "high but reasonable maturity demands, good communication, and mutual respect" (p. 20) and the development of academic self-regulation, regardless of whether students were still living with their parents or on their own.

In a recent study, Bong (2008) found significant associations between parent/child relationships combined with classroom goal structures and aspects of independent learning, specifically, self-efficacy, adaptive help-seeking and motivational beliefs in Korean high school students. Student perceptions of conflict with parents in conjunction with performance goal orientation in the classroom were significantly and positively associated with undesirable outcomes including help-seeking avoidance and cheating. Family closeness was also found by Lee, Hamman, and Lee (2007) to be positively correlated with self-regulation and successful adjustment in college students.

Grolnick and Ryan (1989) found that there was a significant positive correlation between autonomy support from parents and the development of self-regulation in elementary school children in a sample of 50 fathers and 64 mothers. The development of adaptive help-seeking, one of the components of independent or self-regulated learning, was examined in terms of its relationship to parenting practices by Puustinen, Lyyra, Metsapelto, and Pulkkinen (2008). Chouinard et al. (2007) constructed and tested a structural equation model which showed, among other variables, positive relationships between perceived parental support, utility value of math in the academic setting, students' competence beliefs, goal orientation, and effort.

Xu (2004) found that it was helpful to the development of good study habits for parents to become involved in students' homework at the middle school level, and to some degree at the high school level. Parents can facilitate effective studying and the completion of homework by providing a quiet place to study and minimizing distractions during a time designated for homework or studying. Students who received homework help from their parents, regardless of the parents' education levels, were found to be more likely to have received the types of facilitation just mentioned.

Parents' Actions and Academic Achievement

The relationship between parents' actions and children's academic achievement may be mediated by children's development of self-regulation or independent learning abilities, but some researchers have attempted to find a direct relationship between parenting and achievement. A Swedish study of 2nd grade children (Folkesson & Swalander, 2007) looked at computer-supported self-regulated learning and reading comprehension. The researchers noted that many studies had documented greater reading proficiency in children whose parents read to them from an early age and who had a large number of books in the home. However, in their sample, structural equation modeling did not reveal a significant relationship between home literacy and reading comprehension.

Griffith (1996) used a school-level analysis based on parent surveys and aggregated standardized test scores. He noted a positive relationship between parent involvement in school and academic achievement. In-depth case studies of two elementary students who differed in reading achievement looked at family context including home literacy and indicators of student self-regulation (Perry, Nordby, & VandeKamp, 2003). The high-achieving student lived with a divorced mother who had a "top-down" approach to reading with emphasis on meaning. In contrast, the low achiever lived in an intact family with parents who favored a "bottom-up" approach stressing an initial focus on individual letters and sounds. Parents in both households provided help, guidance, encouragement, and an environment that included many available reading materials. The primary difference, other than family structure, appeared to be parents' beliefs about how reading and writing should be taught.

Parental Influence, Independent Learning, and Academic Achievement

As has been seen in the foregoing discussion, there have been several studies addressing the association of parental practices and children's development as self-regulated learners or the correlation of parents' actions and children's academic achievement. Some researchers, however, have looked at the larger picture involving all three of these components. In one such study using the Education Longitudinal Study of 2002 (ELS:2002), Bembenutty (2005) found by factor analysis that parent actions could be classified into two categories, one which had a positive correlation with mathematics achievement, and one which had a negative relationship with achievement. He referred to these parent factors as active (checking homework and helping with school assignments) and reactive (providing rewards and consequences for students' academic performance). Self-efficacy was the strongest positive predictor of mathematics test scores, followed by parents' reactive involvement, effort regulation, and intrinsic interest. Excluding ethnicity and gender, the largest negative predictor was parents' active involvement. Non-white and female students tended to score lower than white and male students, with the largest negative effect attributable to ethnicity.

Martinez-Pons (2002) studied the relationship between parental involvement and the development of self-regulatory behavior and academic achievement in children. He performed bivariate correlations on four parental actions (modeling, encouragement, facilitation, and rewarding) and four dimensions of self-regulated learning (motivation, goal setting, strategy use, and self-evaluation). He also performed a path analysis (Martinez-Pons, 1996) which revealed a significant positive correlation between parent actions and the development of self-regulated learning, and also between parent actions and achievement, with the stronger relationship being the former. The parents' actions studied were specifically geared towards attempting to instill self-regulation in their children, such as modeling desired behavior and facilitating it. Hoover-Dempsey and Sandler (1995) sought to explain why parents' involvement in their children's education had a positive association with the children's academic success in school. Specific parental actions examined were modeling, reinforcement, and instruction.

Data from elementary and high school students in Spain were analyzed by Gonzalez-Pienda et al. (2002) to construct a structural equation model showing the relationships between parent involvement, child factors including aspects of independent learning, and academic achievement. Findings included significant and positive effects of parent involvement on causal attributions, self-concept, and academic aptitudes, and a significant and positive effect of academic aptitudes on academic achievement. The relationship between self-concept and academic achievement was a reciprocal one, but was only significant in the direction from achievement to self-concept. Grolnick, Ryan, and Deci (1991) found relationships between the parent variables of autonomy support and involvement, components of children's academic motivation, and school performance in a structural equation model. Grolnick and Ryan (1989) studied the relationship of parenting style and involvement with elementary school children's autonomy, self-regulation, and academic achievement, finding that parenting styles which provided structure and support autonomy were associated with higher levels of self-regulation and achievement.

Components of Independent or Self-Regulated Learning

Motivation, Volition, and Interest

Researchers of the topic of academic motivation have promoted various theories about the nature of the construct. According to Corno (1989), motivation is what brings a person to the point of making a commitment to take a specific action or strive for a particular goal. Once that decision is reached, the quality of volition is called into play to help the person carry out the intention to reach the goal. Volition may be likened to willpower, which serves to protect the declared intention by enabling the individual to resist temptation to engage in activities which are attractive but incompatible with the commitment (Beckmann & Kuhl, 1984; Boekaerts & Corno, 2005; Corno, 1986; Fries & Dietz, 2007; Kuhl, 1987). Development of volition in young children was studied by Bullock and Lutkenhaus (1988), who found consistency in the pattern of development wherein children attend to producing a desired outcome as opposed to merely engaging in activity for its own sake.

The concept of interest is a necessary part of motivation and volition, but interest may be intrinsic (for its own sake) or extrinsic (for a reason that pertains to pleasing others or receiving external rewards). Deci and Ryan (1996) describe a continuum of self-regulation in which the nature and degree of motivation is a key factor. They posit that unless a person's actions are undertaken willingly and for intrinsic reasons, true volition is not taking place and self-regulation is at the low end of the scale. When external rewards or consequences are connected with a course of action, it is possible for an individual to internalize the desire to commit to and perform the action. However, according to Deci and Ryan, the motivation for this behavior is considered extrinsic because it was originally undertaken at the behest of an external source. Once the regulatory behavior has become internalized, however, the person may choose to continue to engage in the behavior for truly intrinsic reasons and the behavior becomes volitional. Another view of the intrinsic/extrinsic dichotomy is that intrinsic motivation relates to mastery goals (discussed later in this review) or efforts to improve on one's own past performance, whereas extrinsic motivation applies to competition with others (Nicholls, 1984).

In a review by Linnenbrink and Pintrich (2002), the authors discussed research pertaining to four aspects that contribute to student motivation: self-efficacy, attributions, intrinsic interest, and achievement goals. Motivation is not a stable trait, but can change with the situation, the academic domain, and other characteristics inherent in the individual. Although external influences may contribute to motivation in specific situations, the individual is ultimately capable of controlling his or her own motivation. Bong (2001) found evidence of increased differentiation in academic motivation in high school students as compared to middle school students.

A qualitative study (Jarvenoja & Jarvela, 2005) highlighted the importance of interest in student motivation to learn and to perform academically. Students who have no interest in learning in general or subject matter in particular will have difficulty sustaining the effort needed to succeed in learning tasks. In her dissertation research, Long (2003) found that students who do not have intrinsic interest in a subject may become interested if teachers communicate their own interest in the subject, or if teachers share some other interest with students, such as participation on an athletic team.

The character of motivation as either intrinsic or extrinsic has been shown to affect the quality of retention of learned material. In one study (Benware & Deci, 1984), researchers found that participants who learned material with the goal of passing a test did not perform as well on the test as those who learned the material with the goal of being able to use the information.

Vallerand et al. (1997) used structural equation modeling to illustrate the role of self-efficacy and autonomy as components of motivation for high school students to continue in school. Similar results with regard to self-efficacy and locus of control were found in a study of elementary school children (Boggiano, Main, & Katz, 1988). After data were gathered on intrinsic vs. extrinsic motivation, locus of control, and self-efficacy, participants played a shape matching game with a time limit. Three conditions involved two levels of evaluative feedback and a control with no feedback. After the initial activity, a variety of interesting games/activities were set up and the children were unobtrusively observed for 8 minutes to see whether they would choose more or less challenging activities. Path analysis showed that a sense of personal control leads to intrinsic interest and academic competence, academic competence leads to intrinsic interest and preference for challenge, and intrinsic interest leads to preference for challenge.

Ability beliefs as distinct from self-efficacy have to do with an individual's conception of ability as inherent or malleable. The terms entity and incremental are often used in the literature on ability beliefs, where entity refers to the belief that a person is born with a certain amount and type of ability and that this does not change, and incremental means that with effort, an individual can achieve regardless of inherent ability. Students with incremental ability beliefs often have more intrinsic motivation for learning. Students who believe that those who succeed are born with ability yet do not believe that they are among them, will not be motivated to try to achieve (Li, 2004). Thus, several constructs contribute to an individual's motivation, which in turn is a fundamental element of independent learning.

Autonomy and Self-Regulation

Researchers have shown that gradually increasing the level of autonomy of students brings about development of self-direction and self-regulation (Barak, 2004). In a study of learner control and persistence, Carrier and Williams (1988) found that students who were given the opportunity to choose from a variety of supplementary instructional materials achieved better performance than either students required to use all of the materials or students who received the basic instruction without supplemental materials. Learner control of instruction was also positively correlated with high persistence on learning tasks. Another study concerning developing autonomy in elementary school children (Hendy & Whitebread, 2000) found that parents and teachers who do not provide autonomy support may actually cause students to become more, rather than less, dependent as they progress through years of schooling.

Self-regulated learning strategies may be divided into two groups: deep, which include critical thinking and mental activities aimed to increase understanding and meaning-making from material studied; and surface, which involve lower-level cognitive strategies such as organizing facts, rehearsal, and memorization (Blom & Severiens, 2008). In cases where students exercise self-direction in learning tasks but habitually choose only one of these categories of strategies, motivation (intrinsic or extrinsic) may be factors in the choice of strategies. Surface learning is related to extrinsic motivation and deep learning is associated with intrinsic interest in the subject matter.

Boekaerts and Corno (2005) differentiated between “top-down” and “bottom-up” self-regulation, in which the former is motivated by intrinsic interest and the latter originates from external influences or environmental cues. When a student is engaged in top-down self-regulation, learning or achievement goals are established at the outset, but in bottom-up situations, the student relies on feedback from others or from the environment to develop and refine goals while learning activities are in progress. Students using a bottom-up orientation may be more subject to distractions than those who have committed to a goal using a top-down process of self-regulation who may be said to risk suffering from tunnel vision. Persistence in a task can be affected by the student’s perception of environmental feedback, but this is not always maladaptive. Some objectives, such as well-being, may be considered by a student to be more important than learning or achievement.

A similar typology of intrinsically and extrinsically motivated self-regulation was described by Deci and Ryan (1996). Autonomous self-regulation includes self-direction which is motivated by intrinsic interest or extrinsic values which have been internalized as one's own. In this case, the person is performing the necessary actions because he or she wants to do so. Controlled regulation occurs when an individual performs actions for the purpose of gaining favor or rewards or to avoid negative consequences. In their literature review, Deci and Ryan describe several studies which have shown that autonomous self-regulation resulted in more favorable outcomes than controlled regulation. In a study of college students, Ratelle, Guay, Vallerand, Larose, and Senecal (2007) found that students with high autonomous motivation were more persistent and experienced greater academic adjustment than those with more extrinsic motivation.

Goal Orientation

Goal orientation is usually divided into two categories, performance and mastery. Performance goals are associated with extrinsic motivation for learning, in which the student values receiving recognition for doing well. In contrast, learning or mastery goals are associated with intrinsic motivation, which involves students valuing knowledge for its own sake or for its practical application (Elliott & Dweck, 1988; Kitsantas, Reiser, & Doster, 2004; Newman & Schwager, 1995; Schunk, 1996; Shell & Husman, 2007).

In a study of secondary students in grades 7 through 11, mastery goals in conjunction with domain-specific self-efficacy were found to significantly impact students' efforts to learn mathematics (Chouinard, Karsenti, & Roy, 2007). Elliott and Dweck (1988) studied 5th grade children to determine why some children perceive correction as personal condemnation despite the fact that others who are more mastery-goal oriented perceive the same comment as useful feedback. To encourage a mastery orientation, half of the children were told that the important thing was for them to learn something. The other half of the participants were told that the purpose of the task was to test their ability. All participants were then allowed to choose a task labeled as either "learning" or "performance" and a difficulty level. In reality, all participants were given the same task regardless of the labeling. Results suggested that children, whether their perceived ability was high or low, were more motivated to engage in challenging learning tasks when they adopted a mastery goal orientation rather than a performance goal orientation. In a comparison of Australian and Japanese students, Purdie, Hattie, and Douglas (1996) found that students having a mastery orientation to learning were more likely to make use of self-regulated learning strategies.

Performance goals have traditionally been considered less effective and less adaptive than mastery goals, but contemporary researchers have found that this category can be subdivided into performance-approach and performance-avoidance goals (Bong, 2008; Linnenbrink & Pintrich, 2002). Performance-approach is a positive orientation in which students set goals to perform well in comparison with other students, but performance-avoidance is negative because the student's goal is actually to avoid the appearance of incompetence. When considered separately from performance-avoidance, performance-approach goals have been found to be as correlated with academic achievement as mastery goals.

The negative effects observed when performance goals were applied were found to be due to a student's performance-avoidance orientation. Often the performance-avoidance orientation is manifested as a decision not to participate in the learning activity, but it can also involve the student choosing an objective that is unreasonably difficult for the development level. In this way, the student can point out that even exceptional students could not have succeeded, so his or her failure is not a cause for shame. Unfortunately, performance-avoidance goals do not lead to learning. Their purpose is merely to save face.

Another approach to the study of goals categorizes them by proximity. Proximal goals are those which can be accomplished in a short amount of time, and distal goals are more long-term, necessitating more self-monitoring and volition to keep working towards them. A study on the relationships between self-efficacy, intrinsic interest, and achievement looked at elementary school children who had previously performed poorly in arithmetic (Bandura & Schunk, 1981). The focus of the study was on specific skills needed in order to perform subtraction problems with numbers of up to six digits. A pretest assessed existing skills before students were assigned to treatment groups (instruction using proximal goals, distal goals, no goals, and no treatment). The treatments were implemented by having the experimenter suggest a specific goal to the proximal group (a number of pages per session), the goal of completing all 42 pages of the instructional materials in seven sessions for the distal group, and encouraging the no goals group "to try to complete as many pages of instructional items as possible as they went along" (p. 589). The control group was given the same pre-test and post-test, but without instructional material or suggested goals. Results showed that students in the proximal goals group substantially improved in both self-efficacy and achievement and outperformed all other groups. Those in the distal goals and no goals groups had smaller increases in self-efficacy and achievement, but both of these were much better than the control group, whose performance remained dismal. The short-term, realistic goals used by the proximal group helped focus effort and improved the chances of successful incremental learning. They also were shown to have a positive impact on intrinsic interest and persistence as the proximal group members voluntarily chose to attempt more problems and were willing to spend more time and effort on difficult problems than any other group.

Metacognition and Help-Seeking

Metacognition is thinking about thinking, or being critically aware of one's own thought processes. Muis (2007) theorized that epistemic beliefs, that is, beliefs about the nature of knowledge and learning, are precursors to metacognition. The relationship may be reciprocal, as Muis also stated that self-regulated learning, of which metacognition is a component, may contribute to epistemic beliefs. Metacognition and adaptive help-seeking are related by virtue of the fact that the ability to monitor one's own thought processes and level of understanding is necessary in order to know when assistance in learning is needed.

Much of the lack of development of independent learning in children is due to traditional instructional techniques and practices. Innovative techniques such as cooperative learning, more explanations in direct instruction situations, peer tutoring and dialogues can help solve this problem because all of these approaches encourage metacognition (Paris & Byrnes, 1989). They can also help resolve or avoid the formulation of children's maladaptive theories of ability and effort by helping children realize that there are multiple causes for success and failure.

Hwang (1998) observed kindergarten children for three months in order to classify them as high or low self-regulated learners. After classification, the children were given a learning/performance task and their efforts were observed and recorded. It was found that children who exhibited the metacognitive skills of longer-range goal orientation, planning, and self-monitoring tended to complete the task successfully, but the majority of the low self-regulated students were unsuccessful. When the less self-regulated students encountered problems with the task, they attempted to ignore them, unlike the successful self-regulated children who recognized problems as they occurred and made adjustments to solve those problems before continuing.

Children high in motivation tend to become “richer” but children lacking self-efficacy and motivation become academically poorer as they engage in behaviors designed to conceal their lack of ability (Marchand & Skinner, 2007). Children who have a healthy self-concept and an intrinsic interest in learning are not afraid to ask for help when they do not understand something. The fear of looking foolish or lacking ability keeps other children, driven by concealment goals, from seeking help when it is needed. Self-regulated learners have metacognitive skill which allows them to know when they do not understand a concept, yet knowing this does not detract from their self-worth (Linnenbrink & Pintrich, 2002). Newman (1990) surveyed students in grades 3, 5, and 7 to find explanations for their help-seeking behavior. His findings showed that in middle school, students were likely to evaluate the benefits and costs (such as the possibility of appearing incompetent) of help-seeking before making a decision to ask for assistance with schoolwork. Elementary school children were more likely to focus on the benefits, in addition to being more dependent on the teacher in classroom situations.

Students with metacognitive skill make use of more varied self-regulated learning strategies, both surface and deep, than those without this skill. Metacognition enables them to know when each strategy is appropriate in order to achieve the desired learning goal (Blom & Severiens, 2008). An experiment involving elementary school students compared the reading comprehension achievement of students trained in metacognitive skills with a matched control group (Cross & Paris, 1988). Children who received the training were found to use more metacognitive strategies and to exhibit better reading comprehension than those in the control group.

Self-Efficacy

Self-efficacy can be defined as confidence in one's competence in a particular domain. It is not to be confused with arrogance or inflated ego; as self-efficacy develops, it becomes more and more grounded in a realistic internal appraisal of the individual's strengths (Pajares, 2002). A person with high self-efficacy knows what he or she can and cannot do; those who have low self-efficacy are probably underestimating their capabilities and thus not reaching their potential. The construct of self-efficacy is related to but distinct from self-concept, which is how individuals define themselves in terms of not only skills but characteristics and traits. A meta-analysis of the correlations between self-efficacy and the outcomes of academic performance and perseverance in learning (Multon, Brown, & Lent, 1991) showed significant and positive associations among these variables. The saying "success breeds success" is relevant to the concept of self-efficacy.

Self-efficacy beliefs have been found to be related to academic goals and motivation, as well as parental expectations for students' achievement (Zimmerman, Bandura, & Martinez-Pons, 1992). Path analysis showed that parents' expectations, students' achievement goals, prior grades, and students' self-efficacy were significant predictors of social studies grades. Self-efficacy beliefs regarding the ability to self-regulate were as important as self-efficacy in a specific subject area.

Independent Learning and Academic Achievement

Relationships between components of academic self-regulation and achievement have been studied by several researchers using various approaches. Bullock and Muschamp (2006) used qualitative methods to study metacognition and its relationship to achievement in older elementary school students. They noted that “metacognition is clearly evident in the more able pupils…” (p. 60). In a study of southeast Asian children, Camahalan (2006) found support for positive effects of self-regulated learning on math achievement.

Malpass, O’Neil, and Hocevar (1999) studied 144 high school students taking advanced math classes and found that Advanced Placement (AP) Calculus standardized test scores were moderately and positively correlated with self-regulation and that self-efficacy had a significant positive correlation with both self-regulation and math achievement in a high-stakes testing environment, yet a structural equation model showed no relationship between self-regulation and achievement. Range restriction due to the nature of the convenience sample, which was heavily Asian and identified as mathematically gifted, was cited as a possible explanation of this unexpected finding. Miller (2000) also worked with high school students but looked at the relationship between self-regulated learning and academic achievement in the opposite direction. A path analysis showed that achievement as measured by each domain (English or mathematics) of the American College Testing (ACT) practice test had a positive and significant effect on self-regulated learning of the same domain.

Tuckman (2003) provided training in metacognitive skills to college students and used a comparison group (no training) matched on characteristics including gender, ethnicity, year in school, and prior grade-point average (GPA). Analysis of covariance showed significantly higher grades for the treatment group during the term the training took place and in subsequent terms.

Self-efficacy and locus of control were found to be significant predictors of academic achievement in a sample of elementary school children (Chapman, Cullen, Boersma, & Maguire, 1981). A study focusing on psychopathology in college students (Brackney & Karabenick, 1995) found a significant relationship between students' motivation, self-efficacy, and their use of self-regulated learning strategies, and that in turn the use of these strategies was associated with higher academic achievement.

Students' motivational sets for learning were manipulated by Benware and Deci (1984) by giving two randomly assigned groups material to learn with differing instructions. The control group was told they would be tested on the material, but the treatment group members were instructed to be prepared to teach the material to another student. Motivation, attitudes, and content knowledge were assessed at follow-up. Both groups spent the same amount of time studying the material, but the treatment group appeared to have been more efficient; their test scores were higher for conceptual learning and their attitudes were more positive than those in the control group. Scores for rote learning were comparable for both groups.

Differences in intrinsic and extrinsic motivation at different ages were assessed in a sample of students in grades 3 through 8 (Lepper et al., 2005). Findings revealed that intrinsic motivation levels were lower for older children. They also found that extrinsic motivation was negatively correlated with academic achievement.

At the middle school level, Duckworth and Seligman (2005) found self-discipline to be a good predictor of several achievement measures, including grades and standardized test scores. Many of the indicators used to measure self-discipline in their study are applicable to volition and self-regulation of learning. Gottfried (1985) studied intrinsic motivation and achievement in elementary and middle school aged students and found that academic motivation is differentiated by domain, especially in mathematics. In a later study, Gottfried and associates (Gottfried, Fleming, & Gottfried, 2001) performed a longitudinal analysis to trace the development and stability of academic intrinsic motivation from elementary school through high school. Findings were that, for most subjects, intrinsic motivation remained stable, but it decreased in math; also, mean levels of intrinsic motivation decreased over time.

Family Structure, Parent Actions, Self-Regulation, and Achievement

Children from "broken homes" or homes which have never had two parents are considered at a disadvantage in school and society, especially in the United States (Pong, Dronkers, & Hampden-Thompson, 2003; Schiller, Khmelkov, & Wang, 2002). There are likely to be more single-parent families in the future, due to the high divorce rate as well as an increasing number of women who choose to have children out of wedlock. Pong et al. (2003) noted this trend and reported that over 30% of births in the United States are now to unmarried mothers.

Several researchers have suggested that observed achievement differences between two-parent families and single-parent families become insignificant when controlling for socioeconomic status (SES) (Biblarz & Raftery, 1999; Boggess, 1998; Ricciuti, 2004) although others do not share this conclusion (Ham, 2004). Battle and Coates (2004) compared outcomes for African-American girls from mother-only and father-only families, and concluded that SES is a more important predictor of achievement for single-parent children than the gender of the parent. An interesting finding of this study was that parental control, including checking of homework, was a significant positive predictor for academic achievement in 8^{th} grade, but by 12^{th} grade the influence of this factor (as measured in grade 8) had substantially declined, though it was still positive and statistically significant. Two years post high school, strong parental control during 8^{th} grade had a negative association with outcomes of achievement and attainment.

The question of how SES might impact parent-child relationships was addressed by Chen and Berdan (2006). They found that different behaviors and responses between adolescent and parent were associated with good relationship quality in high- and low-SES families. For example, high-SES parents were more likely to respond to their child's expression of anger than withdrawn behavior, but the opposite was true for low-SES parents. In both instances, however, these responses were associated with family cohesiveness, suggesting that emotional needs may be determined partly by SES.

A study of parental control of education and achievement in South Africa found a significant correlation between these variables for children living with both parents, but no relationship for children of single parents (Cherian & Malehase, 2000). Lack of parental control and communication were among the factors found by Mulkey, Crain, and Harrington (1992) to partly explain the lower achievement levels of single-parent children in a large-scale database. Students with low achievement levels also demonstrated indicators of low self-regulation, such as not doing homework and often being late or absent from school.

Some studies found important effects on educational achievement and attainment from the duration and timing of the experience of living in a single-parent family. Krein and Beller (1988) found a significant impact on long-range educational outcomes for children who lived with a single parent during their preschool years; this effect was present but not significant for children who lived with both parents during preschool but lost a parent during elementary school or high school. Based on his analysis of data from the Panel Study of Income Dynamics (PSID), Boggess (1998) concluded that "duration of time spent in a nonintact family appears to be an important determinant of future educational success" (p. 220). Krein and Beller also found that negative impacts on educational outcomes increased with the amount of time a child lived in a single-parent family.

There is also a question of whether reconstituted or stepfamilies are better for children's development than remaining in a single-parent family. Researchers generally agree that the family structure associated with the best children's achievement is the traditional family where both biological parents are present. Zimiles and Lee (1991) found small but statistically significant differences in achievement, as measured by test scores and grades, among the groups of children living in intact, single-parent, and stepfamilies, but the major finding was that "children living with like-gender custodial parents were less likely to drop out in single-parent families, but more likely to drop out in stepfamilies" (p. 314). A negative effect on educational attainment was found by Boggess (1998) for children living in a stepfamily as compared to living with a mother who remained widowed or divorced. Ham (2004) noted a differential effect of the presence of a stepfather on boys and girls; boys' achievement generally improved when their mother remarried, but girls' achievement suffered in this situation.

Shim, Felner, and Shim (2000) compared grades of students from different family structures, accounting for several SES-related factors, and home environment variables. They found no significant difference in grades based on family structure, but the strongest predictor of high achievement was parents' expectations for their children's achievement. Interestingly, intact two-parent families tended to have higher expectations than single-parent or step-families.

Summary

As researchers in this field have found, many home-related influences are relevant to children's school success and development into independent learners. The construct of independent learning involves multiple aspects which have been studied individually and in groups considered by the researcher to operate together. These studies may have examined one or more of the following issues: motivation, volition, interest, autonomy, use of self-regulatory strategies, goal orientation, metacognition, strategic help-seeking, and self-efficacy. Researchers have studied how to measure these attributes or characteristics and how they relate to self-regulatory or independent learning behavior. Understanding these issues has been an important part of the formulation of the operational definition of independent learning for the current project. An independent learner is one who not only accepts ultimate responsibility for his or her own learning process but also is mentally, emotionally, and strategically equipped to take on this responsibility.

This review of the literature has shown the importance of these characteristics for the successful independent learner, and has shed some light on how parenting style may contribute to the development of self-regulation and academic achievement. More research is needed on the possible differences in development of independent learning for children in non-traditional family structures. This study aims to help fill this gap.

CHAPTER 3

METHODS

This chapter describes the data source and statistical analysis methods used to answer the research questions and test the related hypotheses. From the research questions given in Chapter 1, the following hypotheses were formulated:

(1) There will be a significant positive relationship between parents' actions which encourage autonomy (authoritative parenting style) and students' manifestation of independent learning characteristics.

(2) There will be a negative relationship between parents' actions associated with a high degree of parental control (authoritarian parenting style) and students' manifestation of independent learning characteristics.

(3) There will be a significant positive relationship between student independent learning characteristics and academic achievement.

(4) There will be a positive relationship between parents' actions associated with an authoritative style and students' academic achievement.

(5) There will be a negative relationship between parents' actions associated with an authoritarian style and students' academic achievement.

(6) There will be a difference between children from different family structures in their manifestation of independent learning characteristics.

This study is designed as a secondary cross-sectional analysis of a large-scale national data set. Because the variables of interest were measured at the same time, causation cannot be inferred from this analysis. Approval for this study was granted by the Virginia Tech

Institutional Review Board (IRB) and the approval letter is included in Appendix A. The data source and analytical procedures performed are described in detail below.

Data Source

Data for this study are from the Education Longitudinal Study of 2002 (ELS:2002) (National Center for Education Statistics, 2006). The sample is a nationally representative sample of United States high school students who were in 10^{th} grade in spring 2002. The complex, multistage sample design involved stratified sampling with probability proportional to size (PPS) of schools and random selection of eligible students within selected schools. Because this is not a simple random sample, the design effect must be accounted for in calculating standard errors for analyses where a significance level must be determined. The method of adjusting for the design effect will be described for each analysis below.

The database allows for longitudinal analyses because the representative sample of American 10^{th} graders in 2002 was re-surveyed in 2004 and 2006. Sample freshening techniques and the construction of a system of weights and flags allow researchers to customize the dataset to make it a representative sample for the research design, whether it is cross-sectional, longitudinal, or inter-cohort. The current study is cross-sectional in that it only uses data from the base year.

Data were collected not only from students but also from parents, teachers, and administrators (for school-level data). Student variables encompassed many aspects of students' lives, including attitudes, home and family factors, school environments, and activities. Parent variables included family structure and home environment items, aspirations for the child's education, and parents' involvement with and opinions about the school.

The base year sample included 752 schools with an average of 26 randomly selected 10th grade students per school. As the actual sample was 1,221 schools, this yielded a response rate of 67.8 percent at the school level. Asian and Hispanic students were oversampled in the base year, as were private schools, in order to have a sufficient number of these in the sample to make comparisons. A total of 17,591 students were identified as part of the sample, and 15,362 actually participated by completing the questionnaire, for a student-level response rate of 87.3 percent. Data were also collected from 13,488 parents, 7,135 teachers, 743 principals, and 718 school librarians (National Center for Education Statistics, 2006).

In addition to the questionnaires, participating students were given achievement tests in reading and mathematics. ELS:2002 was designed in a similar fashion as its predecessor, the National Education Longitudinal Study of 1988 (NELS:88), but by the new millennium academic requirements and administrative workloads had increased due to the No Child Left Behind (NCLB) legislation. Because of increased time demands on students and school personnel, it was necessary for the study designers to keep the questionnaires and tests as brief as possible. Therefore, many variables that were in NELS:88 were not carried over into ELS:2002, and instead of achievement testing in four subject areas as was done in NELS:88, ELS:2002 includes only two subject areas. For this analysis, the item response theory (IRT) scores are used for reading and mathematics achievement.

The publicly available dataset has been subjected to analysis for potential bias due to non-response and both logical and statistical imputations were used to compensate for missing data. A system of weights was designed to “compensate for unequal probabilities of selection of schools and students into the base year sample and to adjust for the fact that not all schools and students selected into the sample actually participated” (National Center for Education Statistics, 2006, p. 36). When the base year sample weight is applied to the 15,362 respondents, analyses will yield population estimates for approximately 3.6 million students. To preserve both proper weighting and the actual sample size during analysis with the SPSS software program (SPSS, 2005), a relative weight variable was created by dividing the base year weight by the mean of the weight variable (Thomas, Heck, & Bauer, 2005). Relative weights were used in all analyses.

This dataset is designed so that researchers can use either the student or the school as the unit of analysis. The current study focuses on the student as the unit of analysis. The school level data included in the dataset was intended to serve primarily as contextual information for the student data. Weighted, relative-weighted, and unweighted frequencies of demographic variables in the base year dataset are shown in Table 3.1. The percentages are the same for both types of weighting but are slightly different for the unweighted data.

Table 3.1
Frequencies for Demographic Variables in ELS:2002

Variable/Value	*Base Year Weighted Frequency*	*Relative-Weighted Frequency*	*Weighted Percent*	*Unweighted Frequency*	*Unweighted Percent*
Sex – composite					
Male	1729531	8196	50.4	7689	47.3
Female	1700018	8056	49.6	7741	47.6
Missing	0	0	0.0	822	5.1
Race/ethnicity – composite					
Amer. Indian/Alaska Native, non-Hispanic	33127	157	1.0	131	0.8
Asian, Hawaii/Pac. Islander, non-Hispanic	143121	678	4.2	1465	9.0
Black or African American, non-Hispanic	492864	2336	14.4	2027	12.5
Hispanic, no race specified	243780	1155	7.1	998	6.1
Hispanic, race specified	300525	1424	8.8	1229	7.6
Multiracial, non-Hispanic	148839	705	4.3	740	4.6
White, non-Hispanic	2067293	9797	60.3	8735	53.7
Missing	0	0	0.0	927	5.7
School control					
Public	3167513	15010	92.4	12795	78.7
Catholic	145906	691	4.3	1987	12.2
Other private	116129	550	3.4	1470	9.0
School urbanicity					
Urban	1034955	4904	30.2	5510	33.9
Suburban	1724098	8170	50.3	7790	47.9
Rural	670495	3177	19.6	2952	18.2
Geographic region					
Northeast	636097	3014	18.5	2976	18.3
Midwest	828760	3927	24.2	4045	24.9
South	1174104	5564	34.2	5894	36.3
West	790588	3746	23.1	3337	20.5

Selection of Variables

Four sets of variables were extracted initially from the complete public dataset for use in this study: measures of academic achievement, parent variables, student independent learning indicators, and demographics.

Achievement Variables

For the first set of variables, achievement test scores for mathematics and reading were available in several versions, including IRT estimated number right, standardized scores, quartile scores, and probability of proficiency scores (National Center for Education Statistics, 2006). For this study, the IRT estimated number right variables were selected because they are criterion-referenced measures recommended for use in cross-sectional studies involving correlations with behavioral variables and models using more than one dependent variable.

IRT stands for "item response theory," which is a way of measuring examinees' ability levels by taking into account the difficulty levels and discrimination abilities of test items. The probability of a particular student getting a particular unanswered item correct can be calculated using IRT methods, based on the pattern of the student's responses to the test questions that were answered.

In the achievement tests used in ELS:2002, the math test contained 73 items and the reading test had 51 items (National Center for Education Statistics, 2006). All students did not answer all items on these tests. The tests were designed to assess a broad range of knowledge and skills, and could be used at other grade levels so that scores for the same student in different years could be compared to assess progress. The IRT estimated number right is the sum of the probabilities of correct responses for each item for a particular student.

In the base year of ELS:2002, all participants were in 10th grade. At that time, the weighted mean of the math achievement IRT estimated number right was 37.4 (of a maximum possible score of 73). The weighted mean of the reading IRT estimated number right was 29.4 (of a maximum possible score of 51). These two variables, mathematics IRT estimated number right and reading IRT estimated number right, were chosen as the achievement outcome variables for this study. Note that these scores are not standardized and the math and reading scores are not directly comparable without dividing them by the total number of items for each test.

Parent Variables

For the second set of variables, representing parents' actions, variables were found which described specific ways in which parents became involved in their child's school, household rules for child behavior, and specific kinds of activities participated in with the child. The items used as parent actions indicators were taken from the parent questionnaire and the variable names begin with BYP. In addition, two composite variables were created from groups of related dichotomous (yes or no) variables. These were the parent school involvement score and the family rules score. The 24 parent variables selected for the initial factor analysis, including the two composites, are shown in Appendix B.

The parent school involvement composite score is the sum of the following five binary variables (1 = yes, 0 = no): Belong to parent-teacher organization; Attend parent-teacher organization meetings; Take part in parent-teacher organization activities; Act as a volunteer at the school; and Belong to other organizations with parents from school. The maximum possible score was 5, the mean was 1.41, the median was 1, and the standard deviation was 1.519. A large percentage of parents in the sample (29.3%) did not engage in any of these types of school involvement, and 18.9% had only one type of involvement. Percentages were much smaller for higher levels of parental involvement in school.

The family rules composite score was calculated in a similar fashion. Four binary variables (1 = yes, 0 = no) were summed: Family rules for 10th grader about maintaining grade average; Family rules for 10th grader about doing homework; Family rules for 10th grader about doing household chores; and Family rules for 10th grader about watching TV. The range of possible scores was 0 to 4, the mean was 3.28, the median was 4, and the standard deviation was 0.974. This is in marked contrast to the parent involvement score with its low mean and median.

Student Independent Learning Variables

The third set of variables pertained to student behavior. The student questionnaire items in ELS:2002 dataset were scanned for variables that could serve as indicators of the characteristics considered to be components of independent or self-regulated learning, including motivation, volition, self-regulation, metacognition, and self-efficacy. Initially, 52 student items were chosen. These items included the amount of time spent studying inside and outside of school, how often the student goes to class unprepared (e.g., without writing implements, books, or homework done), time spent in voluntary reading, use of computers for academic purposes, various social values, literacy-related resources available in the home, aspects of the home environment, academic competence beliefs, and attitudes towards learning and school.

Items were reverse coded as necessary so that the higher end of the scale would always represent the more desirable state of affairs. For example, the three preparation for class subscale items referred to how often the student went to class *without* the specified article and were reverse coded accordingly (1 = usually, 2 = often, 3 = seldom, 4 = never). In addition, the variable Hours/week spent reading outside of school (BYS43) was recoded as CBYS43. The original BYS43 had 22 response categories, numbered 0 through 21 corresponding to the specific number of hours. To make this variable comparable to the other items, CBYS43 was created with the following response categories: 1 = 0 hours, 2 = 1-7 hours, 3 = 8-15 hours, and 4 = 16 or more hours.

Some of the student independent learning items can be considered measures of metacognition as well as motivation and volition (Hacker, Dunlosky, & Graesser, 1998). Specifically, metacognition was expected to be represented by these variables: Remembers most important things when studies, Works as hard as possible when studies, Keeps studying even if material is difficult, Does best to learn what studies, Puts forth best effort when studying, Reverse coded totally absorbed in math, Reverse coded math is fun, Reverse coded math is important, Can understand difficult math texts, Can understand difficult math class, Can get no problems wrong if decides to, Can understand difficult English texts, Can learn something really hard, Can understand difficult English class, Reverse coded reading is fun, and Reverse coded totally absorbed in reading. My rationale for these variables as indicators of metacognition is that students would have to make judgments of what constitutes "difficult" material, the amount of effort needed to perform a learning task, and whether or not material has been understood (Hacker et al., 1998).

Many of these items may relate to more than one component of independent learning. For example, the following may be seen as involving self-efficacy as well as metacognition: Can understand difficult math texts, Can understand difficult math class, Can get no problems wrong if decides to, Can understand difficult English texts, Can learn something really hard, and Can understand difficult English class. Motivation and volition can be inferred from the following items: Works as hard as possible when studies, Keeps studying even if material is difficult, Does best to learn what studies, Puts forth best effort when studying, Reverse coded math is important, and Can get no problems wrong if decides to.

Demographic Variables

A final set of variables consisted of sampling information, school-level data, and demographic attributes. The school ID, stratum, primary sampling unit (PSU), Grade 10 cohort flag, and base year student weight variables were included in the extracted data in order to properly apply weights for the purpose of generalizing the results. Demographic variables included sex, race/ethnicity, family composition, and version 2 of the socioeconomic status composite (SES). School-level variables were school control (public vs. private), school urbanicity, and geographic region of the school. Both versions of the SES variables are composites created by NCES based on father's and mother's education levels, family income, and father's and mother's occupations. Version 2 of the SES variable was selected for this study because it used an updated occupational prestige score in the composite. These demographic and school-level variables will allow grouping of students to facilitate comparisons, although some of these may not be used in the final analysis.

Analytical Methods

Several techniques were used to analyze the data in order to investigate the research questions and test the hypotheses. These included bivariate correlations, canonical correlations, structural equation modeling (SEM), and multivariate analysis of variance (MANOVA), but before any of these procedures could be performed, appropriate variables had to be selected from the database and subjected to an exploratory factor analysis (EFA). The EFA results provided the basis for grouping items into factors which were then used in the other statistical procedures. All of these procedures are described in detail below.

Exploratory Factor Analysis (EFA)

Exploratory factor analysis with maximum likelihood estimation and promax oblique rotation was performed on each set of variables for data reduction purposes. Oblique rotation was judged to be appropriate for this study because some degree of correlation among the items was expected to exist. The initial parent factor analysis included 24 indicators which yielded 6 factors (see Appendix B). Items that did not load well on any factor and factors with fewer than three indicators were deleted from the analysis, and the factor analysis was run again to verify the results. The revised factor analysis retained 18 parent indicators with 4 factors explaining 47.69% of the variance.

These results were studied to determine what the items loading on each factor had in common. The first parent factor, named "parental involvement," included four items encompassing enriching activities shared by parents and students as well as the parent school involvement composite score. In the second parent factor, called "parental advice," five items were retained which pertained to communication between parents and students in the form of parental advice-giving. Six items loaded on the third parent factor, designated "parental control/homework," which related to parental control and parents helping with homework or school projects. Two of the parental control items, "How often know whereabouts" and "How often make/enforce school night curfews," had loadings of less than 0.4, but they were retained because they were important to the theoretical concept of the factor. Finally, the fourth parent factor, named "family fun," was represented by three items which appeared similar to some of the items in the first factor. These items, however, may be viewed as relating to non-school or non-educational pursuits engaged in by parents and students together, just for fun.

Composite scores for each subscale were calculated, using the mean of the subscale items. Table 3.2 shows descriptive statistics for the items and reliabilities for the parent subscales. The table also includes information about the response scales of the variables.

Table 3.2
Items and Descriptive Statistics for Parent Scales

Scale and Item	*M*	*SD*	*Loading*	*Coefficient α*
Parental involvement				0.707
Attended school activities with 10th grader[2]	2.90	1.123	0.731	
Attended concerts/plays/movies with 10th grader[2]	2.84	0.962	0.384	
Attended sports events outside school with 10th grader[2]	2.57	1.104	0.733	
Worked on hobby/played sports with 10th grader[2]	2.85	0.992	0.612	
Parent school involvement composite score[4]	1.41	1.520	0.497	
Parental advice				0.739
Provide advice about selecting courses or programs[1]	2.41	0.647	0.428	
Provide advice about plans for college entrance exams[1]	2.11	0.762	0.735	
Provide advice about applying to college/school after HS[1]	2.09	0.779	0.832	
Provide advice about jobs to apply for after high school[1]	2.17	0.730	0.494	
Parental control/homework				0.576
How often check that homework completed[3]	2.97	0.931	0.666	
How often discuss report card[3]	3.83	0.479	0.452	
How often know whereabouts[3]	3.81	0.449	0.262	
How often make/enforce school night curfews[3]	3.76	0.666	0.355	
Worked on homework/school projects with 10th grader[2]	2.92	0.876	0.457	
Family rules composite score[5]	3.28	0.974	0.396	
Family fun				0.594
Took day trips/vacations with 10th grader[2]	3.13	0.830	0.379	
Went shopping with 10th grader[2]	3.36	0.788	0.704	
Went to restaurants with 10th grader[2]	3.39	0.683	0.744	

[1] 3-point scale: 1=never, 2=sometimes, 3=often
[2] 4-point scale: 1=never, 2=rarely, 3=sometimes, 4=frequently
[3] 4-point scale: 1=never, 2=seldom, 3=usually, 4=always
[4] Sum of responses of 5 binary indicators, 0=no, 1=yes
[5] Sum of responses of 4 binary indicators, 0=no, 1=yes

Initially, 52 student independent learning indicators were entered into a factor analysis which resulted in 12 factors (see Appendix B). The revised student factor analysis retained 30 independent learning indicators in 5 factors explaining 66.982% of the variance. Factor analysis of the student variables did not identify a factor that was solely related to metacognition; however, as discussed above, metacognitive skills were implicit in several of the variables which loaded onto identified factors.

The first student independent learning factor, called “motivation/volition,” included eight variables which were indicative of either motivation or volition. The second and third student factors pertained to intrinsic interest and academic self-efficacy. These factors were domain specific, with factor 2 comprising nine indicators explicitly about mathematics (named “math interest/self-efficacy”) and factor 3 consisting of six variables, five of which refer to “English” plus one non-subject-specific variable concerned with general learning self-efficacy (called “English and learning interest/self-efficacy”). The fourth student factor was designated “voluntary reading” because it comprised four indicators describing participation in and enjoyment of reading outside of academic requirements. The last student factor included three variables that were related to self-regulation as it is manifested in the student being prepared for participation in learning activities in class. This factor, named “preparation for class,” is especially relevant to self-regulation because it is a measure of students taking responsibility and appropriate initiative in a learning situation.

See Table 3.3 for descriptive statistics for the student independent learning items and reliabilities for the subscales. The table also includes information about the response scales of the variables.

Table 3.3
Items and Descriptive Statistics for Student Scales

Scale and Item	*M*	*SD*	*Loading*	*Coefficient α*
Motivation/volition				.915
Studies to get a good grade[1]	2.69	0.926	0.732	
Remembers most important things when studies[1]	2.90	0.856	0.562	
Studies to increase job opportunities[1]	2.65	0.960	0.826	
Works as hard as possible when studies[1]	2.72	0.876	0.851	
Keeps studying even if material is difficult[1]	2.66	0.882	0.615	
Studies to ensure financial security[1]	2.71	0.959	0.802	
Does best to learn what studies[1]	2.78	0.859	0.628	
Puts forth best effort when studying[1]	2.76	0.878	0.799	
Math interest and self-efficacy				.903
Reverse coded totally absorbed in math[2]	2.49	0.813	0.427	
Reverse coded math is fun[2]	2.18	0.841	0.624	
Reverse coded math is important[2]	2.45	0.886	0.559	
Can do excellent job on math tests[1]	2.53	0.930	0.856	
Can understand difficult math texts[1]	2.35	0.933	0.895	
Can understand difficult math class[1]	2.46	0.956	0.862	
Can get no problems wrong if decides to[1]	2.49	0.883	0.384	
Can do excellent job on math assignments[1]	2.62	0.934	0.811	
Can master math class skills[1]	2.65	0.937	0.815	
English and learning self-efficacy				.915
Can understand difficult English texts[1]	2.62	0.889	0.857	
Can learn something really hard[1]	2.82	0.906	0.302	
Can understand difficult English class[1]	2.65	0.912	0.863	
Can do excellent job on English assignments[1]	2.84	0.880	0.784	
Can do excellent job on English tests[1]	2.79	0.892	0.806	
Can master skills in English class[1]	2.75	0.887	0.825	
Voluntary reading				.853
Recoded hours/wk spent reading outside of school[3]	1.84	0.648	0.557	
Reverse coded reading is fun[2]	2.49	0.904	0.845	
Reverse coded reads in spare time[2]	2.48	0.917	0.865	
Reverse coded totally absorbed in reading[2]	2.71	0.919	0.719	
Preparation for class				.807
Reverse coded paper/pencil to class[4]	3.25	0.967	0.828	
Reverse coded books to class[4]	3.25	0.954	0.836	
Reverse coded homework to class[4]	2.86	0.900	0.629	

[1] 4-point scale: 1=almost never, 2=sometimes, 3=often, 4=almost always
[2] Reversed 4-point scale: 1=strongly disagree, 2=disagree, 3=agree, 4=strongly agree
[3] Recoded 4-point scale: 1=0 hours, 2=1-7 hours, 3=8-15 hours, 4=16 or more hours
[4] Reversed 4-point scale: 1=usually, 2=often, 3=seldom, 4=never

Canonical Correlation

In order to examine the relationships among groups of items, a multivariate method of correlation was used. Canonical correlation evaluates the relationships between two groups or sets of variables.

In this study, canonical correlations were used to examine three pairs of relationships: (a) parents' actions and students' independent learning, (b) students' independent learning and academic achievement, and (c) parents' actions and students' academic achievement. Composite scores for the subscales derived from the factor analysis were used as the variables representing parents' actions and students' independent learning. Academic achievement variables were IRT estimated number right scores for mathematics and reading. After calculation of the canonical correlations in SPSS, AM software (Cohen, 2005) was used to determine correct significance levels for the correlations based on the complex sample design.

The canonical correlation procedure generates non-overlapping linear combinations of variables so that collinearity is not present in the results (Stevens, 2002; Tabachnick & Fidell, 2007). The number of canonical correlations that will be generated is equal to the number of variables in the smaller set and these correlations are presented in descending order by magnitude. Often, only the first canonical correlation will be statistically significant, but sometimes others are also significant. The original variables in each set load onto a canonical variate representing the combination of those variables. Each set has a canonical variate, and the two variates (X and Y) are then correlated to arrive at the canonical correlation coefficient. It is customary to designate each canonical variate combination by the name of the variable which loads most heavily on it.

Structural Equation Modeling (SEM)

The foregoing procedures were followed by a series of structural equation models illustrating the hypothesized relationships among parent actions, student independent learning behaviors, and academic achievement outcomes. This analysis was performed using version 8.8 of the LISREL software program (Joreskog & Sorbom, 2005). Structural equation modeling (SEM) is a way of looking at complex relationships among a relatively large number of variables (Hoyle, 1995; Schumacker & Lomax, 2004). It is used to determine whether or not a theoretical model is supported by empirical data. The canonical correlations in this study showed how pairs of groups of variables related to each other, but only two groups at a time could be examined. SEM allows a look at the larger picture involving all three constructs of interest in this study. SEM also allows for correlation of errors, which is an advantage over regression analysis.

SEM involves a two-step process (Anderson & Gerbing, 1988): the creation and testing of a measurement model, and the creation and testing of a structural model. A confirmatory factor analysis (CFA) was performed to establish the measurement model. The exploratory factor analysis performed previously established factors comprising related items from the original dataset, using pairwise deletion to handle missing data in order to minimize impact on the sample size. For the CFA, however, it was necessary to use listwise deletion so that all items were based on the same sample size. Item parceling involves grouping together items which represent a common dimension, thus reducing the number of individual indicators for each latent variable in the model (Bandalos, 2002). Composite scores for the factors for parent actions and student independent learning behaviors were the item parcels used as observed indicators for the associated latent constructs in the measurement model.

Using SPSS, the dataset was randomly split into two parts so that cross-validation could be done. The two resulting datasets were then imported into AM. In a comparison of methods of compensating for complex sample designs for SEM, Stapleton (2006) found that the most accurate results were achieved by using software that allows exact calculation of design effects. For this reason, AM was used to calculate weighted design effect-adjusted correlations and standard deviations for each of the datasets to be used as input for LISREL.

The correlation matrices and standard deviations generated by AM for the two halves of the dataset are shown in Tables 3.4 and 3.5. For purposes of comparison, Table 3.6 shows relative-weighted, design effect-adjusted correlations for the complete dataset, as generated by SPSS with pairwise deletion of missing data.

To help ensure that the model would be identifiable, at least three observed indicators were used for two of the three latent variables. A metric was established for each latent variable by assigning a value of 1.0 to the indicator with the highest reliability from the initial run of LISREL. Fit statistics were evaluated, including χ^2, root mean square error of approximation (RMSEA), normed fit index (NFI), comparative fit index (CFI), parsimony normed fit index, the root mean square residual (RMR), and the expected cross-validation index (ECVI). Changes in the initial measurement model were made in accordance with theory, as described in Chapters 4 and 5. In the model, there were four indicators for parents' actions, five indicators for student independent learning, and two measures of academic achievement. For this study, control variables or covariates, such as SES and prior achievement, were not included because the focus was on testing the theoretical model as described below.

Table 3.4
First Half Design Effect-Adjusted Correlations and Standard Deviations

	BYTXMIRR	BYTXRIRR	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
BYTXMIRR	1.000										
BYTXRIRR	0.740	1.000									
IL1_MOT	0.165	0.148	1.000								
IL2_MSE	0.323	0.124	0.530	1.000							
IL3_ESE	0.251	0.312	0.622	0.383	1.000						
IL4_VRE	0.150	0.286	0.194	0.098	0.328	1.000					
IL5_PRE	0.152	0.149	0.187	0.093	0.125	0.092	1.000				
PA1_INV	0.160	0.140	0.112	0.108	0.112	0.010	0.057	1.000			
PA2_ADV	0.075	0.075	0.114	0.081	0.105	0.091	0.038	0.350	1.000		
PA3_CTL	-0.114	-0.087	0.046	0.009	0.026	0.027	0.007	0.347	0.345	1.000	
PA4_FUN	0.007	0.023	0.065	0.018	0.051	0.006	0.028	0.406	0.257	0.301	1.000
SD	11.760	9.583	0.714	0.681	0.750	0.712	0.762	0.777	0.542	0.425	0.540

Listwise N=4631

Abbreviations:

BYTXMIRR	Math IRT estimated number right
BYTXRIRR	Reading IRT estimated number right
IL1_MOT	Student independent learning factor 1, motivation/volition
IL2_MSE	Student independent learning factor 2, math interest/self-efficacy
IL3_ESE	Student independent learning factor 3, English interest/self-efficacy
IL4_VRE	Student independent learning factor 4, voluntary reading
IL5_PRE	Student independent learning factor 5, preparation for class
PA1_INV	Parent factor 1, parental involvement
PA2_ADV	Parent factor 2, parental advice giving
PA3_CTL	Parent factor 3, parental control/helping with homework
PA4_FUN	Parent factor 4, family fun

Table 3.5
Second Half Design Effect-Adjusted Correlations and Standard Deviations

	BYTXMIRR	BYTXRIRR	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
BYTXMIRR	1.000										
BYTXRIRR	0.754	1.000									
IL1_MOT	0.191	0.191	1.000								
IL2_MSE	0.341	0.167	0.539	1.000							
IL3_ESE	0.270	0.334	0.638	0.397	1.000						
IL4_VRE	0.152	0.296	0.242	0.153	0.355	1.000					
IL5_PRE	0.159	0.167	0.193	0.109	0.120	0.080	1.000				
PA1_INV	0.142	0.129	0.141	0.096	0.120	0.015	0.084	1.000			
PA2_ADV	0.048	0.066	0.107	0.037	0.114	0.098	0.054	0.331	1.000		
PA3_CTL	-0.113	-0.099	0.043	-0.024	-0.001	0.021	-0.003	0.360	0.351	1.000	
PA4_FUN	0.010	0.016	0.081	0.000	0.053	0.014	0.039	0.407	0.249	0.315	1.000
SD	11.883	9.583	0.731	0.687	0.764	0.723	0.765	0.787	0.544	0.432	0.554

Listwise N=4644

Abbreviations:

BYTXMIRR	Math IRT estimated number right
BYTXRIRR	Reading IRT estimated number right
IL1_MOT	Student independent learning factor 1, motivation/volition
IL2_MSE	Student independent learning factor 2, math interest/self-efficacy
IL3_ESE	Student independent learning factor 3, English interest/self-efficacy
IL4_VRE	Student independent learning factor 4, voluntary reading
IL5_PRE	Student independent learning factor 5, preparation for class
PA1_INV	Parent factor 1, parental involvement
PA2_ADV	Parent factor 2, parental advice giving
PA3_CTL	Parent factor 3, parental control/helping with homework
PA4_FUN	Parent factor 4, family fun

Table 3.6
Full Dataset Relative-Weighted, Design Effect-Adjusted Correlations

	BYTXMIRR	BYTXRIRR	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
BYTXMIRR	1.000										
BYTXRIRR	0.760**	1.000									
IL1_MOT	0.193**	0.195**	1.000								
IL2_MSE	0.296**	0.124**	0.537**	1.000							
IL3_ESE	0.259**	0.326**	0.644**	0.399**	1.000						
IL4_VRE	0.140**	0.254**	0.230**	0.145**	0.334**	1.000					
IL5_PRE	0.190**	0.198**	0.184**	0.094**	0.134**	0.083**	1.000				
PA1_INV	0.170**	0.165**	0.115**	0.085**	0.113**	0.008	0.086**	1.000			
PA2_ADV	0.073**	0.082**	0.118**	0.058**	0.115**	0.071**	0.045*	0.329**	1.000		
PA3_CTL	-0.100**	-0.076**	0.028	-0.020	-0.001	0.002	0.004	0.350**	0.359**	1.000	
PA4_FUN	0.019	0.050**	0.072**	0.008	0.057**	0.016	0.055**	0.400**	0.253**	0.302**	1.000

* *p < .01*
** *p < .001*

Abbreviations:

BYTXMIRR	Math IRT estimated number right
BYTXRIRR	Reading IRT estimated number right
IL1_MOT	Student independent learning factor 1, motivation/volition
IL2_MSE	Student independent learning factor 2, math interest/self-efficacy
IL3_ESE	Student independent learning factor 3, English interest/self-efficacy
IL4_VRE	Student independent learning factor 4, voluntary reading
IL5_PRE	Student independent learning factor 5, preparation for class
PA1_INV	Parent factor 1, parental involvement
PA2_ADV	Parent factor 2, parental advice giving
PA3_CTL	Parent factor 3, parental control/helping with homework
PA4_FUN	Parent factor 4, family fun

In the proposed structural model, shown in Figure 3.1, parental actions are exogenous and they lead to student independent learning. There are paths from both parent actions and student independent learning to academic achievement. This model illustrates the theory presented in Chapter 1. This model is not intended to be a complete explanation of the relationships among the constructs; no covariates are used in this analysis.

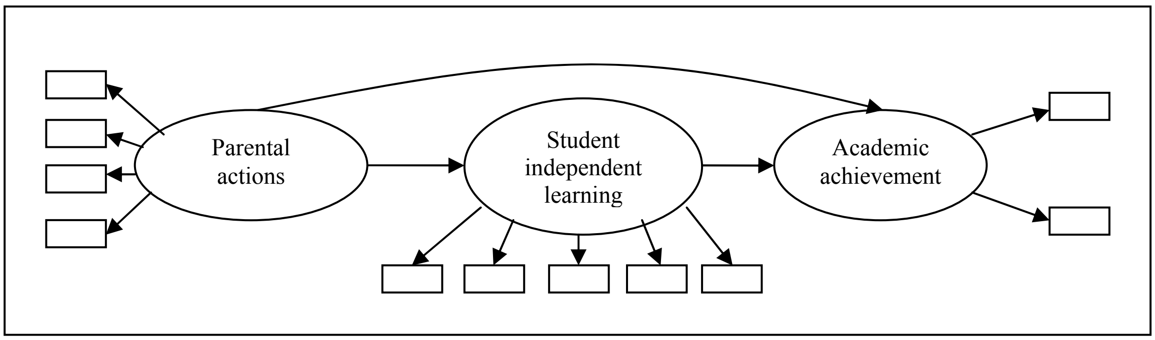

Figure 3.1: Proposed structural model

The expected cross-validation index (ECVI) was used as the primary means of determining whether the model was likely to cross-validate. In addition, the final measurement and structural models were run using the second dataset and the results for the two datasets were compared. These results are reported in Chapter 4.

Multivariate Analysis of Variance (MANOVA)

A multivariate analysis of variance (MANOVA) was performed to compare means for different family structure groups on student independent learning subscales. MANOVA is a procedure used to compare values of a set of variables within and among more than two groups (Stevens, 2002). For this analysis, the effect of the complex sampling design was compensated for by creating and using a special design effect weight (Thomas et al., 2005). The design effect weight was calculated by dividing the relative weight by the mean design effect given in the ELS:2002 documentation (National Center for Education Statistics, 2006). After applying the design effect-adjusted weight to the data, the MANOVA analysis was done in SPSS. While the sum of the relative weights yields a sample size equal to the actual sample size in the dataset, the design effect weight sums to the "effective sample size," which is the size of a simple random sample that would be equivalent in statistical power to the sample obtained using clustering and stratification. Using this smaller sample size in the computations produces more robust standard errors and hence more accurate significance levels (Stapleton, 2006).

Because the group sizes were far from equal, Box's M was calculated to verify homogeneity of variances. This test is used to compare the covariance matrices of the groups in the analysis to determine whether the amount of variation in the factors can be considered equal among groups (Stevens, 2002).

To evaluate the relationship of family structure to students' manifestation of independent learning behaviors, the base year family composition variable was selected as a grouping variable. In the ELS:2002 database, this variable had 9 response categories: 1 = mother and father; 2 = mother and male guardian; 3 = father and female guardian; 4 = two guardians; 5 = mother only; 6= father only; 7 = female guardian only; 8 = male guardian only; and 9 = lives with student less than half time. Due to theoretical concerns about the effects of living in a home with one biological parent and another adult (referred to hereafter as "stepfamilies"), this variable was recoded as follows: 1 = both parents; 2 = stepfamilies (combining categories 2 and 3); 3 = single parent (combining categories 5 and 6); and 4 = other (combining categories 4, 7, 8, and 9). Category 9 was included in "other" because it involves children who live less than half of the time with a biological parent who completed the parent survey; the majority of the time, the child could conceivably live in any of the other eight environments or in an institution. Base year-weighted, design effect-weighted, and unweighted frequencies for the original and recoded variables are shown in Tables 3.7 and 3.8. Note that percentages are the same regardless of the type of weight applied, but the unweighted percentages are different due to the purposive oversampling of some strata within the population.

Table 3.7
Frequencies of Original Family Composition Variable

Value	*Description*	*Base Year Weighted Freq.*	*Student Design Weighted Freq.*	*Weighted (all weights) Percent*	*Unweighted Freq.*	*Unweighted Percent*
1	Mother and father	1948633	3929	56.8	9138	56.2
2	Mother and male guardian	460751	929	13.4	1890	11.6
3	Father and female guardian	110889	224	3.2	495	3.2
4	Two guardians	63699	128	1.9	267	1.6
5	Mother only	652921	1317	19.0	2767	17.0
6	Father only	108880	220	3.2	453	2.8
7	Female guardian only	44740	90	1.3	191	1.2
8	Male guardian only	8401	17	0.2	49	0.3
9	Lives with student less than half time	30634	62	0.9	146	0.9
	Missing	0	0	0.0	34	0.2
	Legitimate skip	0	0	0.0	171	1.1
	Nonrespondent	0	0	0.0	651	4.0

Table 3.8
Frequencies of Recoded Family Composition Variable

Value	*Description*	*Base Year Weighted Freq.*	*Student Design Weighted Freq.*	*Weighted (all weights) Percent*	*Unweighted Freq.*	*Unweighted Percent*
1	Mother and father	1948633	3929	56.8	9138	56.2
2	Stepfamily	571640	1153	16.7	2385	14.7
3	Single parent	761801	1536	22.2	3220	19.8
4	Other	147474	297	4.3	653	4.0
	Missing	0	0	0.0	856	5.3

The results of the MANOVA will demonstrate whether or not there is a significant and substantive difference in the development of independent learning behaviors in students from different family structures. When a significant difference is found in MANOVA, post hoc procedures may be used to identify which differences among groups are significant. The specific procedures selected depend upon the determination of homogeneity of variance. If the variances of the groups are not significantly different, the Student-Newman-Keuls and Tukey's Honestly Significant Difference (HSD) are suitable post hoc tests. Of the two, Tukey's tends to be more conservative. When the variances are quite different among groups, Dunnett's C is an appropriate test (Howell, 2002). Due to the vastly different sizes of the groups, the variances are expected to be significantly different.

Because several previous researchers have shown SES to be an important factor in differences found among family structure groups, a multivariate analysis of covariance (MANCOVA) was considered for this study, using SES as a covariate. A good covariate is strongly correlated with dependent variables but not with independent variables. Therefore, bivariate Pearson correlations were performed for SES, the recoded family structure variable, and student independent learning subscales.

Correlations of SES with student factors ranged from $r = .102$ for the math interest/self-efficacy subscale to $r = .195$ for the English and learning interest/self-efficacy subscale. The correlation of SES and the recoded family structure variable was -.232, which was stronger than any of the correlations of SES with the dependent variables. For this reason, MANCOVA was not included in the final analysis for this study.

Note that the correlation between SES and recoded family structure was negative. This reflects the fact that the families containing two biological parents are at the low end of the response scale, with “other” family structures, which may potentially have no biological parents present, at the high end of the scale. To the degree that family structure and SES are associated, the tendency is for two-parent families to have a higher SES level than other family structures.

CHAPTER 4

RESULTS

In this chapter, the results of the analyses described in Chapter 3 are presented. Canonical correlations and structural equation models were used to test Hypotheses 1 through 5, pertaining to relationships among sets of factors for parents' actions, student independent learning characteristics, and academic achievement. Hypothesis 6 was tested by a MANOVA comparing the independent learning subscale scores for students from different family structures. The hypotheses are repeated here for the reader's convenient reference.

(1) There will be a significant positive relationship between parents' actions which encourage autonomy (authoritative parenting style) and students' manifestation of independent learning characteristics.

(2) There will be a negative relationship between parents' actions associated with a high degree of parental control (authoritarian parenting style) and students' manifestation of independent learning characteristics.

(3) There will be a significant positive relationship between student independent learning characteristics and academic achievement.

(4) There will be a positive relationship between parents' actions associated with an authoritative style and students' academic achievement.

(5) There will be a negative relationship between parents' actions associated with an authoritarian style and students' academic achievement.

(6) There will be a difference between children from different family structures in their manifestation of independent learning characteristics.

A discussion of the implications of the results presented in this chapter will be featured in Chapter 5.

Canonical Correlation

Statistically significant canonical correlations were found for all three tested relationships between pairs of factor groups. These relationships were parents' actions and independent learning, independent learning and academic achievement, and parents' actions and academic achievement. Canonical correlations with effect sizes of at least 1% are reported below.

Canonical Correlation Between Parent Factors and Independent Learning

There were four canonical correlations between parental factors and independent learning behavior, with two of sufficient magnitude to be of interest. In the first, shown in Figure 4.1, the strongest parent factor was parental involvement, which had a loading of -.815. This was followed by parental advice (-.630) and family fun (-.332). Parental control/homework had a very low magnitude loading on the variate at .006. This pattern of loadings was consistent with an authoritative parenting style.

In this correlation, the student independent learning factor with the strongest association was English interest/self-efficacy (-.834), followed by motivation/volition (-.804), mathematics interest/self-efficacy (-.654), preparation for class (-.491), and voluntary reading (-.216). For this correlation, $r = .183$ and $\chi^2 = 495.554$ with 20 *df* ($p < .001$). The square of the canonical correlation is the effect size, approximately 3.35%.

Hypothesis 1, which states that there will be a significant positive correlation between authoritative parenting and student independent learning characteristics, is supported by this result.

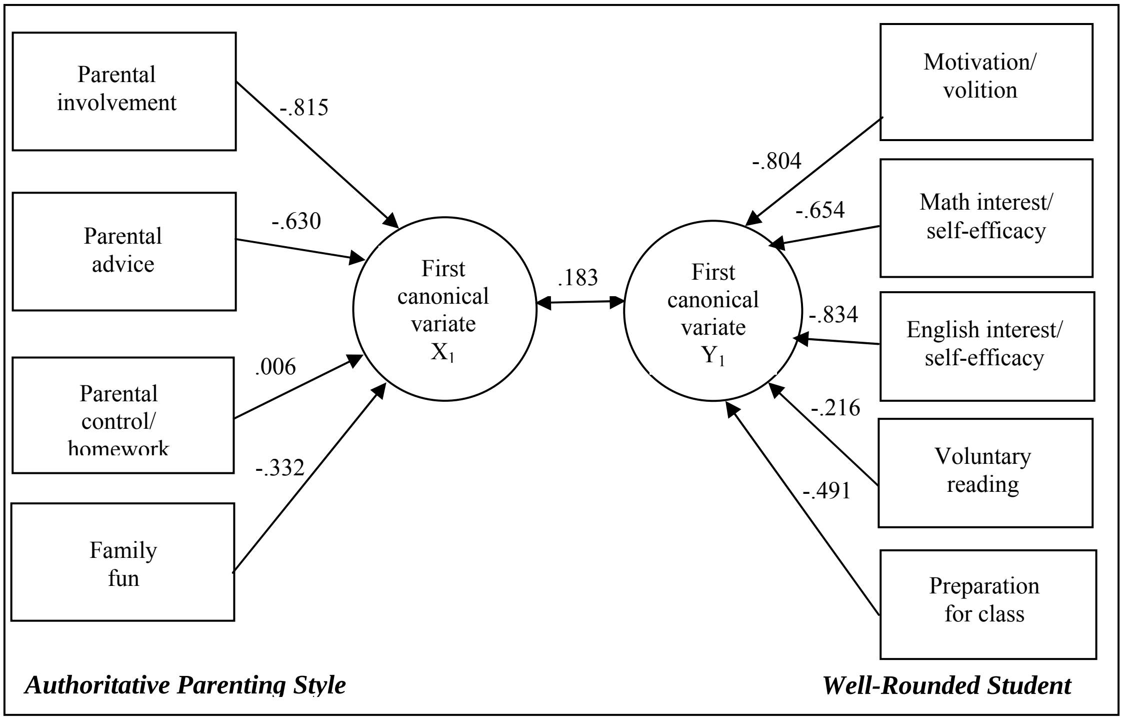

Figure 4.1: First canonical correlation between parent factors and student independent learning

In the second correlation (Figure 4.2), the dominant parent factor was parental advice with a loading of -.751. In order of magnitude, this was followed by parental control/homework (-.350), parental involvement (positive .301), and family fun (-.216). This combination of relatively high parental control and high parental advice could depict an authoritarian parenting style.

The strongest associated student independent learning factor in this canonical correlation was voluntary reading (-.820). Other negative loadings onto the variate were motivation/volition (-.290) and English interest/self-efficacy (-.242). Positive loadings were .251 for math interest/self-efficacy and .181 for preparation for class.

This canonical correlation was statistically significant and had a coefficient of $r = .100$ and $\chi^2 = 158.077$ with 12 *df* ($p < .001$). The effect size of 1% was not large. This combination of parent actions had a positive association with voluntary reading, motivation/volition, and English interest/self-efficacy, but a negative relationship with math interest/self-efficacy and preparation for class. Thus, it appears that Hypothesis 2 is supported with regard to two independent learning factors, math interest/self-efficacy and preparation for class. However, the hypothesized negative relationship between authoritarian parenting and the other three independent learning factors is not supported.

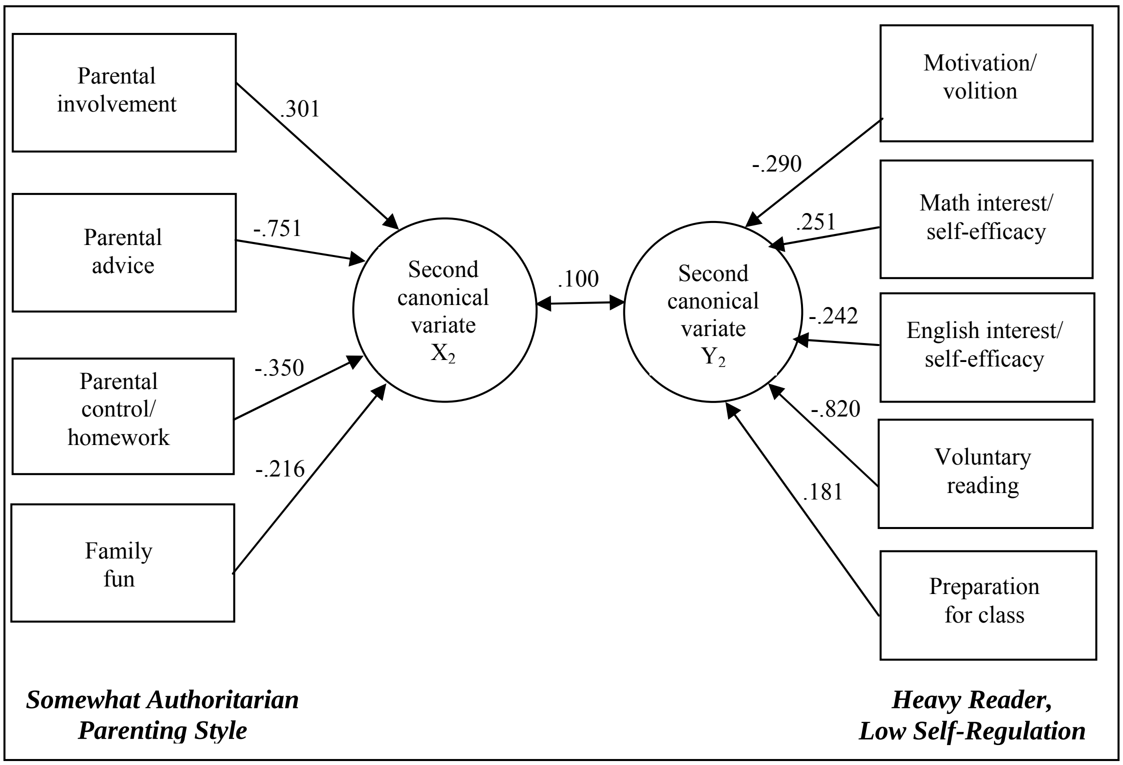

Figure 4.2: Second canonical correlation between parent factors and independent learning

Canonical Correlation Between Independent Learning and Achievement

Three canonical correlations for the second tested relationship, between student independent learning factors and academic achievement, were all significant ($p < .001$). The first two were of sufficient size to be of interest. In the first correlation (Figure 4.3), the strongest loadings on the independent learning variate were English interest/self-efficacy with a loading of .788 and voluntary reading with a loading of .721, followed by preparation for class (.419) and motivation/volition (.427), with math interest/self-efficacy having the smallest loading (.131). This combination characterizes a student who is strongly interested in the verbal domain and enjoys reading. This student also has moderately good motivation for learning and takes responsibility for arriving in class prepared to learn and participate, but has a low level of interest and self-efficacy in math.

The strongest loading on the corresponding variate was reading achievement (.972). Math achievement, although much lower than English, still had a strong positive loading of .572 on the variate. In this correlation, shown in Figure 4.3, r = .396 and χ^2 = 3896.571 with 10 *df*. The effect size was fairly substantial at approximately 15.7%.

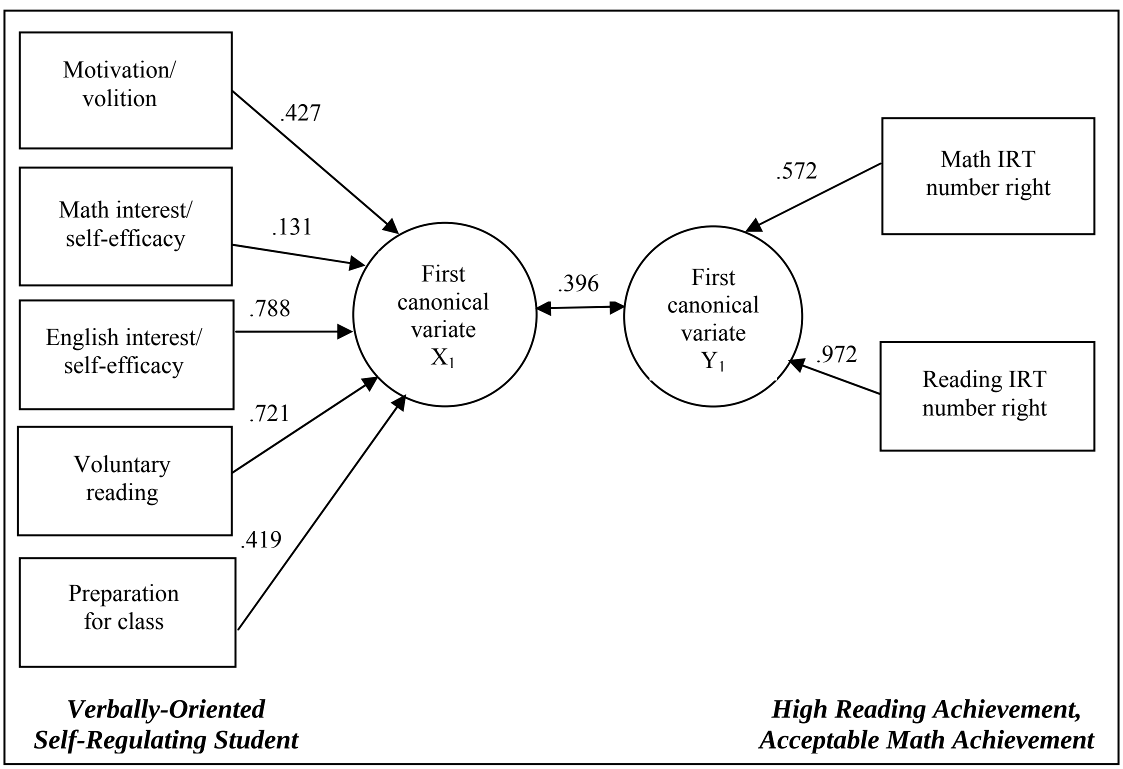

Figure 4.3: First canonical correlation between student independent learning and achievement.

Figure 4.4 shows the second significant canonical correlation for this pair of factors. In this correlation, mathematics interest/self-efficacy loaded very strongly (.925) on the independent learning variate, distantly followed by motivation/volition (.307), preparation for class (.266), and English interest/self-efficacy (.261). Voluntary reading was the only factor that had a negative loading (-.113) on the X variate.

The math achievement score was the dominant factor loading on the Y variate with a loain of .820. Reading achievement followed very distantly with a loading of .235. This indicates that a student whose dominating interest and sense of self-efficacy is in the mathematical domain is likely to excel in math achievement. In this relationship, $r = .374$ and $\chi^2 = 1823.974$ with 4 *df*. The effect size was approximately 14%. Hypothesis 3 was supported by both of the canonical correlations between independent learning and achievement. These analyses also demonstrated that the relationships can be strongly domain-specific.

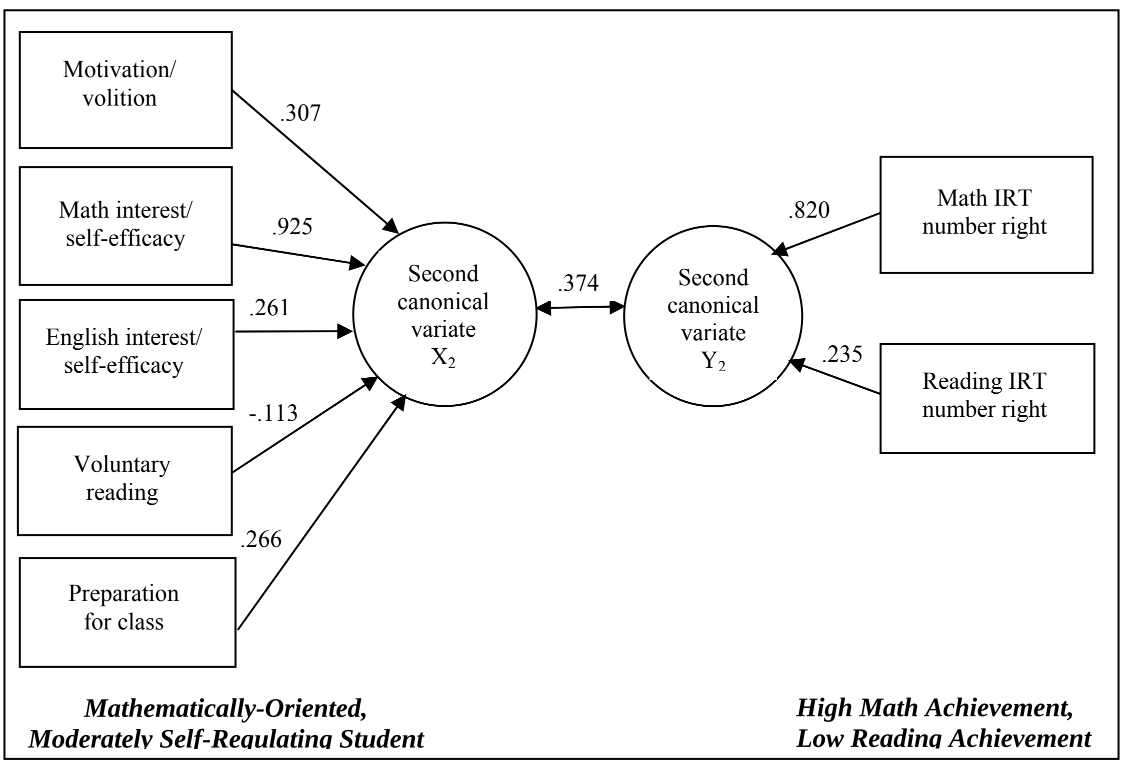

Figure 4.4: Second canonical correlation between independent learning and achievement

Canonical Correlation Between Parent Factors and Achievement

Finally, examination of the relationship between parental factors and academic achievement produced two canonical correlations, with one of sufficient magnitude to be of interest. In this correlation, shown in Figure 4.5, the factor of parental involvement had the strongest loading (-.690) on the parent actions variate. Loadings were negative for parental advice (-.303) and family fun (-.115), but positive for parental control/homework (.379). The parental control/homework factor had the second highest magnitude loading on the X variate but it was the only loading with a positive sign. This indicates that parental control is negatively associated with the other parent factors and the achievement measures.

Both achievement measures were strongly associated with the corresponding Y variate with the loading for math achievement (-.976) surpassing reading achievement (-.881). Overall, high parental involvement but not parental control, is associated with high math and reading achievement. The correlation was $r = .259$, and $\chi^2 = 949.0$ with 8 *df* ($p < .001$). Squaring the canonical correlation yielded an effect size of approximately 6.7%.

Although the magnitudes are different, the pattern of loadings onto the X variate is similar to that of Figure 4.1, which represents an authoritative parenting style. Therefore, Hypothesis 4, which states that parental actions associated with an authoritative parenting style are positively associated with academic achievement, is supported. Hypothesis 5 is not supported because there are no remaining statistically significant canonical correlations.

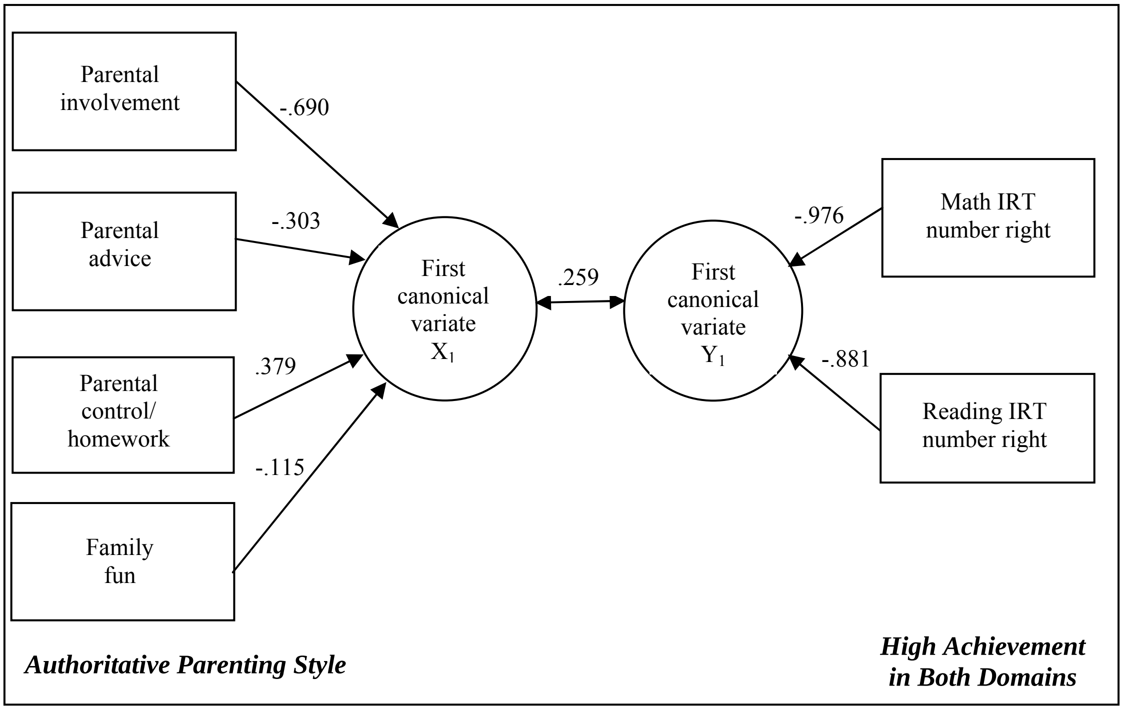

Figure 4.5: First canonical correlation between parent factors and achievement

In summary, canonical correlations produced evidence supporting three of the first five hypotheses advanced in this study, with partial support for a fourth. A pattern of parent factors consistent with the authoritative style was seen to have a positive association with student independent learning factors. Significant positive relationships were found between independent learning factors and academic achievement, and also between parent factors indicative of authoritative parenting and achievement.

An authoritarian parenting style was expected to have a negative relationship with independent learning, but this was the case for only two of the independent learning factors, math interest/self-efficacy and preparation for class. The other three factors, motivation/volition, English interest/self-efficacy, and especially voluntary reading, were found to have a positive relationship with authoritarian parenting.

Structural Equation Modeling (SEM)

To gain perspective on the nature and magnitude of relationships among the parent factors, independent learning factors, and achievement measures, structural equation modeling was used. First, a measurement model was established. Then a structural model depicting the theoretical relationships was tested. Results of these procedures are described below.

Measurement Model

The dataset was randomly split into two parts so that cross-validation of the final models could be done. Using the first half of the data, an initial measurement model was run to determine which of the indicators for each construct should serve as the metric for the construct. Adjustments were made and the model was rerun. There were no changes in the fit statistics, and the results are discussed below as the initial measurement model.

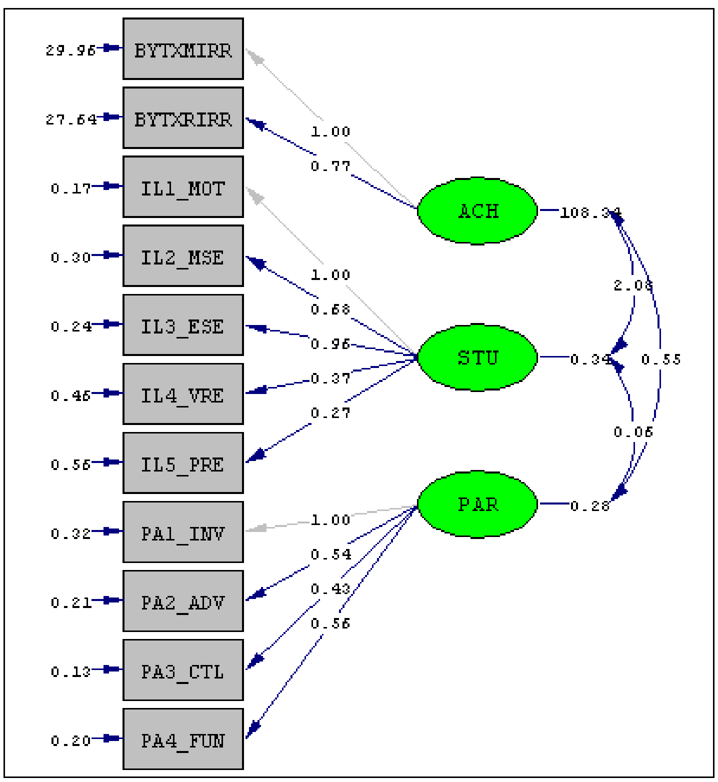

Figure 4.6: Diagram of initial measurement model

In the initial model, illustrated in Figure 4.6, all of the factor loadings were statistically significant, but some were of small magnitude. In this case, statistical significance may be due to the large sample size (n = 4,631). The weighted least squares χ^2 was 1913.61 (p = 0.00) with 41 degrees of freedom. The minimum fit function χ^2 was 1857.83 (p = 0.00), and the non-centrality parameter (NCP) was 1872.61. The root mean square error of approximation (RMSEA) was 0.099; ideally, this should be less than 0.05. All of these indicated a poor fit of the model to the data.

The expected cross-validation index (ECVI) for the initial model was 0.42, which fell between the ECVI for the saturated model (0.029) and the ECVI for the independence model (2.92). According to Schumacker and Lomax (2004), smaller values of ECVI are desirable because they indicate models that are likely to be stable for the population. Akaike's Information Criterion (AIC) for the model was 1963.61, which also fell between the saturated AIC (132.00) and the independence AIC (13525.05). Other fit indices were low, including the normed fit index (NFI) of 0.86, non-normed fit index (NNFI) of 0.81, comparative fit index (CFI) of 0.86, incremental fit index (IFI) of 0.86, and relative fit index (RFI) of 0.81. Values of more than 0.95 would be desirable for all of these. Parsimony was found to be unsatisfactory as evaluated by the parsimony normed fit index (PNFI), which was 0.64, and the parsimony goodness-of-fit index (PGFI), which was 0.58. For the parsimony indices, a higher number indicates a more parsimonious model, which is desirable.

The Critical N (CN) of the initial model was 158.15. Values of at least 200 are considered good, so this indicates a need for improvement. The root mean square residual (RMR) was 0.35 and the standardized RMR was 0.058. The goodness-of-fit index (GFI) was 0.93 and the adjusted goodness-of-fit index (AGFI) was 0.89. These indices also were in need of improvement.

Several pairs of correlated errors were included in the final model. For each of the allowed correlated errors, it is conceivable within the theory advanced in this study that common factors outside of the model could influence both of the observed variables. Further suggested modifications were not made because they were not theoretically defensible. Changes entered at each step are described as follows:

1. Correlated errors of math self-efficacy and math achievement. This specification was allowed because a factor such as prior math achievement could impact both current math test performance and self-efficacy in the subject.
2. Correlated errors of math self-efficacy and motivation/volition. A concept such as learned helplessness may affect both the sense of self-efficacy and the willingness to commit to learning goals and put forth effort.
3. Correlated errors of voluntary reading and reading achievement. Voluntary readers are likely to be able to read faster and this faster reading ability would be beneficial in a timed test.
4. Correlated errors of preparation for class and English self-efficacy. In accordance with the concepts of learned helplessness and performance-avoidance goals, students who do not feel capable of learning may purposely come to class unprepared, using the lack of required materials as an excuse for not being able to attempt class learning tasks.
5. Correlated errors of parental control and parental advice. Most of the items loading on both of these factors make reference to school. The highest loading item on the parental control factor is checking that homework is completed, and the highest loading on parental advice is for advice about applying to college.

Parents' aspirations of higher education for their children could explain the correlation of these errors.

6. Correlated errors of English self-efficacy and math achievement. This pair of correlated errors could be explained by the prevalence of word problems in standardized math tests. Students who have strong numerical ability but are weak in reading may have difficulty demonstrating their math ability if the test requires strong reading ability in order to understand the math problem.

Table 4.1 allows comparison of selected statistics for several iterations of the measurement model.

Table 4.1
Comparison of Measurement Model Fit Statistics

Model	WLS χ^2	*df*	CFI	GFI	RMSEA	PGFI	ECVI	AIC	CN
Initial (a)	1913.61	41	.86	.93	.099	.58	.42	1963.61	158.15
b	1298.40	40	.91	.95	.082	.58	.29	1350.94	228.03
c	889.18	39	.94	.97	.069	.57	.20	943.18	326.07
d	689.14	38	.95	.97	.061	.56	.16	745.14	411.92
e	551.92	37	.96	.98	.055	.55	.13	609.92	503.44
f	495.71	36	.97	.98	.053	.54	.12	555.71	548.52
g	438.03	35	.97	.98	.050	.52	.11	500.03	607.12

The final measurement model, shown in Figure 4.7, has a WLS χ^2 of 438.03 (p = 0.00) with 35 degrees of freedom, NCP of 403.03, and RMSEA of 0.050. The RMSEA value indicates acceptable fit, yet the χ^2 is still statistically significant, which signifies a poor fit. Other fit indices such as NFI, NNFI, CFI, IFI, RFI, GFI, and AGFI are all at least 0.95, indicating acceptable fit. The model ECVI is 0.11, which still falls between the saturated and independence estimates but is close to the ECVI for the saturated model (0.029). With each change to the model, the ECVI was reduced, indicating that the model was becoming more likely to cross-validate. Ideally, the ECVI for the model should be lower than both the saturated and independence values for this index. AIC for the model was 500.03; this value fell between the saturated AIC (132.00) and the independence AIC (13525.05). As with ECVI, it would be ideal for the model AIC value to fall below the values for both the saturated and independence AIC values.

There was a non-significant negative variance estimate for English self-efficacy in the final model. This produced a reliability of over 1.00 for the indicator, but the lack of statistical significance would seem to ameliorate the impact on the suitability of the model specification. Reliabilities for all other indicators ranged from 0.10 to 0.79, with the achievement variables having the highest ratings.

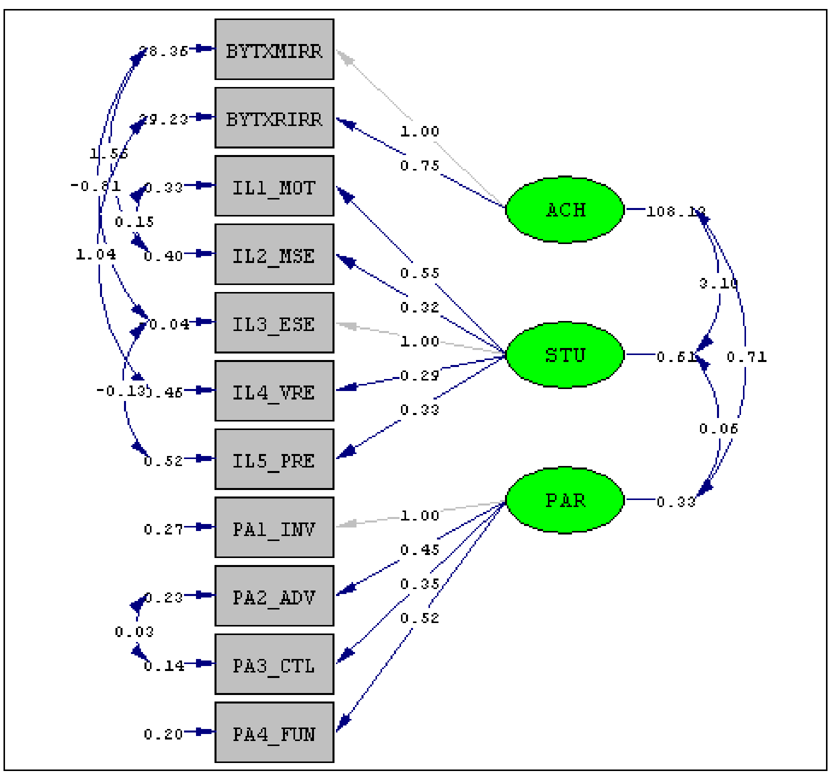

Figure 4.7: Diagram of final measurement model

The CN of the initial model was 158.15; in the final model, this increased to 607.12, which is well over the desired minimum value of 200. RMR changed slightly from 0.35 in the initial model to 0.40 in the final model, and the final standardized RMR was 0.040. Table 4.2 shows the factor loadings, standardized loadings, reliabilities, and variances for the indicators in this model.

Table 4.2
Final Measurement Model Factor Loadings Using Set 1

Construct/Item parcel variable	Unstandardized Loading	Standardized Loading	Indicator Reliability	Error Variance
Academic achievement (ACH)				
Mathematics IRT (BYTXMIRR)	1.00	10.40	0.79	28.36
Reading IRT (BYTXRIRR)	0.75	7.84	0.68	29.23
Student independent learning (STU)				
Student motivation/volition (IL1_MOT)	0.55	0.43	0.35	0.33
Student math self-efficacy/interest (IL2_MSE)	0.32	0.25	0.13	0.40
Student English self-efficacy/interest (IL3_ESE)	1.00	0.78	1.08	-0.04
Student voluntary reading (IL4_VRE)	0.29	0.23	0.10	0.46
Student preparation for class (IL5_PRE)	0.33	0.26	0.11	0.52
Parents' actions (PAR)				
Parent involvement (PA1_INV)	1.00	0.57	0.55	0.27
Parent advising (PA2_ADV)	0.45	0.26	0.22	0.23
Parental control/homework (PA3_CTL)	0.35	0.20	0.23	0.14
Parent having fun with student (PA4_FUN)	0.52	0.30	0.31	0.20

NOTE: All factor loadings are statistically significant. All error variances are statistically significant except English self-efficacy.

When the final measurement model was run on the second dataset, the results were slightly different from those obtained for the first dataset. All loadings of indicators onto latent factors were statistically significant. The WLS χ^2 was 468.43 ($p = 0.00$) with 35 degrees of freedom, NCP was 433.43, and RMSEA was 0.052. These indicated that the fit was slightly worse for the second set than for the first, but RMSEA was still close to 0.050. The ECVI was the same at 0.11, which fell between the ECVI for the saturated model (0.028) and for the independence model (3.13). CFI (0.97), GFI (0.98), and PGFI (0.52) did not change from the values for the first dataset. CN (569.37) was slightly lower but still well over the critical value of 200. Overall, the fit of the model to the second dataset is about as good as for the first set. The negative variance problem noted in the model for set 1 did not occur with set 2; however, the variance for English self-efficacy remained not statistically significant with the second dataset. Table 4.3 shows a comparison of selected fit indices for the two datasets. Factor loadings, reliabilities, and variances for set 2 are shown in Table 4.4.

Table 4.3
Comparison of Measurement Model Fit Statistics for Both Datasets

Dataset	WLS χ^2	*df*	CFI	GFI	RMSEA	PGFI	ECVI	AIC	CN
1	438.03	35	.97	.98	.050	.52	.11	500.03	607.12
2	468.43	35	.97	.98	.052	.52	.11	530.43	569.37

Table 4.4
Final Measurement Model Factor Loadings Using Set 2

Construct/Item parcel variable	Unstandardized Loading	Standardized Loading	Indicator Reliability	Error Variance
Academic achievement (ACH)				
Mathematics IRT (BYTXMIRR)	1.00	10.14	0.74	36.23
Reading IRT (BYTXRIRR)	0.81	8.26	0.75	22.16
Student independent learning (STU)				
Student motivation/volition (IL1_MOT)	0.64	0.47	0.42	0.31
Student math self-efficacy/interest (IL2_MSE)	0.37	0.28	0.16	0.40
Student English self-efficacy/interest (IL3_ESE)	1.00	0.75	0.96	0.03
Student voluntary reading (IL4_VRE)	0.35	0.26	0.13	0.46
Student preparation for class (IL5_PRE)	0.32	0.24	0.10	0.53
Parents' actions (PAR)				
Parent involvement (PA1_INV)	1.00	0.57	0.53	0.29
Parent advising (PA2_ADV)	0.43	0.25	0.21	0.23
Parental control/homework (PA3_CTL)	0.38	0.22	0.25	0.14
Parent having fun with student (PA4_FUN)	0.55	0.31	0.32	0.21

NOTE: All factor loadings are statistically significant. All error variances are statistically significant except English self-efficacy.

Structural Model

In the structural model, parent actions are viewed as exogenous variables whose antecedents are outside of the model. There is a path from parent actions to student independent learning characteristics as well as to the outcome construct of academic achievement. Fit statistics for the first dataset did not change with the specification of student independent learning as an endogenous construct and the addition of structural paths. Because there is more than one dependent construct in the structural model, it was necessary to adjust the specifications for the Psi matrix. For complete details, see the LISREL output in Appendix C. Figure 4.8 illustrates the structural model using the first dataset. The magnitude of the relationship between parent actions and student independent learning (r = 0.17) is small compared to the other structural paths in the model, but this relationship is still statistically significant.

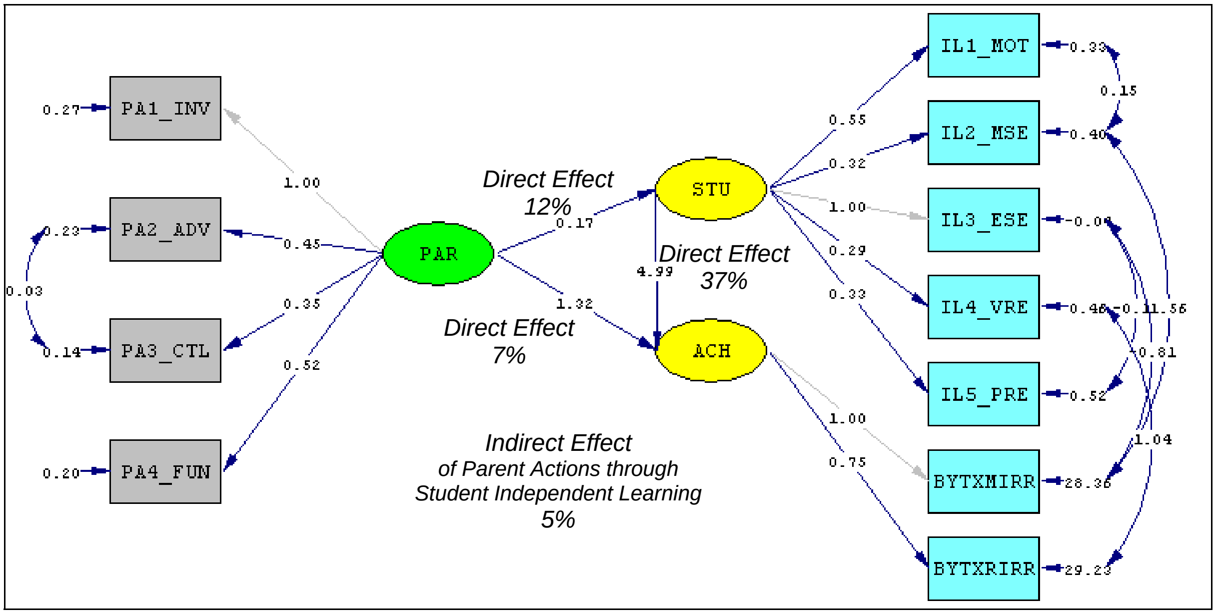

Figure 4.8: Structural model (dataset 1)

The results of applying the first structural model to the second dataset are shown in Figure 4.9. (See Appendix D for LISREL output.) In this sample, the relationships between parent actions and student independent learning, and between student independent learning and academic achievement, are of higher magnitude than in dataset 1, but the path from parent actions to academic achievement has a lower coefficient. Standardized effects for both datasets are shown in Table 4.5 below.

Table 4.5
Standardized Total, Direct, and Indirect Effects for Structural Model

	Set 1			Set 2		
Path	Total	Direct	Indirect	Total	Direct	Indirect
To Achievement						
From Student independent learning	0.37	0.37	-	0.40	0.40	-
From Parent actions	0.12	0.07	0.05	0.10	0.04	0.06
To Student independent learning						
From Parent actions	0.12	0.12	-	0.15	0.15	-

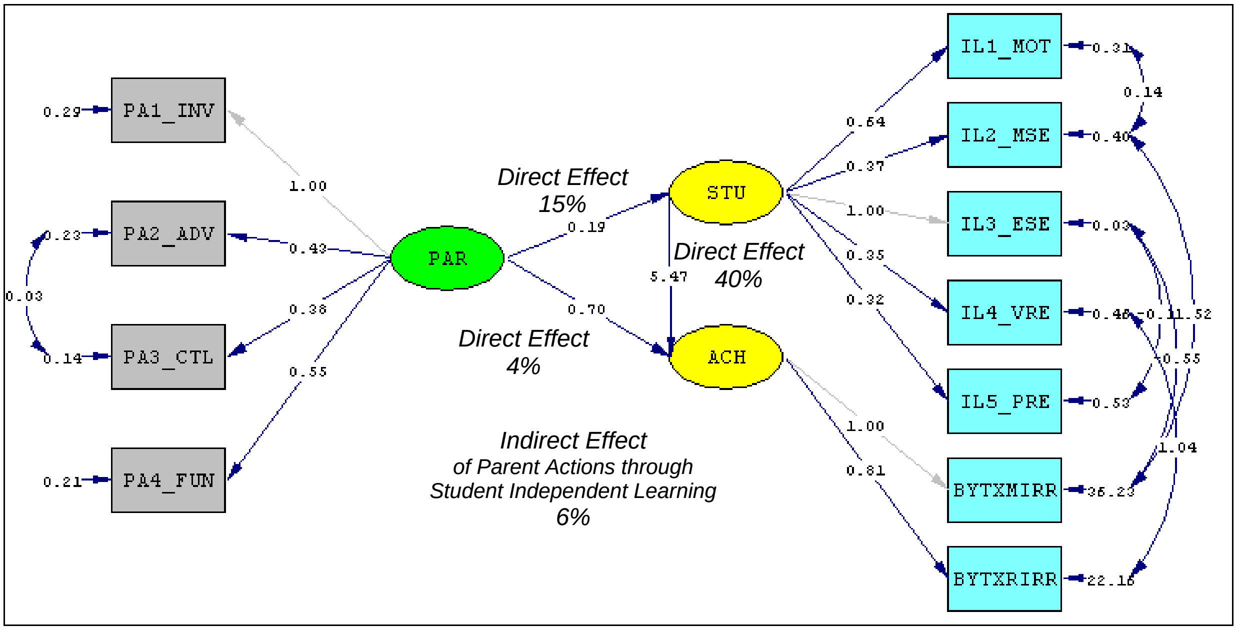

Figure 4.9: Cross-validation of structural model (dataset 2).

In summary, it is clear that student independent learning factors are more strongly and directly related to achievement than parent factors are. The relationship between student independent learning and achievement is both statistically significant and substantively important. However, the relationships of parent actions with both student independent learning and achievement, although statistically significant, have effect sizes under 20%. This does not indicate an important association of parent actions with either outcome.

Multivariate Analysis of Variance (MANOVA)

The possibility of differences in prevalence of independent learning characteristics among 10th graders based on family composition was investigated by means of MANOVA. Independent learning subscale scores for students in four types of family structure were compared, using recoded family composition as the grouping variable. The results of the MANOVA were all statistically significant but the effects were not substantial.

The Box's M test result was not significant ($M = 54.949$, $F = 1.215$, $df1 = 45$, $df2 = 1895438.250$, $p = .152$). In spite of unequal group sizes, variances among groups could be considered equal. Homogeneity of error variances applied to the groups on three of the five factors, as shown by the Levene's test results in Table 4.6. Error variances among groups on the motivation/volition and preparation for class factors were significantly different.

Table 4.6
Levene's Test of Equality of Error Variances for Independent Learning Factors

	F	*df1*	*df2*	Sig.
Motivation/volition student subscale composite score	2.723	3	4387	.043
Math interest/self-efficacy student subscale score	.296	3	4387	.829
English and learning self-efficacy subscale score	.667	3	4387	.572
Voluntary reading student subscale score	.246	3	4387	.864
Preparation for class student subscale score	2.963	3	4387	.031

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

Due to the results of the equality of variances tests, the appropriate multivariate test for this analysis is Pillai's Trace, which has a value of .012 ($F = 3.597$, $p < .001$). The overall effect size of the differences between family structure groups on student independent learning factors is 0.4%. Table 4.7 gives details of the multivariate test results.

Table 4.7
Multivariate Tests for Student Independent Learning Factors MANOVA

Effect		Value	*F*	Hypothesis *df*	Error *df*	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.942	14302.087[a]	5.000	4383.000	.000	.942
	Wilks' Lambda	.058	14302.087[a]	5.000	4383.000	.000	.942
	Hotelling's Trace	16.315	14302.087[a]	5.000	4383.000	.000	.942
	Roy's Largest Root	16.315	14302.087[a]	5.000	4383.000	.000	.942
RBYFCOMP	Pillai's Trace	.012	3.597	15.000	13155.000	.000	.004
	Wilks' Lambda	.988	3.603	15.000	12099.934	.000	.004
	Hotelling's Trace	.012	3.607	15.000	13145.000	.000	.004
	Roy's Largest Root	.009	8.169[b]	5.000	4385.000	.000	.009

a Exact statistic
b The statistic is an upper bound on F that yields a lower bound on the significance level.

The corrected model shown in Table 4.8 shows statistically significant differences among groups for four of the independent learning factors, motivation/volition ($F = 7.206$, $p < .001$), mathematics interest/self-efficacy ($F = 2.913$, $p < .05$), English self-efficacy ($F = 5.191$, $p = .001$), and preparation for class ($F = 10.100$, $p < .001$). Voluntary reading is not significantly different for students in different family structures. Effect sizes for the significant factors range from 0.2% for math self-efficacy to 0.7% for preparation for class. Table 4.9 gives estimated marginal means.

Table 4.8
Tests of Between-Subjects Effects for Student Independent Learning Factors

Source	Dependent Variable	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
Corrected Model	Motivation/volition student subscale composite score	11.322[a]	3	3.774	7.206	.000	.005
	Math interest/self-efficacy student subscale score	4.024[b]	3	1.341	2.913	.033	.002
	English and learning self-efficacy subscale score	8.930[c]	3	2.977	5.191	.001	.004
	Voluntary reading student subscale score	.310[d]	3	.103	.202	.895	.000
	Preparation for class student subscale score	18.441[e]	3	6.147	10.100	.000	.007
Error	Motivation/volition student subscale composite score	2297.640	4387	.524			
	Math interest/self-efficacy student subscale score	2019.875	4387	.460			
	English and learning self-efficacy subscale score	2515.773	4387	.573			
	Voluntary reading student subscale score	2250.360	4387	.513			
	Preparation for class student subscale score	2670.031	4387	.609			
Corrected Total	Motivation/volition student subscale composite score	2308.962	4390				
	Math interest/self-efficacy student subscale score	2023.899	4390				
	English and learning self-efficacy subscale score	2524.704	4390				
	Voluntary reading student subscale score	2250.670	4390				
	Preparation for class student subscale score	2688.472	4390				

a R Squared = .005 (Adjusted R Squared = .004)

b R Squared = .002 (Adjusted R Squared = .001)

c R Squared = .004 (Adjusted R Squared = .003)

d R Squared = .000 (Adjusted R Squared = -.001)

e R Squared = .007 (Adjusted R Squared = .006)

Table 4.9
Estimated Marginal Means for Family Composition Groups on Student Factors

Dependent Variable	Recoded family composition	Mean	Std. Error
Motivation/volition student subscale composite score	Mother and father	2.749	.014
	Stepfamily	2.635	.026
	Single parent	2.652	.024
	Other	2.676	.052
Math interest/self-efficacy student subscale score	Mother and father	2.468	.014
	Stepfamily	2.394	.025
	Single parent	2.424	.022
	Other	2.402	.048
English and learning self-efficacy subscale score	Mother and father	2.767	.015
	Stepfamily	2.683	.028
	Single parent	2.671	.025
	Other	2.673	.054
Voluntary reading student subscale score	Mother and father	2.386	.014
	Stepfamily	2.388	.026
	Single parent	2.382	.023
	Other	2.425	.051
Preparation for class student subscale score	Mother and father	3.177	.016
	Stepfamily	3.163	.029
	Single parent	3.021	.025
	Other	3.059	.056

Because of the results of the Box's M and Levene's tests, significant differences were examined further by means of Dunnett's C for the motivation/volition and preparation for class factors (unequal variances) and by Tukey's HSD for the domain-specific self-efficacy factors (equal variances). Post hoc test results are shown in Tables 4.10 and 4.11. Students living in two-parent families have significantly more motivation and volition than children in either stepfamilies or single-parent households. Single-parent and stepfamilies are not significantly different from each other in regard to academic motivation of 10th graders. Other family structures occupy a middle range and are not significantly different from any of the other three groups. For mathematics interest/self-efficacy, students in two-parent families have a significantly higher mean score than students in stepfamilies. All other differences for this outcome are nonsignificant. Student scores for English and general learning self-efficacy are significantly higher in families where both mother and father are present than in stepfamilies and single-parent families. No other differences are significant for this factor. For the preparation for class factor, single-parent families have lower scores than two-parent and stepfamilies. These were the only significant differences for this outcome.

Table 4.10
Dunnett's C Significant Multiple Comparisons

Dependent Variable	Comparison	Mean Difference	Standard Error
Motivation/volition	Mother & father minus Stepfamily	.1142	.03047
Motivation/volition	Mother & father minus Single parent	.0968	.02772
Preparation for class	Mother & father minus Single parent	.1561	.03080
Preparation for class	Stepfamily minus Single parent	.1421	.03898

Table 4.11
Tukey's HSD Significant Multiple Comparisons

Dependent Variable	Comparison	Mean Difference	Standard Error	Sig.
Math interest/self-efficacy	Mother & father minus Stepfamily	.0740	.02830	.044
English interest/self-efficacy	Mother & father minus Stepfamily	.0840	.03159	.039
English interest/self-efficacy	Mother & father minus Single parent	.0956	.02891	.005

To sum up these findings, there are small but statistically significant differences between family structure groups on four of the five student independent learning factors. In general, 10^{th} graders living with both parents have the highest mean score on each of the independent learning subscales except voluntary reading, which was the factor that did not have significant differences among groups. Students being raised by a single parent have higher means than those living in stepfamilies for motivation/volition and math interest/self-efficacy, but single-parent students have the lowest mean scores of all groups on English interest/self-efficacy, voluntary reading, and preparation for class. These results will be discussed further in Chapter 5.

CHAPTER 5

DISCUSSION AND CONCLUSIONS

Summary and Discussion of Results

The purpose of this study was to identify parent factors associated with the development of students as independent learners and to illustrate the relationship between independent learning and academic achievement. Previous studies had addressed some of these issues, but this study used multivariate methods and SEM as well as a more recent dataset. Results were thus either confirmed or extended. The unique contribution of this study to the field was the comparison of independent learning behaviors for students from different family structures. In this chapter, the results of the analyses will be considered and interpreted in light of the four research questions presented in Chapter 1 and their associated hypotheses described in Chapter 3.

Question 1: How do parents' actions relate to children's independent learning characteristics?

Hypothesis 1: There will be a significant positive relationship between parents' actions which encourage autonomy (authoritative parenting style) and students' manifestation of independent learning characteristics.

Hypothesis 2: There will be a negative relationship between parents' actions associated with a high degree of parental control (authoritarian parenting style) and students' manifestation of independent learning characteristics.

In previous research (Baumrind, 2005; Hoang, 2007; Strage, 1998), a significant positive correlation was found between the authoritative parenting style and the development of student autonomy. The authoritative parenting style is characterized by parental advice-giving combined with a relatively low level of parental control. The level of parental involvement may be moderate to high. The first canonical correlation (see Figure 4.1) illustrates the characteristics of this parenting style. It can be seen that associations with the five independent learning factors are positive. Hypothesis 1 is supported by this finding with statistical significance and an effect size of 3.35%. Therefore, I conclude that authoritative parenting practices are positively but not substantially associated with independent learning behaviors in 10^{th} grade students.

In the second linear combination of these two sets of factors (see Figure 4.2), parental control has a loading onto the variate of -.350, which aligns with two of the other parent factors, parental advice and family fun, but is in contrast to parental involvement which has a positive loading. This depiction is characteristic of an authoritarian parenting style, with high advice combined with high control. The positive correlation coefficient along with the loadings on the independent learning variate suggest that authoritarian parenting may have an insubstantial but positive association with motivation/volition and English self-efficacy, a relatively strong positive relationship with voluntary reading, and a negative association with math interest/self-efficacy and preparation for class. The latter circumstance may be because too much parental control does not support development of autonomy, and children may rebel if they feel that adults are being too dictatorial. In Hoang's (2007) study, authoritarian parenting was found to have a non-significant negative correlation with student autonomy but Strage (1998) found significant negative correlations of authoritarian parenting with students' sense of being in control and being able to manage their time.

The relatively strong positive relationship between authoritarian parenting and voluntary reading is interesting. Although voluntary reading is generally desirable, a high level of voluntary reading may also be a means of escaping a restrictive or otherwise intolerable home life. Due to the mixture of positive and negative loadings on the Y variate, Hypothesis 2 was not fully supported. It may be inferred that some aspects of independent learning are negatively impacted by the authoritarian parenting style, but others may be positively affected. The effect size of this canonical correlation is only 1%, which is indicative of a lack of practical importance.

The parental control factor includes checking homework, helping with homework or school projects, enforcing curfews on school nights, discussing report cards with the student, and knowing the student's whereabouts when away from home or school. The canonical correlation results suggest that these actions may not be relevant to the development of independent learning or self-regulation. This conclusion is in accordance with theory and the empirical results found by Bembenutty (2005) and Hoang (2007).

Although the canonical correlations are preferred because they eliminate the problem of collinearity in the results, a look at the bivariate correlations of the factors can be helpful in interpreting the findings. Bivariate correlations based on design effect-adjusted weighting (see Table 3.6) showed that parent involvement was significantly and positively related to four of the student independent learning factors, motivation/volition, math interest/self-efficacy, English interest/self-efficacy, and preparation for class, although the effect sizes (r^2) of these relationships were too small to matter. The second parent factor, parental advice-giving, had statistically significant positive correlations with all five student independent learning factors. Again, these effect sizes were all around 1%, which is too small to be considered important.

Parental control, the third parent factor, had no significant associations with any of the student factors. This across-the-board finding was unexpected. It was hypothesized that tight parental control, such as that present in families with authoritarian parents, would show a negative correlation with some of the independent learning factors. On the basis of the bivariate correlations, one might conclude that the parental control factor has no relationship whatsoever with student independent learning, but this conclusion would not be entirely correct. This factor is probably susceptible to interactions with other parent factors. It appears that collinearity hides the relationships which become measurable and statistically significant in the canonical correlations.

The final parent factor, family fun, was positively associated with motivation/volition, English interest/self-efficacy, and preparation for class, but was not related bivariately to math interest/self-efficacy or voluntary reading. In spite of statistical significance, the effect sizes of the relationships were less than 1%.

The structural equation model also shed some light on the first research question. The model had a statistically significant path coefficient between parent factors and student independent learning. The standardized effects were 12% for Set 1 and 15% for Set 2 (Table 4.5). The SEM analysis confirmed a significant relationship between parent actions and student independent learning, but the effect size was less than 20% and was therefore probably not substantively important.

Question 2: How do students' independent learning behaviors and attitudes correlate with their academic achievement?

Hypothesis 3: There will be a significant positive relationship between student independent learning characteristics and academic achievement.

The first significant canonical correlation between independent learning factors and academic achievement measures showed that a linear combination of English interest/self-efficacy, voluntary reading, motivation/volition, and preparation for class, with a very small loading for math interest/self-efficacy, was strongly correlated with both reading and math achievement, but especially reading. The effect size of 15.7% was the highest observed in the series of canonical correlations performed in this study. The second canonical correlation had an effect size of 14%, which was the next highest effect obtained. Both of these effect sizes were below 20%, so the substantive importance of these relationships is questionable.

The left side of the second canonical correlation featured a combination dominated by math interest/self-efficacy, with low positive loadings for motivation/volition, preparation for class, and English interest/self-efficacy, and a small negative loading for voluntary reading. The strongest loading on the dependent side was math achievement. This domain-specific structure confirms the finding of Gottfried (1985) that academic motivation is differentiated by domain. These results also accord with the findings of Duckworth and Seligman (2005), who concluded that self-discipline (as measured by variables similar to the indicators of the motivation/volition and preparation for class factors) is a predictor of achievement.

The SEM results showed that the relationship between independent learning and achievement was much stronger than the other two relationships tested in this study, between parents' actions and independent learning, and between parents' actions and achievement. Standardized direct effects for this path in the model are 37% for the first sample and 40% for the cross-validation sample. These effect sizes do indicate an important and sizable relationship between independent learning and achievement. Hypothesis 3 is supported by these results, and I conclude that there is a significant and substantive positive relationship between student independent learning and academic achievement.

Question 3: How are parents' actions associated with their children's academic achievement?

Hypothesis 4: There will be a positive relationship between parents' actions associated with an authoritative style and students' academic achievement.

Hypothesis 5: There will be a negative relationship between parents' actions associated with an authoritarian style and students' academic achievement.

Overall, the canonical correlation between the parent factors and the achievement factors was significant and had an effect size of 6.7%. The parental control factor, however, loaded onto the variate with the opposite sign from the other three factors. This combination is more representative of the authoritative parenting style than authoritarian, and the positive correlation supports Hypothesis 4, although the magnitude of the effect size does not indicate that the observed relationship is important. This was the only statistically significant canonical correlation for these two sets of factors; thus, Hypothesis 5 was not supported at all by this analysis. The bivariate correlations, however, showed a significant negative relationship between parental control and both achievement scores, though these effect sizes were less than 1% (math $r = -0.1$, $p < .001$; reading $r = -0.076$, $p < .001$).

Lepper et al (2005) found a negative correlation between extrinsic motivation and academic achievement. Parental control is theoretically related to extrinsic motivation because it may involve inducing children to perform in order to avoid punishment or to gain rewards in the form of material goods or privileges. This is one possible explanation of the observed negative correlation of the parental control factor and the achievement measures. Another possible explanation is that stronger parental control by the time a child reaches 10^{th} grade means less autonomy support; children who are less autonomous may not perform as well when they are away from their support structure, i.e., children whose parents routinely help them with their homework may lack the confidence to perform in a standardized testing situation where no outside help is allowed.

This scenario is not to be confused with adaptive help-seeking, which is a characteristic of independent learning. A student using adaptive help-seeking is metacognitively aware of when help is truly needed and refrains from seeking help when he or she is actually capable of performing the task independently. A valid purpose of achievement tests is to measure mastery of concepts and skills that the examinee has had an opportunity to learn. Thus, behaviors that are considered adaptive in a learning situation may not be appropriate in an assessment situation. In the testing situation, students who have developed a measure of autonomy are likely to fare better than those who see themselves as dependent on others for academic help due to learned helplessness or some similar construct.

In the structural model, there was a small difference in the standardized total effects from parents' actions to achievement, with an effect size of 12% for the first sample and 10% for the cross-validation sample. The direct effect was 7% for the first sample and 4% for the second sample, with an indirect effect through student independent learning of 5% for sample 1 and 6% for sample 2. The conclusion is that, though statistically significant, the relationship between parent actions and academic achievement is too small to be considered substantively important.

Question 4: Are single-parent children less likely to have developed characteristics of independent learning by grade 10 than children living with both of their parents?
Hypothesis 6: There will be a difference between children from different family structures in their manifestation of independent learning characteristics.

The MANOVA for student independent learning factors indicated significant differences among the recoded family structure groups. Children in families headed by both mother and father had the highest mean scores for each of the independent learning characteristics. There were significant differences for four of the five factors, with the exception being voluntary reading. As mentioned previously, engagement in reading can be a positive indication of interest in learning, but it can also be a means of escaping an unhappy environment. While there was no significant difference in the prevalence of voluntary reading among the different family structures, it is possible that the source of motivation for reading may be dissimilar due to different stresses within the household. This issue is beyond the scope of the current study.

Having two adults present in the home appears to be associated with higher scores on the English interest/self-efficacy and preparation for class subscales. However, the advantage is a small one. According to Mulkey et al (1992), the lack of self-regulatory behavior on the part of single-parent children seemed to explain the small but significant differences they found in achievement for different family structures. The conduct they viewed as being responsible for poor achievement in students from single-parent homes included variables similar to those constituting the preparation for class subscale. They suggested that lack of parental supervision or a need for attention may have contributed to rebellion and lack of engagement in learning for single-parent children, which coincides with the theoretical framework of this study. Hypothesis 6 was supported by statistical significance, but the substantive differences among the family structure groups were very small, with an effect size of only 0.4%. I cautiously conclude that the advantage that children growing up with two parents have over those raised by a single parent or in a stepfamily in the development of independent learning is too small to be substantively important. It is possible that the growing number of both single-parent and step families has brought about social changes which offer added support to children in these family structures (Pong et al., 2003).

Limitations and Recommendations for Future Research

No research study is without limitations, and this one is no exception. This study was designed as a cross-sectional study and therefore causation cannot be claimed based on its results. It is tempting, in view of path diagrams and statistical significance, to say that a small percentage of student independent learning behaviors are caused by a particular combination of parent actions, or that 15% (or possibly as much as 38%) of academic achievement is caused by student independent learning factors, but such conclusions cannot be justified based on the design of this study. Future studies could make use of the longitudinal data available in later waves of ELS:2002 and test the relationships either by using repeated measures or by extracting the parent factors from an earlier wave than the independent learning factors (Schneider, Carnoy, Kilpatrick, Schmidt, & Shavelson, 2007).

The data source did not have as many variables to choose from as its predecessor, NELS:88, especially in the academic achievement area. NELS included achievement in four areas, English, math, science, and social studies, while ELS had only math and English. Future research could make use of some of the other available large scale databases which may have other relevant variables. This study was limited to the United States; international datasets will allow researchers to explore independent learning across nations and cultures.

Because this was a secondary analysis of existing data, all aspects of independent learning could not be included because of limitations in the available variables. It was difficult to find a large number of variables that represented the theorized characteristics of independent learners. In particular, a separate factor for metacognition failed to emerge in the EFA. Although elements of metacognition were present in more than one factor, specific inferences regarding this essential component of independent learning cannot be made from the results of the analyses in this study.

Modification indices in the LISREL program suggested correlating several errors among indicators for the constructs of parent actions and student independent learning. This made it apparent that forces outside of the hypothesized model account for some of the variance in these constructs, and that some of these influences are common to both constructs. Future researchers of this topic should attempt to identify other important factors to include in the model that would explain more of the variance. These factors may consist of additional parent factors, other home environment factors, teacher and school factors, and/or peer influence.

Relatively low reliabilities for the parental control/homework and family fun subscales were another limitation, with Cronbach's α of 0.576 and 0.594, respectively. In addition, it was not possible to determine whether the items in the family fun factor were engaged in spontaneously or used as rewards by the parents for desired behavior or academic performance. The motivation for these activities could help explain the relationships observed between the family fun factor and aspects of independent learning. Perhaps this issue could be addressed in future research. Likewise, the reasons for students engaging in high levels of voluntary reading may be adaptive or maladaptive, and it was not possible to separate these motives in the available data. In future research, a qualitative approach may enable better understanding of the results observed in this study.

The model described and tested in this study partially supported the path analysis findings of Martinez-Pons (1996), which revealed significant path coefficients between parent actions and independent learning, and between parent actions and academic achievement, with the larger effect being between parent actions and independent learning. The pattern described by

Martinez-Pons was observed in the direct effects of the structural model for both datasets (see Table 4.5 and Figures 4.8 and 4.9). By far, the association between student independent learning and academic achievement was stronger than any of the tested relationships involving parent actions. In future research, these relationships should be further clarified by replications of the models using different samples.

Another limitation of this study was that no covariates were used in the analyses. An alternative explanation for observed effects may be found if SES, prior achievement, or other variables are included as covariates for parent actions. This is an avenue for future research.

In the early stages of this research, a set of variables from the student questionnaire was included in the parent factors because they measured an aspect of the parent/child relationship rather than behaviors specifically associated with the definition of independent learning. This factor comprised eight items involving the student discussing various things with parents and was labeled “student/parent communication.” When this factor was included in the first canonical correlation, the relationship between the parent actions and student independent learning factors was .450, quite a bit more substantial than the current set of factors. The effect size would have been 20.25%. However, the communication factor did not truly belong to the parent factors set as it was the student’s viewpoint of the communication with the parent, and it is likely that the magnitude of the correlation was due to the student being the source of the data. When the factor was used in SEM, it became clear that it had significant loadings on both the parent actions and student independent learning latent constructs, with the strongest loading on the student side. It was subsequently removed from the analysis and eventually replaced by the parental advice factor. A suggestion for a future study is to devise and test a model that incorporates the concept of parent/student communication as a separate construct that is correlated with both parent actions and student independent learning. Possible reciprocal effects between parent actions and student independent learning can also be investigated.

In summary, the results of this study suggest a few areas in which parents may choose actions that could help their children develop as independent learners and enhance their academic achievement. However, due to the effect sizes observed, these actions alone will not make a major difference. Future research needs to be done to determine factors which have a larger effect on the development of independent learning. Several avenues for future research along these lines have been recommended based on insights emerging from this analysis.

More young people than in previous generations expect to get a college education. For many occupations, a college degree has replaced the high school diploma as the required entry-level credential. Development of independent learning characteristics has been shown to be important for students who intend to go on to higher education. In a college or university environment, students must use the skills of self-regulation, motivation, volition, and metacognition in order to succeed. Ideally, students should begin developing these skills while still in secondary school.

From the results of this study, it seems clear that attempts by parents to maintain or increase their control over children at the high school age level are unlikely to have a positive effect on either independent learning or academic achievement. Instead, other factors should be examined for their association with student independent learning and self-regulation. These may include cooperation between parents and teachers to encourage student autonomy, peer influences, and the character of the communication between students and parents.

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Appendix A

IRB Approval

VirginiaTech

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FWA00000572(expires 1/20/2010)
IRB # is IRB00000667

DATE: September 22, 2008

MEMORANDUM

TO: Mido Chang
Pamela Murphy

FROM: Carmen Green

SUBJECT: **IRB Exempt Approval:** "Relationships of Parenting Practices, Independent Learning, Achievement, and Family Structure" , IRB # 08-531

I have reviewed your request to the IRB for exemption for the above referenced project. The research falls within the exempt status. Approval is granted effective as of September 22, 2008.

As an investigator of human subjects, your responsibilities include the following:

1. Report promptly proposed changes in the research protocol. The proposed changes must not be initiated without IRB review and approval, except where necessary to eliminate apparent immediate hazards to the subjects.

2. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

cc: File

Appendix B

Variables Used in Initial Factor Analysis

Table B.1
Parent Variables Used in Initial Factor Analysis

Variable	Description/Label	Factor	Loading
BYP55A	How often check that homework completed	4	.667
BYP55B	How often discuss report card	4	.386
BYP55C	How often know whereabouts	4	.221
BYP55D	How often make/enforce school night curfews	4	.301
BYP57A	Attended school activities with 10th grader	1	.722
BYP57B	Worked on homework/school projects with 10th grader	4	.405
BYP57C	Attended concerts/plays/movies with 10th grader	1	.355
BYP57D	Attended sports events outside school with 10th grader	1	.732
BYP57E	Attended religious services with 10th grader	1	.249
BYP57F	Attended family social functions with 10th grader	3	.386
BYP57G	Took day trips/vacations with 10th grader	3	.454
BYP57H	Worked on hobby/played sports with 10th grader	1	.614
BYP57I	Went shopping with 10th grader	3	.492
BYP57J	Went to restaurants with 10th grader	3	.656
BYP57K	Spent time talking with 10th grader	5*	.587
BYP57L	Did something else fun with 10th grader	5*	.699
BYP56A	Provide advice about selecting courses or programs	2	.368
BYP56B	Provide advice about plans for college entrance exams	2	.759
BYP56C	Provide advice about applying to college/school after HS	2	.827
BYP56D	Provide advice about jobs to apply for after high school	2	.429
BYP56E	Provide information about community/national/world events	6*	.491
BYP56F	Provide advice about things troubling 10th grader	6*	.604
PARSCH	Parent school involvement score	1	.489
FRULES	Family rules composite score	4	.407

* Variables which loaded on factors with less than three indicators were deleted.

Table B.2
Student Independent Learning Variables Used in Initial Factor Analysis

Variable	Description/Label	Factor	Loading
BYS34A	Hours/week spent on homework in school	10	.575
BYS34B	Hours/week spent on homework out of school	10	.543
RBYS38A	Reverse coded paper/pencil to class	6	.804
RBYS38B	Reverse coded books to class	6	.823
RBYS38C	Reverse coded homework to class	6	.632
BYS43	Hours/week spent reading outside of school	4	.583
BYS45B	How often uses computer for school work	9	.366
BYS45C	How often uses computer to learn on own	9	.625
BYS54A	Importance of being successful in line work	8	.657
BYS54B	Importance of marrying right person/having happy family	5	.761
BYS54C	Importance of having lots of money	8*	.297
BYS54D	Importance of having strong friendships	5	.388
BYS54E	Importance of being able to find steady work	8	.551
BYS54F	Importance of helping others in community	5*	.337
BYS54G	Importance of giving children better opportunities	5	.457
BYS54H	Importance of living close to parents/relatives	5	.372
BYS54I	Importance of getting away from this area	11	.354
BYS54J	Importance of working to correct inequalities	11	.573
BYS54K	Importance of having children	5	.762
BYS54L	Importance of having leisure time	5*	.210
BYS54N	Importance of being expert in field of work	8	.545
BYS54O	Importance of getting good education	8	.427
RBYS87A	Reverse coded totally absorbed in math	7	.518
RBYS87B	Reverse coded reading is fun	4	.845
RBYS87C	Reverse coded math is fun	7	.729
RBYS87D	Reverse coded reads in spare time	4	.944
RBYS87E	Reverse coded totally absorbed in reading	4	.757
RBYS87F	Reverse coded math is important	7	.688
RBYS88A	Reverse coded most can learn math	12	.414
BYS88B	Have to be born with ability to be good at math	12	.440
BYS89A	Can do excellent job on math tests	2	.863
BYS89B	Can understand difficult math texts	2	.921
BYS89C	Can understand difficult English texts	3	.894
BYS89D	Studies to get a good grade	1*	.915
BYS89E	Can learn something really hard	1*	.299
BYS89F	Can understand difficult English class	3	.929
BYS89G	Remembers most important things when studies	1	.564
BYS89H	Studies to increase job opportunities	1*	1.032
BYS89I	Can do excellent job on English assignments	3	.821
BYS89J	Works as hard as possible when studies	1	.810
BYS89K	Can do excellent job on English tests	3	.847
BYS89L	Can understand difficult math class	2	.870
BYS89M	Can master skills in English class	3	.847
BYS89N	Can get no bad grades if decides to	2	.303
BYS89O	Keeps studying even if material is difficult	1	.594
BYS89P	Studies to ensure financial security	1	.958

BYS89Q	Can get no problems wrong if decides to	2	.452
BYS89R	Can do excellent job on math assignments	2	.842
BYS89S	Does best to learn what studies	1	.608
BYS89T	Can learn something well if wants to	2	.326
BYS89U	Can master math class skills	2	.833
BYS89V	Puts forth best effort when studying	1	.766

* Item loaded on more than one factor; if loading shown is less than .3, item did not load well on any factor but had two loadings that were at least .2.

Appendix C

LISREL Output for Structural Equation Model

(Dataset 1)

```
                            L I S R E L  8.80

                                   BY

                     Karl G. Jöreskog & Dag Sörbom



                 This program is published exclusively by
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!Structural Model Set 1 with Effects
 DA NI=11 NO=4631
 LA
 BYTXMIRR BYTXRIRR IL1_MOT IL2_MSE IL3_ESE IL4_VRE IL5_PRE PA1_INV PA2_ADV PA3_CTL
PA4_FUN
 KM
 1.000
 0.740 1.000
 0.165 0.148 1.000
 0.323 0.124 0.530 1.000
 0.251 0.312 0.622 0.383 1.000
 0.150 0.286 0.194 0.098 0.328 1.000
 0.152 0.149 0.187 0.093 0.125 0.092 1.000
 0.160 0.140 0.112 0.108 0.112 0.010 0.057 1.000
 0.075 0.075 0.114 0.081 0.105 0.091 0.038 0.350 1.000
 -0.114 -0.087 0.046 0.009 0.026 0.027 0.007 0.347 0.345 1.000
 0.007 0.023 0.065 0.018 0.051 0.006 0.028 0.406 0.257 0.301 1.000
 SD
 11.760 9.583 0.714 0.681 0.750 0.712 0.762 0.777 0.542 0.425 0.540
 SE
 3 4 5 6 7 1 2 8 9 10 11/
 MO NX=4 NK=1 NY=7 NE=2 LX=FU,FI LY=FU,FI PH=SY,FR TD=SY TE=SY PS=SY,FR BE=FU,FI
 LE
 STU ACH
 LK
 PAR
 VA 1.0 LY 3 1 LY 6 2 LX 1 1
 FR LY 1 1 LY 2 1 LY 4 1 LY 5 1 LY 7 2 LX 2 1 LX 3 1 LX 4 1
 FR TE 6 2 TE 2 1 TE 7 4 TE 5 3 TD 3 2 BE 2 1 TE 6 3
 FI PS 2 1
 PATH DIAGRAM
 OU RS EF MI SC AD=OFF


                          Number of Input Variables 11
                          Number of Y - Variables    7
                          Number of X - Variables    4
                          Number of ETA - Variables  2
                          Number of KSI - Variables  1
                          Number of Observations  4631
```

Covariance Matrix

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR
IL1_MOT	0.51					
IL2_MSE	0.26	0.46				
IL3_ESE	0.33	0.20	0.56			
IL4_VRE	0.10	0.05	0.18	0.51		
IL5_PRE	0.10	0.05	0.07	0.05	0.58	
BYTXMIRR	1.39	2.59	2.21	1.26	1.36	138.30
BYTXRIRR	1.01	0.81	2.24	1.95	1.09	83.40
PA1_INV	0.06	0.06	0.07	0.01	0.03	1.46
PA2_ADV	0.04	0.03	0.04	0.04	0.02	0.48
PA3_CTL	0.01	0.00	0.01	0.01	0.00	-0.57
PA4_FUN	0.03	0.01	0.02	0.00	0.01	0.04

Covariance Matrix

	BYTXRIRR	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
BYTXRIRR	91.83				
PA1_INV	1.04	0.60			
PA2_ADV	0.39	0.15	0.29		
PA3_CTL	-0.35	0.11	0.08	0.18	
PA4_FUN	0.12	0.17	0.08	0.07	0.29

Parameter Specifications

LAMBDA-Y

	STU	ACH
IL1_MOT	1	0
IL2_MSE	2	0
IL3_ESE	0	0
IL4_VRE	3	0
IL5_PRE	4	0
BYTXMIRR	0	0
BYTXRIRR	0	5

LAMBDA-X

	PAR
PA1_INV	0
PA2_ADV	6
PA3_CTL	7
PA4_FUN	8

BETA

	STU	ACH
STU	0	0
ACH	9	0

GAMMA

	PAR
STU	10
ACH	11

PHI

PAR
12

PSI

STU	ACH
13	14

THETA-EPS

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
IL1_MOT	15						
IL2_MSE	16	17					
IL3_ESE	0	0	18				
IL4_VRE	0	0	0	19			
IL5_PRE	0	0	20	0	21		
BYTXMIRR	0	22	23	0	0	24	
BYTXRIRR	0	0	0	25	0	0	26

THETA-DELTA

	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
PA1_INV	27			
PA2_ADV	0	28		
PA3_CTL	0	29	30	
PA4_FUN	0	0	0	31

Number of Iterations = 18

LISREL Estimates (Maximum Likelihood)

LAMBDA-Y

	STU	ACH
IL1_MOT	0.55 (0.02) 22.03	- -
IL2_MSE	0.32 (0.02) 18.21	- -
IL3_ESE	1.00	- -
IL4_VRE	0.29 (0.02) 16.84	- -
IL5_PRE	0.33 (0.02) 15.05	- -
BYTXMIRR	- -	1.00
BYTXRIRR	- -	0.75 (0.04) 21.43

```
        LAMBDA-X

                 PAR
              --------
PA1_INV        1.00

PA2_ADV        0.45
              (0.02)
               20.46

PA3_CTL        0.35
              (0.02)
               20.57

PA4_FUN        0.52
              (0.02)
               22.99

        BETA

                 STU        ACH
              --------   --------
    STU          - -        - -

    ACH        4.99         - -
              (0.30)
               16.55

        GAMMA

                 PAR
              --------
    STU        0.17
              (0.02)
                7.31

    ACH        1.32
              (0.33)
                4.00

        Covariance Matrix of ETA and KSI

                 STU        ACH        PAR
              --------   --------   --------
    STU        0.61
    ACH        3.10     108.13
    PAR        0.06       0.71       0.33

        PHI

                 PAR
              --------
                0.33
              (0.02)
               19.05

        PSI
        Note: This matrix is diagonal.

                 STU        ACH
              --------   --------
                0.60      91.71
              (0.03)     (4.75)
               21.61      19.31
```

Squared Multiple Correlations for Structural Equations

STU	ACH
0.02	0.15

NOTE: R^2 for Structural Equations are Hayduk's (2006) Blocked-Error R^2

Reduced Form

	PAR
STU	0.17
	(0.02)
	7.31
ACH	2.16
	(0.35)
	6.22

Squared Multiple Correlations for Reduced Form

STU	ACH
0.02	0.01

THETA-EPS

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
IL1_MOT	0.33						
	(0.01)						
	33.14						
IL2_MSE	0.15	0.40					
	(0.01)	(0.01)					
	22.34	47.21					
IL3_ESE	- -	- -	-0.04				
			(0.02)				
			-1.79				
IL4_VRE	- -	- -	- -	0.46			
				(0.01)			
				47.37			
IL5_PRE	- -	- -	-0.13	- -	0.52		
			(0.01)		(0.01)		
			-10.76		41.07		
BYTXMIRR	- -	1.56	-0.81	- -	- -	28.36	
		(0.07)	(0.11)			(4.95)	
		21.99	-7.15			5.72	
BYTXRIRR	- -	- -	- -	1.04	- -	- -	29.23
				(0.07)			(2.84)
				15.47			10.30

Squared Multiple Correlations for Y - Variables

IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
0.35	0.13	1.08	0.10	0.11	0.79	0.68

```
        THETA-DELTA

            PA1_INV    PA2_ADV    PA3_CTL    PA4_FUN
           --------   --------   --------   --------
 PA1_INV       0.27
             (0.01)
              19.03

 PA2_ADV        - -       0.23
                        (0.01)
                         39.76

 PA3_CTL        - -       0.03       0.14
                        (0.00)     (0.00)
                          8.08      39.58

 PA4_FUN        - -        - -        - -       0.20
                                              (0.01)
                                               36.20

        Squared Multiple Correlations for X - Variables

            PA1_INV    PA2_ADV    PA3_CTL    PA4_FUN
           --------   --------   --------   --------
               0.55       0.22       0.23       0.31

                          Goodness of Fit Statistics

                            Degrees of Freedom = 35
             Minimum Fit Function Chi-Square = 439.24 (P = 0.0)
     Normal Theory Weighted Least Squares Chi-Square = 438.03 (P = 0.0)
             Estimated Non-centrality Parameter (NCP) = 403.03
         90 Percent Confidence Interval for NCP = (339.25 ; 474.26)

                     Minimum Fit Function Value = 0.095
             Population Discrepancy Function Value (F0) = 0.087
           90 Percent Confidence Interval for F0 = (0.073 ; 0.10)
          Root Mean Square Error of Approximation (RMSEA) = 0.050
         90 Percent Confidence Interval for RMSEA = (0.046 ; 0.054)
           P-Value for Test of Close Fit (RMSEA < 0.05) = 0.51

               Expected Cross-Validation Index (ECVI) = 0.11
          90 Percent Confidence Interval for ECVI = (0.094 ; 0.12)
                      ECVI for Saturated Model = 0.029
                     ECVI for Independence Model = 2.92

   Chi-Square for Independence Model with 55 Degrees of Freedom = 13503.05
                          Independence AIC = 13525.05
                               Model AIC = 500.03
                             Saturated AIC = 132.00
                          Independence CAIC = 13606.90
                              Model CAIC = 730.68
                            Saturated CAIC = 623.07

                        Normed Fit Index (NFI) = 0.97
                      Non-Normed Fit Index (NNFI) = 0.95
                   Parsimony Normed Fit Index (PNFI) = 0.62
                      Comparative Fit Index (CFI) = 0.97
                      Incremental Fit Index (IFI) = 0.97
                       Relative Fit Index (RFI) = 0.95

                            Critical N (CN) = 607.12

                     Root Mean Square Residual (RMR) = 0.40
                            Standardized RMR = 0.040
                      Goodness of Fit Index (GFI) = 0.98
                 Adjusted Goodness of Fit Index (AGFI) = 0.97
                Parsimony Goodness of Fit Index (PGFI) = 0.52
```

Fitted Covariance Matrix

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR
IL1_MOT	0.51					
IL2_MSE	0.26	0.47				
IL3_ESE	0.33	0.19	0.56			
IL4_VRE	0.10	0.06	0.18	0.51		
IL5_PRE	0.11	0.06	0.07	0.06	0.58	
BYTXMIRR	1.69	2.54	2.29	0.90	1.02	136.49
BYTXRIRR	1.28	0.74	2.34	1.72	0.77	81.56
PA1_INV	0.03	0.02	0.06	0.02	0.02	0.71
PA2_ADV	0.01	0.01	0.02	0.01	0.01	0.32
PA3_CTL	0.01	0.01	0.02	0.01	0.01	0.25
PA4_FUN	0.02	0.01	0.03	0.01	0.01	0.37

Fitted Covariance Matrix

	BYTXRIRR	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
BYTXRIRR	90.75				
PA1_INV	0.54	0.60			
PA2_ADV	0.24	0.15	0.29		
PA3_CTL	0.19	0.12	0.08	0.18	
PA4_FUN	0.28	0.17	0.08	0.06	0.29

Fitted Residuals

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR
IL1_MOT	0.00					
IL2_MSE	0.00	0.00				
IL3_ESE	0.00	0.00	0.00			
IL4_VRE	0.00	-0.01	0.00	0.00		
IL5_PRE	-0.01	-0.01	0.00	-0.01	0.00	
BYTXMIRR	-0.31	0.04	-0.07	0.36	0.34	1.81
BYTXRIRR	-0.26	0.07	-0.10	0.23	0.32	1.84
PA1_INV	0.03	0.04	0.01	-0.01	0.02	0.75
PA2_ADV	0.03	0.02	0.02	0.03	0.01	0.16
PA3_CTL	0.00	0.00	-0.01	0.00	0.00	-0.82
PA4_FUN	0.01	0.00	-0.01	-0.01	0.00	-0.33

Fitted Residuals

	BYTXRIRR	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
BYTXRIRR	1.09				
PA1_INV	0.51	0.00			
PA2_ADV	0.15	0.00	0.00		
PA3_CTL	-0.54	0.00	0.00	0.00	
PA4_FUN	-0.16	0.00	0.00	0.01	0.00

Summary Statistics for Fitted Residuals

```
Smallest Fitted Residual =   -0.82
   Median Fitted Residual =    0.00
  Largest Fitted Residual =    1.84
```

Stemleaf Plot

```
- 0|85
 - 0|3332110000000000000000000000000000000000000000000
   0|1122334
   0|58
   1|1
   1|88
```

Standardized Residuals

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR
IL1_MOT	- -					
IL2_MSE	-1.83	-1.72				
IL3_ESE	2.12	2.94	0.18			
IL4_VRE	0.67	-1.34	-0.28	-1.82		
IL5_PRE	-2.12	-2.43	-1.48	-1.17	- -	
BYTXMIRR	-4.91	0.60	-3.21	3.49	3.36	2.67
BYTXRIRR	-4.69	0.88	-4.80	3.90	3.58	4.11
PA1_INV	4.65	5.40	2.43	-1.34	1.89	10.76
PA2_ADV	5.76	4.17	3.69	5.03	1.28	2.07
PA3_CTL	0.80	-0.86	-2.94	0.58	-0.89	-13.61
PA4_FUN	1.80	-0.48	-1.86	-1.10	0.35	-4.65

Standardized Residuals

	BYTXRIRR	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
BYTXRIRR	3.96				
PA1_INV	7.80	- -			
PA2_ADV	2.32	-0.01	- -		
PA3_CTL	-10.78	-1.97	- -	- -	
PA4_FUN	-2.71	-5.14	-1.04	5.65	- -

Summary Statistics for Standardized Residuals

```
Smallest Standardized Residual =  -13.61
   Median Standardized Residual =    0.00
  Largest Standardized Residual =   10.76
```

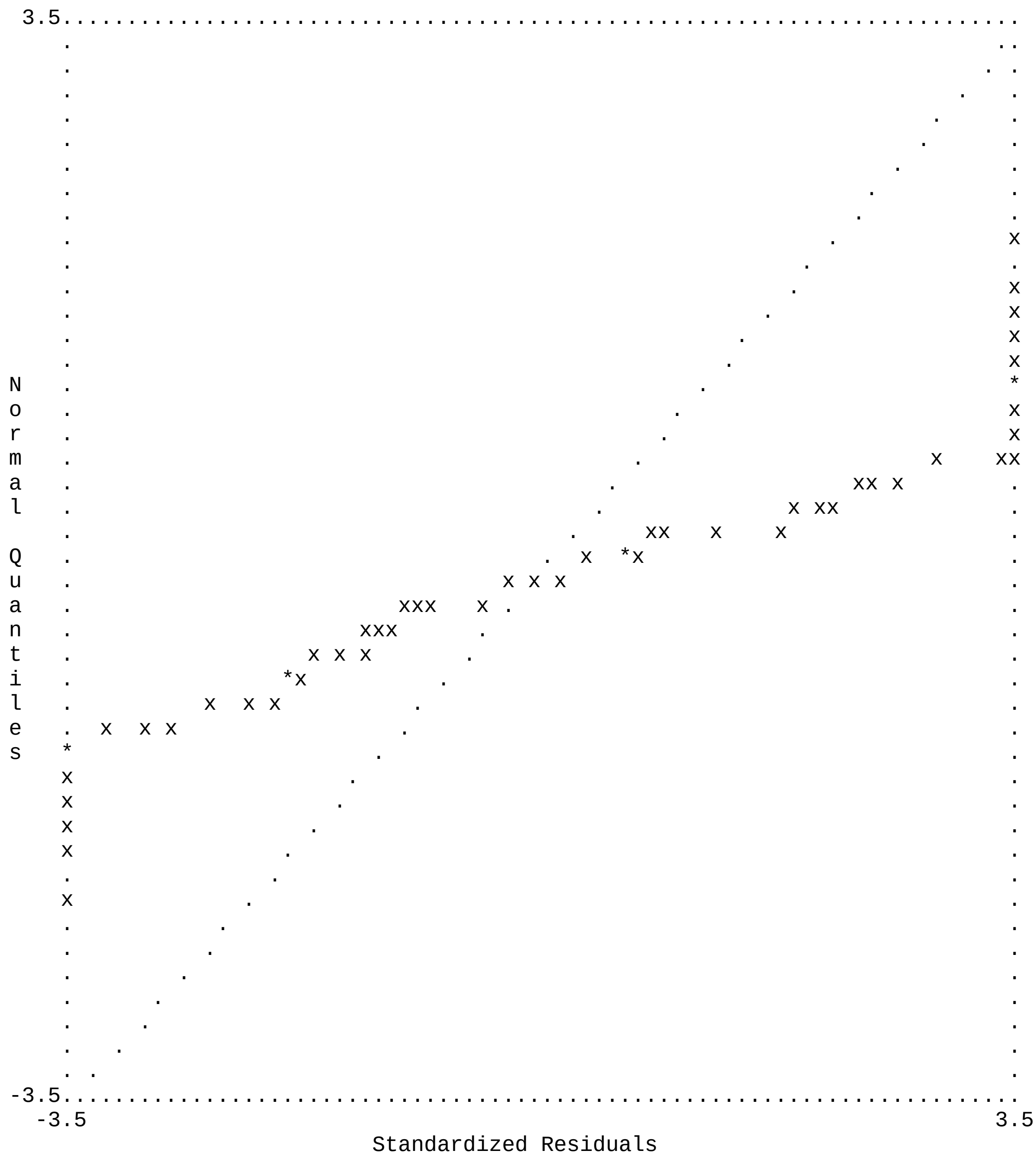
Stemleaf Plot

```
-12|6
 -10|8
 - 8|
 - 6|
 - 4|19877
 - 2|297410
 - 0|9887533210995300000000
   0|2366789389
   2|11347945679
   4|01260478
   6|8
   8|
  10|8
```

```
 Largest Negative Standardized Residuals
 Residual for BYTXMIRR and  IL1_MOT  -4.91
 Residual for BYTXMIRR and  IL3_ESE  -3.21
 Residual for BYTXRIRR and  IL1_MOT  -4.69
 Residual for BYTXRIRR and  IL3_ESE  -4.80
 Residual for  PA3_CTL and  IL3_ESE  -2.94
 Residual for  PA3_CTL and BYTXMIRR -13.61
 Residual for  PA3_CTL and BYTXRIRR -10.78
 Residual for  PA4_FUN and BYTXMIRR  -4.65
 Residual for  PA4_FUN and BYTXRIRR  -2.71
 Residual for  PA4_FUN and  PA1_INV  -5.14
 Largest Positive Standardized Residuals
 Residual for  IL3_ESE and  IL2_MSE   2.94
 Residual for BYTXMIRR and  IL4_VRE   3.49
 Residual for BYTXMIRR and  IL5_PRE   3.36
 Residual for BYTXMIRR and BYTXMIRR   2.67
 Residual for BYTXRIRR and  IL4_VRE   3.90
 Residual for BYTXRIRR and  IL5_PRE   3.58
```

```
Residual for BYTXRIRR and BYTXMIRR   4.11
Residual for BYTXRIRR and BYTXRIRR   3.96
Residual for  PA1_INV and  IL1_MOT   4.65
Residual for  PA1_INV and  IL2_MSE   5.40
Residual for  PA1_INV and BYTXMIRR  10.76
Residual for  PA1_INV and BYTXRIRR   7.80
Residual for  PA2_ADV and  IL1_MOT   5.76
Residual for  PA2_ADV and  IL2_MSE   4.17
Residual for  PA2_ADV and  IL3_ESE   3.69
Residual for  PA2_ADV and  IL4_VRE   5.03
Residual for  PA4_FUN and  PA3_CTL   5.65
```

Qplot of Standardized Residuals



Modification Indices and Expected Change

Modification Indices for LAMBDA-Y

	STU	ACH
IL1_MOT	- -	30.28
IL2_MSE	- -	8.54
IL3_ESE	- -	0.05
IL4_VRE	- -	15.71
IL5_PRE	- -	19.64
BYTXMIRR	3.30	- -
BYTXRIRR	3.30	- -

Expected Change for LAMBDA-Y

	STU	ACH
IL1_MOT	- -	-0.01
IL2_MSE	- -	0.00
IL3_ESE	- -	0.00
IL4_VRE	- -	0.00
IL5_PRE	- -	0.01
BYTXMIRR	1.93	- -
BYTXRIRR	-1.45	- -

Standardized Expected Change for LAMBDA-Y

	STU	ACH
IL1_MOT	- -	-0.06
IL2_MSE	- -	0.03
IL3_ESE	- -	-0.01
IL4_VRE	- -	0.05
IL5_PRE	- -	0.06
BYTXMIRR	1.50	- -
BYTXRIRR	-1.13	- -

Completely Standardized Expected Change for LAMBDA-Y

	STU	ACH
IL1_MOT	- -	-0.09
IL2_MSE	- -	0.05
IL3_ESE	- -	-0.01
IL4_VRE	- -	0.07
IL5_PRE	- -	0.08
BYTXMIRR	0.13	- -
BYTXRIRR	-0.12	- -

No Non-Zero Modification Indices for LAMBDA-X

No Non-Zero Modification Indices for BETA

No Non-Zero Modification Indices for GAMMA

No Non-Zero Modification Indices for PHI

No Non-Zero Modification Indices for PSI

Modification Indices for THETA-EPS

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
IL1_MOT	- -						
IL2_MSE	- -	- -					
IL3_ESE	3.21	1.41	- -				
IL4_VRE	6.23	8.57	3.10	- -			
IL5_PRE	0.01	5.07	- -	3.65	- -		
BYTXMIRR	5.39	- -	- -	15.99	1.97	- -	
BYTXRIRR	10.46	7.48	0.07	- -	2.91	- -	- -

Expected Change for THETA-EPS

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
IL1_MOT	- -						
IL2_MSE	- -	- -					
IL3_ESE	0.03	0.01	- -				
IL4_VRE	0.01	-0.02	-0.02	- -			
IL5_PRE	0.00	-0.01	- -	-0.02	- -		
BYTXMIRR	-0.27	- -	- -	0.46	0.12	- -	
BYTXRIRR	-0.21	0.21	0.04	- -	0.12	- -	- -

Completely Standardized Expected Change for THETA-EPS

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
IL1_MOT	- -						
IL2_MSE	- -	- -					
IL3_ESE	0.06	0.03	- -				
IL4_VRE	0.03	-0.03	-0.04	- -			
IL5_PRE	0.00	-0.03	- -	-0.03	- -		
BYTXMIRR	-0.03	- -	- -	0.05	0.01	- -	
BYTXRIRR	-0.03	0.03	0.01	- -	0.02	- -	- -

Modification Indices for THETA-DELTA-EPS

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
PA1_INV	0.03	8.05	1.24	15.71	0.58	19.71	6.72
PA2_ADV	5.73	0.24	0.28	21.27	0.14	2.98	0.00
PA3_CTL	1.06	0.10	0.76	3.23	0.30	55.83	4.57
PA4_FUN	4.19	2.89	1.85	0.59	0.00	9.34	0.22

Expected Change for THETA-DELTA-EPS

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
PA1_INV	0.00	0.01	-0.01	-0.03	0.01	0.33	0.16
PA2_ADV	0.01	0.00	0.00	0.02	0.00	0.09	0.00
PA3_CTL	0.00	0.00	0.00	0.01	0.00	-0.31	-0.07
PA4_FUN	0.01	-0.01	-0.01	0.00	0.00	-0.16	0.02

Completely Standardized Expected Change for THETA-DELTA-EPS

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
PA1_INV	0.00	0.03	-0.01	-0.05	0.01	0.04	0.02
PA2_ADV	0.02	0.01	-0.01	0.06	0.00	0.01	0.00
PA3_CTL	0.01	0.00	-0.01	0.02	-0.01	-0.06	-0.02
PA4_FUN	0.02	-0.02	-0.01	-0.01	0.00	-0.03	0.00

Modification Indices for THETA-DELTA

	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
PA1_INV	- -			
PA2_ADV	0.07	- -		
PA3_CTL	2.98	- -	- -	
PA4_FUN	26.43	2.84	26.43	- -

Expected Change for THETA-DELTA

	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
PA1_INV	- -			
PA2_ADV	0.00	- -		
PA3_CTL	-0.01	- -	- -	
PA4_FUN	-0.14	-0.01	0.02	- -

Completely Standardized Expected Change for THETA-DELTA

	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
PA1_INV	- -			
PA2_ADV	0.01	- -		
PA3_CTL	-0.04	- -	- -	
PA4_FUN	-0.33	-0.03	0.08	- -

Maximum Modification Index is 55.83 for Element (3, 6) of THETA DELTA-EPSILON

Standardized Solution

LAMBDA-Y

	STU	ACH
IL1_MOT	0.43	- -
IL2_MSE	0.25	- -
IL3_ESE	0.78	- -
IL4_VRE	0.23	- -
IL5_PRE	0.26	- -
BYTXMIRR	- -	10.40
BYTXRIRR	- -	7.84

LAMBDA-X

	PAR
PA1_INV	0.57
PA2_ADV	0.26
PA3_CTL	0.20
PA4_FUN	0.30

BETA

	STU	ACH
STU	- -	- -
ACH	0.37	- -

GAMMA

	PAR
STU	0.12
ACH	0.07

Correlation Matrix of ETA and KSI

	STU	ACH	PAR
STU	1.00		
ACH	0.38	1.00	
PAR	0.12	0.12	1.00

PSI
Note: This matrix is diagonal.

STU	ACH
0.98	0.85

Regression Matrix ETA on KSI (Standardized)

	PAR
STU	0.12
ACH	0.12

Completely Standardized Solution

LAMBDA-Y

	STU	ACH
IL1_MOT	0.60	- -
IL2_MSE	0.36	- -
IL3_ESE	1.04	- -
IL4_VRE	0.32	- -
IL5_PRE	0.34	- -
BYTXMIRR	- -	0.89
BYTXRIRR	- -	0.82

LAMBDA-X

	PAR
PA1_INV	0.74
PA2_ADV	0.47
PA3_CTL	0.48
PA4_FUN	0.56

BETA

	STU	ACH
STU	- -	- -
ACH	0.37	- -

GAMMA

	PAR
STU	0.12
ACH	0.07

Correlation Matrix of ETA and KSI

	STU	ACH	PAR
STU	1.00		
ACH	0.38	1.00	
PAR	0.12	0.12	1.00

PSI
Note: This matrix is diagonal.

STU	ACH
0.98	0.85

THETA-EPS

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
IL1_MOT	0.65						
IL2_MSE	0.32	0.87					
IL3_ESE	- -	- -	-0.08				
IL4_VRE	- -	- -	- -	0.90			
IL5_PRE	- -	- -	-0.22	- -	0.89		
BYTXMIRR	- -	0.20	-0.09	- -	- -	0.21	
BYTXRIRR	- -	- -	- -	0.15	- -	- -	0.32

THETA-DELTA

	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
PA1_INV	0.45			
PA2_ADV	- -	0.78		
PA3_CTL	- -	0.12	0.77	
PA4_FUN	- -	- -	- -	0.69

Regression Matrix ETA on KSI (Standardized)

	PAR
STU	0.12
ACH	0.12

Total and Indirect Effects

Total Effects of KSI on ETA

	PAR
STU	0.17
	(0.02)
	7.31
ACH	2.16
	(0.35)
	6.22

Indirect Effects of KSI on ETA

	PAR
STU	- -
ACH	0.83
	(0.12)
	6.75

Total Effects of ETA on ETA

	STU	ACH
STU	- -	- -
ACH	4.99	- -
	(0.30)	
	16.55	

Largest Eigenvalue of B*B' (Stability Index) is 24.893

Total Effects of ETA on Y

	STU	ACH
IL1_MOT	0.55	- -
	(0.02)	
	22.03	
IL2_MSE	0.32	- -
	(0.02)	
	18.21	
IL3_ESE	1.00	- -
IL4_VRE	0.29	- -
	(0.02)	
	16.84	
IL5_PRE	0.33	- -
	(0.02)	
	15.05	
BYTXMIRR	4.99	1.00
	(0.30)	
	16.55	
BYTXRIRR	3.76	0.75
	(0.23)	(0.04)
	16.48	21.43

Indirect Effects of ETA on Y

	STU	ACH
IL1_MOT	- -	- -
IL2_MSE	- -	- -
IL3_ESE	- -	- -
IL4_VRE	- -	- -
IL5_PRE	- -	- -
BYTXMIRR	4.99	- -
	(0.30)	
	16.55	
BYTXRIRR	3.76	- -
	(0.23)	
	16.48	

Total Effects of KSI on Y

	PAR
IL1_MOT	0.09
	(0.01)
	6.86
IL2_MSE	0.05
	(0.01)
	6.72
IL3_ESE	0.17
	(0.02)
	7.31

```
 IL4_VRE       0.05
             (0.01)
               6.63

 IL5_PRE       0.05
             (0.01)
               6.65

BYTXMIRR       2.16
             (0.35)
               6.22

BYTXRIRR       1.63
             (0.27)
               6.11
```

Standardized Total and Indirect Effects

Standardized Total Effects of KSI on ETA

	PAR
STU	0.12
ACH	0.12

Standardized Indirect Effects of KSI on ETA

	PAR
STU	- -
ACH	0.05

Standardized Total Effects of ETA on ETA

	STU	ACH
STU	- -	- -
ACH	0.37	- -

Standardized Total Effects of ETA on Y

	STU	ACH
IL1_MOT	0.43	- -
IL2_MSE	0.25	- -
IL3_ESE	0.78	- -
IL4_VRE	0.23	- -
IL5_PRE	0.26	- -
BYTXMIRR	3.89	10.40
BYTXRIRR	2.93	7.84

Completely Standardized Total Effects of ETA on Y

	STU	ACH
IL1_MOT	0.60	- -
IL2_MSE	0.36	- -
IL3_ESE	1.04	- -
IL4_VRE	0.32	- -
IL5_PRE	0.34	- -
BYTXMIRR	0.33	0.89
BYTXRIRR	0.31	0.82

Standardized Indirect Effects of ETA on Y

	STU	ACH
IL1_MOT	- -	- -
IL2_MSE	- -	- -
IL3_ESE	- -	- -
IL4_VRE	- -	- -
IL5_PRE	- -	- -
BYTXMIRR	3.89	- -
BYTXRIRR	2.93	- -

Completely Standardized Indirect Effects of ETA on Y

	STU	ACH
IL1_MOT	- -	- -
IL2_MSE	- -	- -
IL3_ESE	- -	- -
IL4_VRE	- -	- -
IL5_PRE	- -	- -
BYTXMIRR	0.33	- -
BYTXRIRR	0.31	- -

Standardized Total Effects of KSI on Y

	PAR
IL1_MOT	0.05
IL2_MSE	0.03
IL3_ESE	0.10
IL4_VRE	0.03
IL5_PRE	0.03
BYTXMIRR	1.24
BYTXRIRR	0.93

Completely Standardized Total Effects of KSI on Y

	PAR
IL1_MOT	0.07
IL2_MSE	0.04
IL3_ESE	0.13
IL4_VRE	0.04
IL5_PRE	0.04
BYTXMIRR	0.11
BYTXRIRR	0.10

Time used: 0.047 Seconds

Appendix D

LISREL Output for Structural Model Cross-Validation

(Dataset 2)

```
                              L I S R E L  8.80

                                     BY

                        Karl G. Jöreskog & Dag Sörbom



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!Structural Model Set 2 with Effects
 DA NI=11 NO=4644
 LA
 BYTXMIRR BYTXRIRR IL1_MOT IL2_MSE IL3_ESE IL4_VRE IL5_PRE PA1_INV PA2_ADV PA3_CTL
PA4_FUN
 KM
 1.000
 0.754 1.000
 0.191 0.191 1.000
 0.341 0.167 0.539 1.000
 0.270 0.334 0.638 0.397 1.000
 0.152 0.296 0.242 0.153 0.355 1.000
 0.159 0.167 0.193 0.109 0.120 0.080 1.000
 0.142 0.129 0.141 0.096 0.120 0.015 0.084 1.000
 0.048 0.066 0.107 0.037 0.114 0.098 0.054 0.331 1.000
 -0.113 -0.099 0.043 -0.024 -0.001 0.021 -0.003 0.360 0.351 1.000
 -0.010 0.016 0.081 0.000 0.053 0.014 0.039 0.407 0.249 0.315 1.000
 SD
 11.883 9.538 0.731 0.687 0.764 0.723 0.765 0.787 0.544 0.432 0.554
 SE
 3 4 5 6 7 1 2 8 9 10 11/
 MO NX=4 NK=1 NY=7 NE=2 LX=FU,FI LY=FU,FI PH=SY,FR TD=SY TE=SY PS=SY,FR BE=FU,FI
 LE
 STU ACH
 LK
 PAR
 VA 1.0 LY 3 1 LY 6 2 LX 1 1
 FR LY 1 1 LY 2 1 LY 4 1 LY 5 1 LY 7 2 LX 2 1 LX 3 1 LX 4 1
 FR TE 6 2 TE 2 1 TE 7 4 TE 5 3 TD 3 2 BE 2 1 TE 6 3
 FI PS 2 1
 PATH DIAGRAM
 OU RS EF MI SC AD=OFF


                          Number of Input Variables 11
                          Number of Y - Variables    7
                          Number of X - Variables    4
                          Number of ETA - Variables  2
                          Number of KSI - Variables  1
                          Number of Observations  4644
```

Covariance Matrix

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR
IL1_MOT	0.53					
IL2_MSE	0.27	0.47				
IL3_ESE	0.36	0.21	0.58			
IL4_VRE	0.13	0.08	0.20	0.52		
IL5_PRE	0.11	0.06	0.07	0.04	0.59	
BYTXMIRR	1.66	2.78	2.45	1.31	1.45	141.21
BYTXRIRR	1.33	1.09	2.43	2.04	1.22	85.46
PA1_INV	0.08	0.05	0.07	0.01	0.05	1.33
PA2_ADV	0.04	0.01	0.05	0.04	0.02	0.31
PA3_CTL	0.01	-0.01	0.00	0.01	0.00	-0.58
PA4_FUN	0.03	- -	0.02	0.01	0.02	-0.07

Covariance Matrix

	BYTXRIRR	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
BYTXRIRR	90.97				
PA1_INV	0.97	0.62			
PA2_ADV	0.34	0.14	0.30		
PA3_CTL	-0.41	0.12	0.08	0.19	
PA4_FUN	0.08	0.18	0.08	0.08	0.31

Parameter Specifications

LAMBDA-Y

	STU	ACH
IL1_MOT	1	0
IL2_MSE	2	0
IL3_ESE	0	0
IL4_VRE	3	0
IL5_PRE	4	0
BYTXMIRR	0	0
BYTXRIRR	0	5

LAMBDA-X

	PAR
PA1_INV	0
PA2_ADV	6
PA3_CTL	7
PA4_FUN	8

BETA

	STU	ACH
STU	0	0
ACH	9	0

GAMMA

	PAR
STU	10
ACH	11

PHI

PAR
12

PSI

STU	ACH
13	14

THETA-EPS

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
IL1_MOT	15						
IL2_MSE	16	17					
IL3_ESE	0	0	18				
IL4_VRE	0	0	0	19			
IL5_PRE	0	0	20	0	21		
BYTXMIRR	0	22	23	0	0	24	
BYTXRIRR	0	0	0	25	0	0	26

THETA-DELTA

	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
PA1_INV	27			
PA2_ADV	0	28		
PA3_CTL	0	29	30	
PA4_FUN	0	0	0	31

Number of Iterations = 15

LISREL Estimates (Maximum Likelihood)

LAMBDA-Y

	STU	ACH
IL1_MOT	0.64 (0.02) 27.02	- -
IL2_MSE	0.37 (0.02) 21.29	- -
IL3_ESE	1.00	- -
IL4_VRE	0.35 (0.02) 19.98	- -
IL5_PRE	0.32 (0.02) 15.07	- -
BYTXMIRR	- -	1.00
BYTXRIRR	- -	0.81 (0.03) 24.08

```
       LAMBDA-X

                 PAR
            --------
PA1_INV        1.00

PA2_ADV        0.43
             (0.02)
              20.08

PA3_CTL        0.38
             (0.02)
              21.40

PA4_FUN        0.55
             (0.02)
              23.37

       BETA

                 STU         ACH
            --------    --------
    STU         - -         - -

    ACH        5.47         - -
             (0.30)
              18.25

       GAMMA

                 PAR
            --------
    STU        0.19
             (0.02)
               8.04

    ACH        0.70
             (0.32)
               2.17

       Covariance Matrix of ETA and KSI

                 STU         ACH         PAR
            --------    --------    --------
    STU        0.56
    ACH        3.09      102.73
    PAR        0.06        0.57        0.33

       PHI

                 PAR
            --------
               0.33
             (0.02)
              19.01

       PSI
       Note: This matrix is diagonal.

                 STU         ACH
            --------    --------
               0.55       85.40
             (0.02)      (4.02)
              24.79       21.26
```

Squared Multiple Correlations for Structural Equations

STU	ACH
0.02	0.17

NOTE: R^2 for Structural Equations are Hayduk's (2006) Blocked-Error R^2

Reduced Form

	PAR
STU	0.19 (0.02) 8.04
ACH	1.74 (0.34) 5.10

Squared Multiple Correlations for Reduced Form

STU	ACH
0.02	0.01

THETA-EPS

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
IL1_MOT	0.31 (0.01) 31.81						
IL2_MSE	0.14 (0.01) 20.45	0.40 (0.01) 46.38					
IL3_ESE	- -	- -	0.03 (0.02) 1.39				
IL4_VRE	- -	- -	- -	0.46 (0.01) 47.01			
IL5_PRE	- -	- -	-0.11 (0.01) -11.25	- -	0.53 (0.01) 43.32		
BYTXMIRR	- -	1.52 (0.07) 21.79	-0.55 (0.10) -5.62	- -	- -	36.23 (4.21) 8.61	
BYTXRIRR	- -	- -	- -	1.04 (0.07) 15.73	- -	- -	22.16 (2.76) 8.01

Squared Multiple Correlations for Y - Variables

IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
0.42	0.16	0.96	0.13	0.10	0.74	0.75

```
        THETA-DELTA

            PA1_INV    PA2_ADV    PA3_CTL    PA4_FUN
           --------   --------   --------   --------
 PA1_INV       0.29
             (0.01)
              20.43

 PA2_ADV        - -       0.23
                        (0.01)
                         40.52

 PA3_CTL        - -       0.03       0.14
                        (0.00)     (0.00)
                          8.33      38.50

 PA4_FUN        - -        - -        - -       0.21
                                              (0.01)
                                               35.58

        Squared Multiple Correlations for X - Variables

            PA1_INV    PA2_ADV    PA3_CTL    PA4_FUN
           --------   --------   --------   --------
               0.53       0.21       0.25       0.32

                         Goodness of Fit Statistics

                           Degrees of Freedom = 35
              Minimum Fit Function Chi-Square = 463.33 (P = 0.0)
      Normal Theory Weighted Least Squares Chi-Square = 468.43 (P = 0.0)
              Estimated Non-centrality Parameter (NCP) = 433.43
          90 Percent Confidence Interval for NCP = (367.25 ; 507.05)

                      Minimum Fit Function Value = 0.100
              Population Discrepancy Function Value (F0) = 0.093
            90 Percent Confidence Interval for F0 = (0.079 ; 0.11)
           Root Mean Square Error of Approximation (RMSEA) = 0.052
          90 Percent Confidence Interval for RMSEA = (0.048 ; 0.056)
             P-Value for Test of Close Fit (RMSEA < 0.05) = 0.25

                Expected Cross-Validation Index (ECVI) = 0.11
           90 Percent Confidence Interval for ECVI = (0.100 ; 0.13)
                       ECVI for Saturated Model = 0.028
                      ECVI for Independence Model = 3.13

   Chi-Square for Independence Model with 55 Degrees of Freedom = 14513.08
                         Independence AIC = 14535.08
                              Model AIC = 530.43
                            Saturated AIC = 132.00
                         Independence CAIC = 14616.96
                             Model CAIC = 761.17
                           Saturated CAIC = 623.26

                        Normed Fit Index (NFI) = 0.97
                      Non-Normed Fit Index (NNFI) = 0.95
                   Parsimony Normed Fit Index (PNFI) = 0.62
                      Comparative Fit Index (CFI) = 0.97
                      Incremental Fit Index (IFI) = 0.97
                       Relative Fit Index (RFI) = 0.95

                           Critical N (CN) = 569.37

                    Root Mean Square Residual (RMR) = 0.41
                           Standardized RMR = 0.041
                      Goodness of Fit Index (GFI) = 0.98
                 Adjusted Goodness of Fit Index (AGFI) = 0.97
                Parsimony Goodness of Fit Index (PGFI) = 0.52
```

Fitted Covariance Matrix

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR
IL1_MOT	0.53					
IL2_MSE	0.27	0.47				
IL3_ESE	0.35	0.21	0.58			
IL4_VRE	0.12	0.07	0.19	0.52		
IL5_PRE	0.11	0.07	0.07	0.06	0.59	
BYTXMIRR	1.97	2.67	2.54	1.07	1.00	138.96
BYTXRIRR	1.60	0.93	2.52	1.91	0.81	83.71
PA1_INV	0.04	0.02	0.06	0.02	0.02	0.57
PA2_ADV	0.02	0.01	0.03	0.01	0.01	0.25
PA3_CTL	0.02	0.01	0.02	0.01	0.01	0.22
PA4_FUN	0.02	0.01	0.03	0.01	0.01	0.31

Fitted Covariance Matrix

	BYTXRIRR	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
BYTXRIRR	90.38				
PA1_INV	0.46	0.62			
PA2_ADV	0.20	0.14	0.30		
PA3_CTL	0.18	0.12	0.08	0.19	
PA4_FUN	0.25	0.18	0.08	0.07	0.31

Fitted Residuals

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR
IL1_MOT	0.00					
IL2_MSE	0.00	0.00				
IL3_ESE	0.00	0.00	0.00			
IL4_VRE	0.00	0.00	0.00	0.00		
IL5_PRE	-0.01	-0.01	0.00	-0.02	0.00	
BYTXMIRR	-0.31	0.12	-0.09	0.23	0.45	2.25
BYTXRIRR	-0.27	0.16	-0.09	0.13	0.41	1.74
PA1_INV	0.04	0.03	0.01	-0.01	0.03	0.76
PA2_ADV	0.03	0.00	0.02	0.03	0.01	0.06
PA3_CTL	0.00	-0.02	-0.02	0.00	-0.01	-0.80
PA4_FUN	0.01	-0.01	-0.01	-0.01	0.01	-0.38

Fitted Residuals

	BYTXRIRR	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
BYTXRIRR	0.59				
PA1_INV	0.50	0.00			
PA2_ADV	0.14	0.00	0.00		
PA3_CTL	-0.58	0.00	0.00	0.00	
PA4_FUN	-0.17	0.00	0.00	0.01	0.00

Summary Statistics for Fitted Residuals

```
Smallest Fitted Residual =   -0.80
  Median Fitted Residual =    0.00
 Largest Fitted Residual =    2.25
```

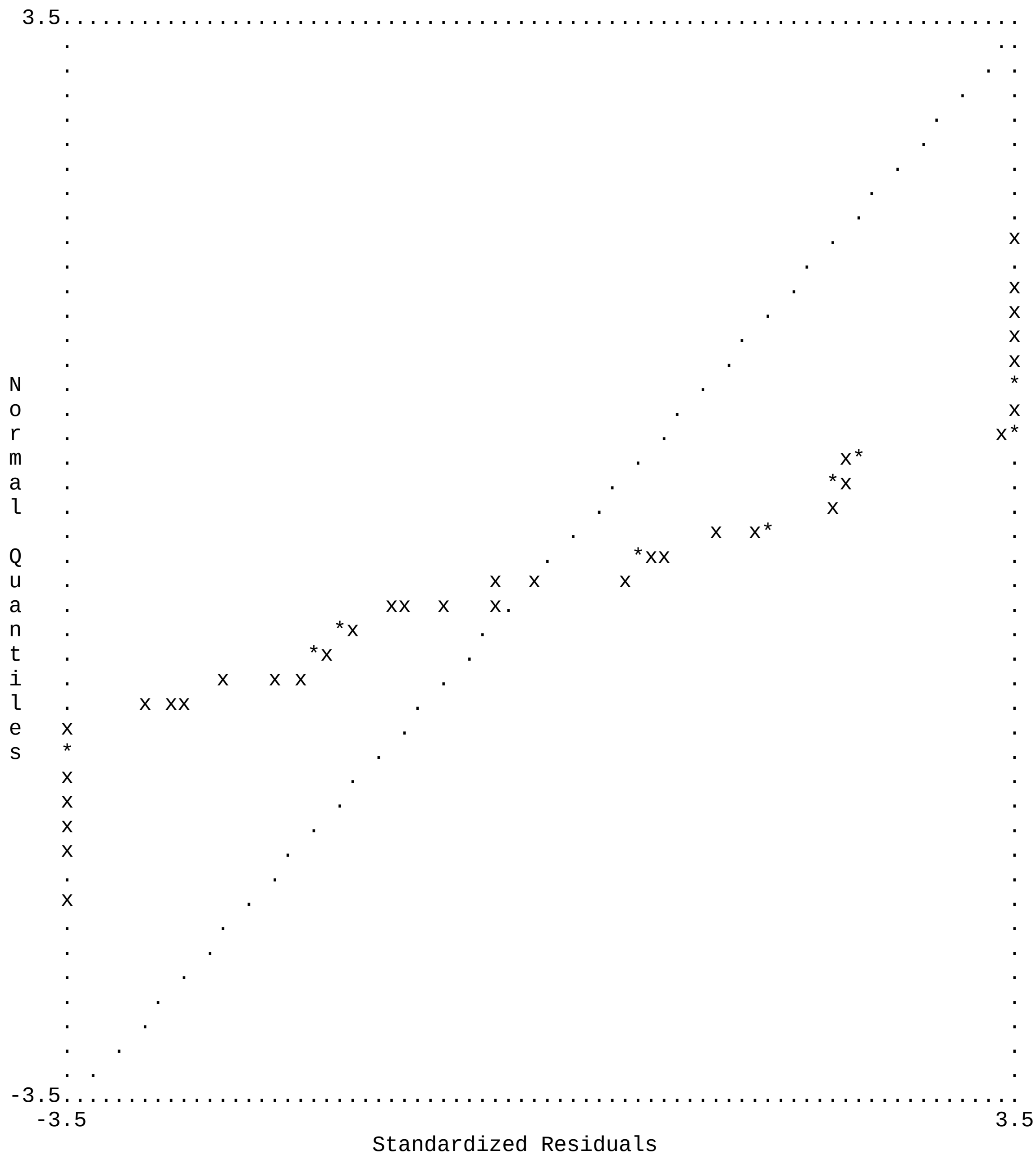
Stemleaf Plot

```
- 0|86
- 0|4332110000000000000000000000000000000000000000000
  0|11112244
  0|568
  1|
  1|7
  2|2
```

```
        Standardized Residuals

            IL1_MOT    IL2_MSE    IL3_ESE    IL4_VRE    IL5_PRE   BYTXMIRR
           --------   --------   --------   --------   --------   --------
 IL1_MOT       - -
 IL2_MSE     -1.58      -1.53
 IL3_ESE      2.31       1.73       0.66
 IL4_VRE      1.26       0.77       1.71      -0.72
 IL5_PRE     -1.93      -1.50      -0.98      -2.71        - -
BYTXMIRR     -5.18       1.61      -4.05       2.26       4.24       3.43
BYTXRIRR     -5.33       2.12      -4.76       2.18       4.63       4.10
 PA1_INV      6.17       3.94       2.28      -1.67       3.64       9.68
 PA2_ADV      4.73       0.72       4.06       5.19       2.31       0.79
 PA3_CTL     -0.34      -3.78      -6.29      -0.37      -1.82     -12.97
 PA4_FUN      2.12      -2.37      -2.62      -1.11       0.92      -5.15

        Standardized Residuals

           BYTXRIRR    PA1_INV    PA2_ADV    PA3_CTL    PA4_FUN
           --------   --------   --------   --------   --------
BYTXRIRR      2.19
 PA1_INV      8.18        - -
 PA2_ADV      2.19      -0.02        - -
 PA3_CTL    -11.87      -1.69        - -        - -
 PA4_FUN     -2.89      -4.73      -1.41       5.49        - -

Summary Statistics for Standardized Residuals

Smallest Standardized Residual =  -12.97
  Median Standardized Residual =    0.00
 Largest Standardized Residual =    9.68

Stemleaf Plot

-12|0
-10|9
- 8|
- 6|3
- 4|321870
- 2|89764
- 0|98776554107430000000O
  0|778893677
  2|112223333469
  4|1126725
  6|2
  8|27
Largest Negative Standardized Residuals
Residual for  IL5_PRE and  IL4_VRE  -2.71
Residual for BYTXMIRR and  IL1_MOT  -5.18
Residual for BYTXMIRR and  IL3_ESE  -4.05
Residual for BYTXRIRR and  IL1_MOT  -5.33
Residual for BYTXRIRR and  IL3_ESE  -4.76
Residual for  PA3_CTL and  IL2_MSE  -3.78
Residual for  PA3_CTL and  IL3_ESE  -6.29
Residual for  PA3_CTL and BYTXMIRR -12.97
Residual for  PA3_CTL and BYTXRIRR -11.87
Residual for  PA4_FUN and  IL3_ESE  -2.62
Residual for  PA4_FUN and BYTXMIRR  -5.15
Residual for  PA4_FUN and BYTXRIRR  -2.89
Residual for  PA4_FUN and  PA1_INV  -4.73
Largest Positive Standardized Residuals
Residual for BYTXMIRR and  IL5_PRE   4.24
Residual for BYTXMIRR and BYTXMIRR   3.43
```

```
Residual for BYTXRIRR and  IL5_PRE   4.63
Residual for BYTXRIRR and BYTXMIRR   4.10
Residual for  PA1_INV and  IL1_MOT   6.17
Residual for  PA1_INV and  IL2_MSE   3.94
Residual for  PA1_INV and  IL5_PRE   3.64
Residual for  PA1_INV and BYTXMIRR   9.68
Residual for  PA1_INV and BYTXRIRR   8.18
Residual for  PA2_ADV and  IL1_MOT   4.73
Residual for  PA2_ADV and  IL3_ESE   4.06
Residual for  PA2_ADV and  IL4_VRE   5.19
Residual for  PA4_FUN and  PA3_CTL   5.49
```

Qplot of Standardized Residuals



Modification Indices and Expected Change

Modification Indices for LAMBDA-Y

	STU	ACH
IL1_MOT	- -	38.73
IL2_MSE	- -	14.35
IL3_ESE	- -	0.82
IL4_VRE	- -	4.80
IL5_PRE	- -	31.63
BYTXMIRR	0.52	- -
BYTXRIRR	0.52	- -

Expected Change for LAMBDA-Y

	STU	ACH
IL1_MOT	- -	-0.01
IL2_MSE	- -	0.00
IL3_ESE	- -	0.00
IL4_VRE	- -	0.00
IL5_PRE	- -	0.01
BYTXMIRR	1.44	- -
BYTXRIRR	-1.17	- -

Standardized Expected Change for LAMBDA-Y

	STU	ACH
IL1_MOT	- -	-0.07
IL2_MSE	- -	0.04
IL3_ESE	- -	0.02
IL4_VRE	- -	0.03
IL5_PRE	- -	0.08
BYTXMIRR	1.07	- -
BYTXRIRR	-0.87	- -

Completely Standardized Expected Change for LAMBDA-Y

	STU	ACH
IL1_MOT	- -	-0.09
IL2_MSE	- -	0.06
IL3_ESE	- -	0.02
IL4_VRE	- -	0.04
IL5_PRE	- -	0.11
BYTXMIRR	0.09	- -
BYTXRIRR	-0.09	- -

No Non-Zero Modification Indices for LAMBDA-X

No Non-Zero Modification Indices for BETA

No Non-Zero Modification Indices for GAMMA

No Non-Zero Modification Indices for PHI

No Non-Zero Modification Indices for PSI

Modification Indices for THETA-EPS

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
IL1_MOT	- -						
IL2_MSE	- -	- -					
IL3_ESE	6.91	0.78	- -				
IL4_VRE	3.74	0.58	1.17	- -			
IL5_PRE	0.14	2.12	- -	13.08	- -		
BYTXMIRR	3.11	- -	- -	4.91	0.93	- -	
BYTXRIRR	20.46	14.80	1.39	- -	7.89	- -	- -

Expected Change for THETA-EPS

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
IL1_MOT	- -						
IL2_MSE	- -	- -					
IL3_ESE	0.04	-0.01	- -				
IL4_VRE	0.01	0.00	-0.01	- -			
IL5_PRE	0.00	-0.01	- -	-0.03	- -		
BYTXMIRR	-0.23	- -	- -	0.25	0.08	- -	
BYTXRIRR	-0.30	0.29	0.16	- -	0.19	- -	- -

Completely Standardized Expected Change for THETA-EPS

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
IL1_MOT	- -						
IL2_MSE	- -	- -					
IL3_ESE	0.08	-0.02	- -				
IL4_VRE	0.02	-0.01	-0.02	- -			
IL5_PRE	-0.01	-0.02	- -	-0.05	- -		
BYTXMIRR	-0.03	- -	- -	0.03	0.01	- -	
BYTXRIRR	-0.04	0.04	0.02	- -	0.03	- -	- -

Modification Indices for THETA-DELTA-EPS

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
PA1_INV	2.06	5.23	1.68	19.91	5.71	19.71	5.48
PA2_ADV	0.65	1.87	3.91	18.52	1.04	0.67	0.17
PA3_CTL	7.56	2.44	12.31	6.04	5.84	20.96	14.74
PA4_FUN	7.80	5.83	3.24	0.26	0.00	10.76	0.78

Expected Change for THETA-DELTA-EPS

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
PA1_INV	0.01	0.01	-0.01	-0.03	0.02	0.32	0.14
PA2_ADV	0.00	-0.01	0.01	0.02	0.01	0.04	0.02
PA3_CTL	0.01	0.00	-0.01	0.01	-0.01	-0.19	-0.13
PA4_FUN	0.01	-0.01	-0.01	0.00	0.00	-0.17	0.04

Completely Standardized Expected Change for THETA-DELTA-EPS

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
PA1_INV	0.01	0.02	-0.01	-0.05	0.03	0.04	0.02
PA2_ADV	0.01	-0.01	0.02	0.05	0.01	0.01	0.00
PA3_CTL	0.03	-0.02	-0.03	0.03	-0.03	-0.04	-0.03
PA4_FUN	0.03	-0.02	-0.02	-0.01	0.00	-0.03	0.01

Modification Indices for THETA-DELTA

	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
PA1_INV	- -			
PA2_ADV	0.03	- -		
PA3_CTL	2.09	- -	- -	
PA4_FUN	22.36	3.76	24.70	- -

Expected Change for THETA-DELTA

	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
PA1_INV	- -			
PA2_ADV	0.00	- -		
PA3_CTL	-0.01	- -	- -	
PA4_FUN	-0.13	-0.01	0.02	- -

Completely Standardized Expected Change for THETA-DELTA

	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
PA1_INV	- -			
PA2_ADV	0.00	- -		
PA3_CTL	-0.03	- -	- -	
PA4_FUN	-0.30	-0.03	0.08	- -

Maximum Modification Index is 38.73 for Element (1, 2) of LAMBDA-Y

Standardized Solution

LAMBDA-Y

	STU	ACH
IL1_MOT	0.47	- -
IL2_MSE	0.28	- -
IL3_ESE	0.75	- -
IL4_VRE	0.26	- -
IL5_PRE	0.24	- -
BYTXMIRR	- -	10.14
BYTXRIRR	- -	8.26

LAMBDA-X

	PAR
PA1_INV	0.57
PA2_ADV	0.25
PA3_CTL	0.22
PA4_FUN	0.31

BETA

	STU	ACH
STU	- -	- -
ACH	0.40	- -

GAMMA

	PAR
STU	0.15
ACH	0.04

Correlation Matrix of ETA and KSI

	STU	ACH	PAR
STU	1.00		
ACH	0.41	1.00	
PAR	0.15	0.10	1.00

PSI
Note: This matrix is diagonal.

STU	ACH
0.98	0.83

Regression Matrix ETA on KSI (Standardized)

	PAR
STU	0.15
ACH	0.10

Completely Standardized Solution

LAMBDA-Y

	STU	ACH
IL1_MOT	0.65	- -
IL2_MSE	0.40	- -
IL3_ESE	0.98	- -
IL4_VRE	0.36	- -
IL5_PRE	0.31	- -
BYTXMIRR	- -	0.86
BYTXRIRR	- -	0.87

LAMBDA-X

	PAR
PA1_INV	0.73
PA2_ADV	0.46
PA3_CTL	0.50
PA4_FUN	0.57

BETA

	STU	ACH
STU	- -	- -
ACH	0.40	- -

GAMMA

	PAR
STU	0.15
ACH	0.04

Correlation Matrix of ETA and KSI

	STU	ACH	PAR
STU	1.00		
ACH	0.41	1.00	
PAR	0.15	0.10	1.00

PSI
Note: This matrix is diagonal.

STU	ACH
0.98	0.83

THETA-EPS

	IL1_MOT	IL2_MSE	IL3_ESE	IL4_VRE	IL5_PRE	BYTXMIRR	BYTXRIRR
IL1_MOT	0.58						
IL2_MSE	0.28	0.84					
IL3_ESE	- -	- -	0.04				
IL4_VRE	- -	- -	- -	0.87			
IL5_PRE	- -	- -	-0.19	- -	0.90		
BYTXMIRR	- -	0.19	-0.06	- -	- -	0.26	
BYTXRIRR	- -	- -	- -	0.15	- -	- -	0.25

THETA-DELTA

	PA1_INV	PA2_ADV	PA3_CTL	PA4_FUN
PA1_INV	0.47			
PA2_ADV	- -	0.79		
PA3_CTL	- -	0.12	0.75	
PA4_FUN	- -	- -	- -	0.68

Regression Matrix ETA on KSI (Standardized)

	PAR
STU	0.15
ACH	0.10

Total and Indirect Effects

Total Effects of KSI on ETA

	PAR
STU	0.19
	(0.02)
	8.04
ACH	1.74
	(0.34)
	5.10

Indirect Effects of KSI on ETA

	PAR
STU	- -
ACH	1.04
	(0.14)
	7.42

Total Effects of ETA on ETA

	STU	ACH
STU	- -	- -
ACH	5.47	- -
	(0.30)	
	18.25	

```
  Largest Eigenvalue of B*B' (Stability Index) is  29.929

        Total Effects of ETA on Y

                STU        ACH
             --------   --------
 IL1_MOT       0.64        - -
             (0.02)
              27.02

 IL2_MSE       0.37        - -
             (0.02)
              21.29

 IL3_ESE       1.00        - -

 IL4_VRE       0.35        - -
             (0.02)
              19.98

 IL5_PRE       0.32        - -
             (0.02)
              15.07

BYTXMIRR       5.47       1.00
             (0.30)
              18.25

BYTXRIRR       4.46       0.81
             (0.23)     (0.03)
              19.38      24.08

        Indirect Effects of ETA on Y

                STU        ACH
             --------   --------
 IL1_MOT        - -        - -

 IL2_MSE        - -        - -

 IL3_ESE        - -        - -

 IL4_VRE        - -        - -

 IL5_PRE        - -        - -

BYTXMIRR       5.47        - -
             (0.30)
              18.25

BYTXRIRR       4.46        - -
             (0.23)
              19.38

        Total Effects of KSI on Y

                PAR
             --------
 IL1_MOT       0.12
             (0.02)
               7.70

 IL2_MSE       0.07
             (0.01)
               7.52

 IL3_ESE       0.19
             (0.02)
               8.04
```

```
 IL4_VRE       0.07
             (0.01)
               7.45

 IL5_PRE       0.06
             (0.01)
               7.19

BYTXMIRR       1.74
             (0.34)
               5.10

BYTXRIRR       1.42
             (0.28)
               5.09
```

Standardized Total and Indirect Effects

Standardized Total Effects of KSI on ETA

	PAR
STU	0.15
ACH	0.10

Standardized Indirect Effects of KSI on ETA

	PAR
STU	- -
ACH	0.06

Standardized Total Effects of ETA on ETA

	STU	ACH
STU	- -	- -
ACH	0.40	- -

Standardized Total Effects of ETA on Y

	STU	ACH
IL1_MOT	0.47	- -
IL2_MSE	0.28	- -
IL3_ESE	0.75	- -
IL4_VRE	0.26	- -
IL5_PRE	0.24	- -
BYTXMIRR	4.09	10.14
BYTXRIRR	3.33	8.26

Completely Standardized Total Effects of ETA on Y

	STU	ACH
IL1_MOT	0.65	- -
IL2_MSE	0.40	- -
IL3_ESE	0.98	- -
IL4_VRE	0.36	- -
IL5_PRE	0.31	- -
BYTXMIRR	0.35	0.86
BYTXRIRR	0.35	0.87

Standardized Indirect Effects of ETA on Y

	STU	ACH
IL1_MOT	- -	- -
IL2_MSE	- -	- -
IL3_ESE	- -	- -
IL4_VRE	- -	- -
IL5_PRE	- -	- -
BYTXMIRR	4.09	- -
BYTXRIRR	3.33	- -

Completely Standardized Indirect Effects of ETA on Y

	STU	ACH
IL1_MOT	- -	- -
IL2_MSE	- -	- -
IL3_ESE	- -	- -
IL4_VRE	- -	- -
IL5_PRE	- -	- -
BYTXMIRR	0.35	- -
BYTXRIRR	0.35	- -

Standardized Total Effects of KSI on Y

	PAR
IL1_MOT	0.07
IL2_MSE	0.04
IL3_ESE	0.11
IL4_VRE	0.04
IL5_PRE	0.04
BYTXMIRR	0.99
BYTXRIRR	0.81

Completely Standardized Total Effects of KSI on Y

	PAR
IL1_MOT	0.09
IL2_MSE	0.06
IL3_ESE	0.14
IL4_VRE	0.05
IL5_PRE	0.05
BYTXMIRR	0.08
BYTXRIRR	0.09

Time used: 0.062 Seconds